

International Conference on Zoology 2021

Himalayan Biodiversity in the Face of Global Change

29 November - 01 December 2021



Abstracts

Organized By



International Conference on Zoology 2021

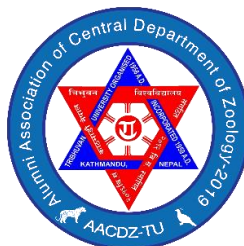
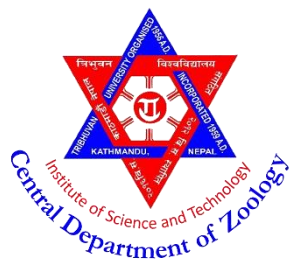
Himalayan Biodiversity in the Face of Global Change

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Foreword

It is our pleasure to welcome you to the **International Conference on Zoology 2021: Himalayan Biodiversity in the Face of Global Change (ICZ 2021)** from November 29 to December 01, 2021, which is being hosted by the Central Department of Zoology and its Alumni to commemorate the Department's 56th anniversary. This conference is one of the major activities of the Central Department of Zoology, Tribhuvan University envisioned in its strategic plan 2019–2023. At this occasion, we recall the spectacular success of the **First National Conference on Zoology** during November 28- 30, 2020.

The main theme of the conference is “*Himalayan Biodiversity in the Face of Global Change*”, which is critical given the global changes that species, ecosystem processes, landscapes and also people currently have to face together. The biodiversity and ecosystem services have been significantly impacted by global change and fast rising anthropogenic activity, with many species on the verge of extinction; all had a negative impact on planetary and species health, as well as human livelihoods. A sustainable approach to managing faunal resources has become unavoidable for current and future generations.

The ICZ 2021 is a zoology conference with a specific focus on the biodiversity of the world's mountain systems, notably the Himalayan Region, which maintains rich biodiversity while providing ecosystem services to over a billion people. Global mountain systems are a rich store of biodiversity and a source of ecosystem services that extend well beyond their geographical boundaries. Almost half of the world's population benefits from mountain systems in terms of water, biodiversity, pharmaceuticals, forest products, recreation, and so on. As a result, mountains play a significant role in the preservation of ecosystem functions and services, biodiversity protection, and the support of people's sustainable livelihoods.

Mountain biodiversity have long been recognized as of special scientific interest, especially in respect to their ecosystem services, vulnerability of global change, means of biotic colonization, evolution of unique biotas and ecosystems, and extensive loss of endemics, making mountain research and conservation an important area of research.

Biodiversity and Ecosystem Services, Conservation Approaches: Bridging Science and Policy, One Health: Species and Planetary Health, Global Change and Nature-based Solutions, and Human Dimensions of Zoology are the key conference themes. We expect that the pioneering ideas, leading theories, novel methodological approaches and recent results presented at this conference will provide advances in the research on the zoology.

The Conference brings together the expertise of a wide spectrum of research fields, in order to expand knowledge and achieve a unified view of mountain biodiversity. The conference includes plenary and regular sessions, aimed to accommodate in-depth discussions in areas in biodiversity. Aside from academic components, the goal of this event is to promote collaboration among institutions and participants, as well as to inspire novel research ideas.

I would like to thank the members of the Organizing Committee, Scientific Committee, and Conference Management Subcommittee, who all worked tirelessly to ensure the success of the conference. We are glad to extend our appreciation to the conference secretariat members for their dedication and prompt response to all contacts. We would like to thank all of our colleagues at the Central Department of Zoology, as well as former faculty, alumni, students, and staff, for their important help with the conference. Our heartfelt appreciation goes to the seven leading scientists who agreed to provide inspiring keynote talks, and we thank you everyone for your intriguing contributions.

Finally, we wish you a successful and entertaining conference, and we hope that you depart with cherished memories, valuable contacts, and renewed excitement for your role in the advancement of zoological science.

We look forward to welcome you all in the ICZ 2021.

Prof Dr Tej Bahadur Thapa

Chairperson, Conference Organizing Committee

Head, Central Department of Zoology, Tribhuvan University

Conference Organizing Committee

Organizing Committee

Prof Dr Tej Bahadur Thapa, Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal

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Prof Dr Mahendra Maharjan, Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal

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Mr Jagan Nath Adhikari, Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal

Program Schedule

International Conference on Zoology 2021: Himalayan Biodiversity in the Face of Global Change

29 November–01 December 2021 (Mangsir 13–15, 2078)

Inaugural Ceremony (29 November 2021)

Hall: Rhino

(09.00-09.25)	Registration and Entry
(09.25-09.30)	Arrival of the Chief Guest and Guests
(09:30-09.35)	Brief about the Program MC: Dr Laxman Khanal, Associate Professor, CDZ
	Virtual Chairing
	Chairperson: Prof Dr Tej Bahadur Thapa , Chairperson, Organizing Committee, ICZ 2021; Head, Central Department of Zoology, TU
	Chief Guest: Prof Dr Bhim Prasad Subedi , Chairman, University Grant Commission Nepal
	Special Guest: Prof Dr Binil Aryal , Dean, Institute of Science and Technology, Tribhuvan University
	Special Guest: Prof Dr Dwij Raj Uprety , Founding member, CDZ; Former Dean Institute of Science and Technology, Tribhuvan University
	Guests:
(09:35-09.38)	National Anthem
(09:39-09:45)	Welcome Speech: Prof Dr Mahendra Maharjan , Member, Organizing Committee
(09:45-09:48)	Declaration of Opening of the Conference: The Chief guest, Prof Dr Bhim Prasad Subedi
(09:48-09:55)	Program Highlights: Prof Dr Kumar Sapkota , Member of Organizing Committee
(9:55-10:00)	Address: Dr Deep Bahadur Swar , Vice President, Alumni Association of the CDZ
(10:00- 10:05)	Address: Prof Dr Dwij Raj Uprety , Founding member, CDZ, Former Dean IOST
(10:05-10:10)	Address: Prof Dr Binil Aryal , Dean, IOST, TU
(10:10-10:20)	Address: The Chief Guest, Prof Dr Bhim Prasad Subedi , Chairman, University Grant Commission Nepal
(10:20-10:30)	Vote of Thanks and Closing of the Inaugural Session: Prof Dr Tej Bahadur Thapa , The Chairperson

Tea break: 10:30-10:40

Day 1 (29 November 2021)

Session 1

Hall: Annapurna

Session Chair: Khadga Basnet

Rapporteur: Bishnu Prasad Bhattarai

Technical Host: Purnaman Shrestha

Time	Presenter	Title
10:40-11:20	Zhibin Zhang (<i>Keynote address</i>)	Impacts of global change on population dynamics of small rodents in Inner Mongolia grassland of China
11:20-11:45	Ram Pandit	Biodiversity conservation and ecosystem services in the changing context: Some observations on science- policy integration
11:45-12:10	Madhu Rao	Protected and Conserved Areas are core mechanisms to safeguard biodiversity with climate mitigation and adaptation co-benefits

12:10-13:00 Lunch break

Session 2

Hall: Annapurna

Session Chair: Madhav Karki

Rapporteur: Laxman Khanal

Technical Host: Purnaman Shrestha

Time	Presenter	Title
13:00-13:40	Christian Körner (<i>Keynote address</i>)	A Global Framework of Mountain Ecology
13:40-14:05	Bo Wang	Control of Wildlife Epidemic Diseases and Protection of Biodiversity in Qinghai-Tibet Plateau

14.05-14.15 Break

Parallel Sessions

Session 3A

Hall: Annapurna

Theme: Biodiversity and Ecosystem services

Session Chair: Tek Bahadur Gurung

Rapporteur: Kishor Pandey

Technical Host: Purnaman Shrestha

Time	Presenter	Title
14:15-14:40	Samiran Chakrabarti	Diversity of aphids (Hemiptera: Aphidomorpha: Aphididae) in the Himalaya
14:40-15:00	Aijaz Ahmad Wachkoo	Ants (Hymenoptera: Formicidae) in Jammu and Kashmir
15:00-15:10	Divyangi Patel	Diversity of order lepidoptera (butterflies) in Anand, Gujarat
15:10-15:20	Manisha Karki	Distribution and Habitat Utilization of Himalayan Goral (<i>Nemorhaedus goral</i>) in Dailekh District, Karnali Province, Nepal
15:20-15:30	Humira Nesar	Stabilities of soil nematode communities with different vegetation types in Dachigam National Park, India.
15:30-15:40	Khalid A. E. Eisawi	Role of ants (Hymenoptera: Formicidae) in the predation of <i>Belenois solilucis</i> eggs in organic agriculture production systems at Rashad, Sudan

15:40-15:50 Break

Session 3 B

Hall: Khaptad

Theme: One Health

Session Chair: Mahendra Maharjan

Rapporteur: Rajendra Prasad Parajuli

Technical Host: Krishna Maharjan

Time	Presenter	Title
14:15-14:40	Martin Gilbert	Canine distemper virus in tigers and leopards – a threat to big cats in the Himalayan region?
14:40-15:00	Biplab Mandal	Vector borne disease and its control strategy

15:00-15:10	Jamuna Kafle	Seasonal variation in ectoparasitic mite <i>Tropilaelaps mercedesae</i> Anderson and Morgan, 2007 in Apistan treated and untreated colonies of <i>Apis mellifera</i> in Kathmandu, Nepal
15:10-15:20	Menuka Aryal	Morphological and Molecular Characterization of Gastrointestinal Parasites of Wild Water Buffalo of Chitwan National Park
15:20-15:30	Dina Nath Dhakal	Prevalence of gastrointestinal parasites in bovines along the elevation gradients of Chitwan Annapurna Landscape, Nepal
15:30-15:40	Siyaram Prasad Sah	Study of Physico-Chemical and Protozoan detection of tap and well water quality in Baneshwor, Chhetrapati and Tripureshwor, Kathmadu valley

15:40-15:50 Break

Session 4

Hall: Annapurna

Session Chair: Narendra Man Babu Pradhan **Rapporteur:** Indra Pd Subedi

Technical Host: Purnaman Shrestha

Time	Presenter	Title
15:50-16:30	Davnah Urbach (<i>Keynote address</i>)	Mountain biodiversity under global change: state of knowledge and research opportunities
16:30-16:55	Kadarkarai Murugan	Host plant association and biodiversity conservations of butterflies in Western Ghats, Southern India

Day 2 (30 November 2021)

Session 1

Hall: Annapurna

Session Chair: Mahendra Shrestha

Rapporteur: Narayan Pd Koju

Technical Host: Purnaman Shrestha

Time	Presenter	Title
9:00-9:40	Paul Beier (<i>Keynote address</i>)	Conserving Nature's Stage: A Strategy to Conserve Biodiversity in a Changing Climate
9:40-10:05	Daniel C. Taylor	Biodiversity Protection Across the Mt. Everest Ecosystem
10:05-10:30	Kailash Chandra	Faunal diversity of selected conservation areas in Indian Himalayan landscape

10:30-10:40 Break

Parallel Sessions

Session 2A

Hall: Annapurna

Theme: Biodiversity and Ecosystem services

Session Chair: Eben Goodale

Rapporteur: Arjun Thapa

Technical Host: Purnaman Shrestha

Time	Presenter	Title
10:40-11:05	David P. Gillette	Identifying imperiled fishes in the Eastern Himalaya Biodiversity Hotspot: Analysis of species ranges over 30 years in the Kaligandaki- Narayani River
11:05-11:25	Maniram Banjade	Molecular identification and phylogenetic relationship of alien deer species in Jeju Island, South Korea
11:25-11:35	Dibya Raj Dahal	Distribution records of Dormer's bat <i>Scotozous dormeri</i> (Dobson, 1875) in Nepal
11:35-11:45	Kishor Chandra Ghimire	Abundance and Species Richness of Bumblebees in Budigandaki River valley of Central Nepal
11:45-11:55	Pit Bahadur Nepali	Species diversity of reptiles in Palpa, Nepal
11:55-12:05	Indra Prasad Subedi	Expanding our knowledge of Nepalese ants: new records and worker-based keys for the predatory subfamily Dorylinae

Session 2B

Hall: Khaptad

Theme: Global Change

Session Chair: Martin Gilbert

Rapporteur: Pradeep Adhikari

Technical Host: Krishna Maharjan

Time	Presenter	Title
10:40-11:05	Bhaiya Khanal	Diversity, distribution and significances of <i>Gazalina</i> species (Lepidoptera: Notodontidae) in Nepal
11:05-11:25	Kanchan Thapa	Carbonated tiger: the relationship between above-ground biomass carbon stock and tiger population density and occupancy in the Terai Arc Landscape, Nepal.
11:25-11:35	Ganesh Pant	Scanning the horizon: Planning for greater one-horned rhinoceros (<i>Rhinoceros unicornis</i>) conservation in the face of climate change
11:35-11:45	Binod Bhattarai	Effects of Habitat Structure and Invasive Alien Plant Species on Bird Assemblages in Jalthal Forest, Eastern Nepal
11:45-11:55	Rajendra Basaula	Effects of the invasive water hyacinth on globally threatened waterbird abundance and diversity at Lake Cluster of Pokhara Valley, Nepal
11:55-12:05	Sanjan Thapa	Current and future predicted distribution range of Indian Flying Fox <i>Pteropus medius</i> Temmink, 1825 roosting colonies in Nepal

Session 2C

Hall: Rara

Theme: Human Dimension/Conservation approach

Session Chair: Himender Bharti

Rapporteur: Kul Prasad Limbu

Technical Host: Hari Basnet

Time	Presenter	Title
10:40-11:05	R. K. Sriyani Dias	The journey through <i>Aneuretus simoni</i> Emery habitats in Sri Lanka: 1999-2017
11:05-11:25	Bisu Singh	Study of HLA gene polymorphism among the Indian Kami population from sub-Himalayan region of West Bengal, India
11:25-11:35	Jitse Bijlmakers	Environmental drivers of grassland in Bardia National Park: historic and annual remotely sensed imagery shows changes in the habitat of megafauna.

Himalayan Biodiversity in the Face of Global Change

11:35-11:45	Jamuna Prajapati	People's perception towards livestock depredation by Snow Leopard <i>Panthera uncia</i> (Schreber, 1775) in Lower Mustang, Annapurna Conservation Area, Nepal
11:45-11:55	Jagan Nath Adhikari	Land use/ land cover changes in the Chitwan Annapurna Landscape, Nepal
11:55-12:05	Ambika Tiwari	Human-Elephant Conflict in the adjoining areas of Koshi Tappu Wildlife Reserve, Eastern Nepal

12:05-13:00 Lunch break

Session 3

Hall: Annapurna

Session Chair: Ghanashyam Gurung **Rapporteur:** Pushpa Raj Acharya

Technical Host: Purnaman Shrestha

Time	Presenter	Title
13:00-13:40	H. O. Pörtner (<i>Keynote address</i>)	Climate and Biodiversity, Overcoming the Current Crises
13:40-14:20	Serge Morand (<i>Keynote address</i>)	One Health Approach and Biodiversity Conservation

14:20-14:30 Tea Break

Parallel sessions

Session 4A

Hall: Annapurna **Theme: Biodiversity and Ecosystem services**

Session Chair: Dhinesh Raj Bhujra **Rapporteur:** Pitambar Dhakal

Technical Host: Purnaman Shrestha

Time	Presenter	Title
14:30-14:55	Samiran Chakrabarti	Diversity of aphids (Hemiptera: Aphidomorpha: Aphididae) in the Himalaya
14:55-15:20	Francisco Javier Peris-Felipo	Effect of the altitudinal gradient on the generic composition of Alysinae (Hymenoptera, Braconidae) in the Swiss mountains (Alps, Switzerland)

15:20-15:40	Md Niraul Islam	Morphological and molecular characterization of <i>Tylencholaimus notrus</i> with first reports of its male and comments on the geographical distribution of the genus <i>Tylencholaimus</i> (Dorylaimida: Tylencholaimoidea)
15:40-16:00	Narayan Prasad Koju	Morphometric analysis to understand the diversity and evolution of genus pika (<i>Ochotona</i>)
16:00-16:10	Punam Ghimire	Distribution, abundance and habitat evaluation of Asian vultures in Kaligandaki Corridor, Western Nepal
16:10-16:20	Shubhas Chandra Bastola	Diversity and habitat association of birds in Seti River basin, Tanahun Nepal
16:20-16:30	Urmila Dyola	Species Distribution Modelling (SDM) of Wild Bee Species: A Case Study in Shivapuri – Nagarjun National Park (SNNP), Nepal

Session 4B

Hall: Khaptad **Theme:** Global Change/Conservation Approach

Session Chair: Buddhi Sagar Poudel **Rapporteur:** Janak Raj Subedi

Technical Host: Krishna Maharjan

Time	Presenter	Title
14:30-14:55	Feng Dong	Potentially dramatic community turnover of Himalayan birds during the Late Pleistocene
14:55-15:20	Liping Zhou	Mixed-species bird flocks of the Hengduan mountains: Community structure and conservation
15:20-15:40	Pradeep Adhikari	Assessment of the spatial invasion risk of intentionally introduced alien plant species under environmental change in South Korea
15:40-16:00	R Ray	Population density of <i>Chitala chitala</i> fry in relation to the Physico-chemical parameters of Muhuri River of Tripura, North-east India
16:00-16:10	Ramji Gautam	Behavior analysis and modeling of White-rumped Vulture (<i>Gyps bengalensis</i>) by using Markov chain modeling
16:10-16:20	Sandesh Gurung	Home Ranges and Habitat use of Mountain Hawk Eagle in the Himalayas of Central-West Nepal
16:20-16:30	Somika Pathak	Effects of Agricultural Land Use Pattern on Amphibians in Rapti Municipality, Chitwan, Nepal

Session 4C

Hall: Rara **Theme:** Human Dimension/Conservation approach/Ecosystem services

Session Chair: Jhamak B. Karki

Rapporteur: Jagan Nath Adhikari

Technical Host: Hari Basnet

Time	Presenter	Title
14:30-14:55	Ajay Kumar Pandey	Fish Diversity of Ramgarh and Bakhira Lake: Present Status for Conservation and Sustainable Exploitation
14:55-15:20	Binay Kumar Chakraborty	Diversification of Aquaculture and Fisheries management in Bangladesh and Impact of COVID 19 on Aquaculture and Fisheries
15:20-15:45	Tek Bahadur Gurung	Fish diversity of Tarai Nepal: Need of conservation and sustainable use of native species
15:45-16:05	Chet Raj Bhatta	Meliponiculture Industry in Nepal: Challenges and Opportunities
16:05-16:25	Metevinu Kechu	Traditional practices and use of indigenous knowledge in fisheries management among selected tribes of Nagaland, India
16:25-16:35	Siddha Raj Pant	Diversity and Abundance of Water Birds Species at Rani Tal in Shuklaphanta National Park of Sudurpaschim Province Nepal

Day 3 (01 December) 2021

Session 1

Hall: Annapurna

Session Chair: Ram Pandit

Rapporteur: Urmila Dyola

Technical Host: Purnaman Shrestha

Time	Presenter	Title
9:00-9:40	David Hik (<i>Keynote address</i>)	Plant-herbivore interactions in warming Arctic and mountain environments
9:40-10:05	Nigel C. Hughes	Ancient Himalayan biodiversity as a tool for understanding Earth's evolution, and as an educational outreach opportunity
10:05-10:30	R. Muniappan	Recent Invasive Species in Nepal and a Proposal for their Management
10:30-10:45 Break		
10:45-11:10	Xiaoming Wang	Vertebrate Palaeontology of the Tibetan Plateau
11:10-11:35	Rinjan Shrestha	Climate integrated conservation planning in the Himalayas: an innovative approach for identifying climate refugia

12:00-13:00 Lunch break

Parallel sessions

Session 2A

Hall: Annapurna

Theme: Biodiversity and ecosystem services

Session Chair: R. K. Sriyani Dias

Rapporteur: Indra Pd Subedi

Technical Host: Purnaman Shrestha

Time	Presenter	Title
13:00-13:25	Jasper Griffioen	How vulnerable are grasslands in the Terai and the Duars as tiger habitat for climate change and hydrological disturbances?
13:25-13:45	Bidhan Chandra Das	Impact of the shrinking Himalayas on the world largest mangrove forest Sundarbans
13:45-14:05	Madhu Chetri	Mammalian diversity and conservation challenges in Gaurishankar Conservation Area, Nepal
14:05-14:25	Pushpa Raj Acharya	Wandering Flying Fox Colonies Require Priority in Biodiversity Conservation Programs of Nepal
13:25-13:45	Yam Prasad Aryal	Functional and structural regeneration of hard tissues based on developmental principles

14:45-15:05	Md Monwar Hossain	Molecular phylogeny of Swallowtail butterflies (Lepidoptera: Papilionidae) based on mitochondrial cytochrome c oxidase I (COI) gene from Bangladesh
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Session 3B

Hall: Khaptad

Theme: One Health

Session Chair: Ranjana Gupta

Rapporteur: Rajendra Pd Parajuli

Technical Host: Krishna Maharjan

Time	Presenter	Title
13:00-13:20	Deb P. Pandey	A prospective study of snakebite in a Tertiary Care Hospital in Southwestern Nepal
13:20-13:40	Haiyan Gong	Ticks and tick-borne pathogens in China
13:40-14:00	Rajarshi Banik	Biochemical analysis of Hilsa fish <i>Tenulosa ilisha</i> (Hamilton, 1822) in relation to Multivariate regression analysis: a review
14:00-14:20	Shah H. A. Mahdi	Investigation on population abundance and diversity of soil-dwelling arthropods in Rajshahi University Campus (RUC), Bangladesh
14:20-14:30	Krishna Prasad Maharjan	Assessment of heavy metal concentrations in water and fish of Bagmati River, Nepal.
14:30-14:40	Puja Jaiswal	Evaluation of Antagonistic Activity of <i>Trichoderma</i> spp. against <i>Meloidogyne</i> spp.
14.40-14.50	Shahid Afzal	Soil nematodes as indicator of change in land use, for replacement of native temperate forests cover with derived land use in Pir-Panjal mountain range of Western Himalayas
14.50-15.00	Sunil Sapkota	Human factors contributing to the death of King Cobra – <i>Ophiophagus hannah</i> (Cantor, 1836) Kaski, Nepal

Hall: Annapurna

15:30-16:30 Closing Ceremony

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Climate and biodiversity, overcoming the current crises

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Abstract

The Intergovernmental Panel on Climate Change (IPCC) during its sixth assessment cycle has released 3 Special Reports (SR), the SR1.5 in 2018, and the SR land and SR ocean and cryosphere in 2019. This year, it has prepared its first joint report with IPBES, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), on climate change and biodiversity. This report has addressed the similarities and differences for land and oceans and come up with some unified conclusions, indicating the benefits of overcoming somewhat siloed approaches. For both land and ocean, the following general statements emerge as outcomes, emphasizing a systemic view. We currently see three crises that are intertwined: The Climate crisis has temperature moving outside of those of the Holocene. Progressive climate change is exacerbating the biodiversity crisis, by causing geographical shifts in biodiversity to high latitudes (or altitudes). This process elicits a progressive removal of higher life from the tropics and an overall drop in biodiversity and ecosystem services, which are important for climate change adaptation and mitigation. Reduced productivity in fisheries and agriculture exacerbate the societal crisis, visible in poverty, hunger, migration, over-exploited and decreasing natural resources, just to mention some challenges. Extreme events and progressive flooding of low-lying areas and small islands add to those. Accordingly, all three crises concern both land and ocean in similar ways but this similarity is not sufficiently explored by the scientific communities or considered in policy. Strengthening biodiversity in all systems will be important to support long term climate stabilization, societal balance and overall sustainability. The presentations will conclude with a view of how this can be achieved.

Keywords: climate impacts, global warming, land, latitude, ocean, society

Conserving nature's stage: a strategy to conserve biodiversity in a changing climate

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Abstract

Geodiversity is the diversity of conditions defined by geological, geomorphological, and soil features; these features are sometimes called “enduring features” because they are more permanent than species or climate or vegetation assemblages. In 2010, conservation scientists started to develop ways that enduring features can be used as a coarse filter for conserving biodiversity. The idea is that if a conservation network conserves the range of abiotic conditions that generate and maintain biodiversity (the “stage” on which species and ecosystems “play”), most species will be conserved. In this talk will introduce the concept of geodiversity, describe evidence for Conserving Nature’s Stage (CNS) as a surrogate for biodiversity, and outline some ways CNS has been and can be integrated in conservation plans. The approach is attractive because it focuses conservation on the physical factors that create diversity, allowing species and communities to rearrange in response to a changing climate. CNS requires only existing, freely-available data, and does not require complex, highly uncertain models and projections.

Keywords: adaptation strategy, coarse filter strategies, conservation planning, enduring features, geodiversity

One health approach and biodiversity conservation

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Abstract

The increase in the emergence and epidemics of infectious diseases affecting humans, but also domestic animals and wildlife, raises questions about the global and local determinants at work. The quantifiable increase in epidemics can be related to the "Great Acceleration" of global planetary changes: globalization of trade, intensification of agriculture and livestock, loss of biodiversity, modification of habitats, urbanization, climate change. The One Health approach is a way to better link human health, animal health and ecosystem health. To prevent the emergence and spread of zoonotic diseases, it is crucial to develop boundary spanning in relation to human and animal health, environment and the economic model. By studying the ecology of wildlife, based on more dynamical methodologies for collecting and sharing data, we should better prevent and control zoonotic infectious diseases while protecting biodiversity. Several important global initiatives are tackling the problems of preventing the emergence of zoonotic diseases using the One Health approach. However, scientists, public health practitioners, and policymakers should reconcile the need to preserve biodiversity while taking into account the health risks.

Keywords: disease ecology, zoonoses, livestock, wildlife, ecosystem health

Impacts of global change on population dynamics of small rodents in Inner Mongolia grassland of China

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Abstract

Rodents are important species in grassland ecosystem. They can cause huge losses to herdsman by destroying pasture land, and impose a big threat to human health by spreading many zoonotic diseases. However, they also play an important role in conserving biodiversity and maintaining ecosystem services. They are very sensitive to climate change and human activities. During past decades, we have conducted a series studies on the population dynamics of small rodents (e.g. Brandt's voles, Mongolia gerbils) in the steppe grassland of Inner Mongolia. We identified several key factors (e.g. climate mode and livestock grazing) influencing population variations of these small rodents. Our results suggest the accelerated global change would significantly shape population dynamics of small rodents and prevalence of zoonotic diseases in grassland ecosystem in China.

Keywords: climate change, livestock grazing, pasture land, population dynamics, steppe grassland

A global framework of mountain ecology

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Abstract

In a strict sense, mountains cover about 12% of the terrestrial surface outside Antarctica. In this presentation, I will discuss mountain definitions and the bioclimatic belts associated with mountains worldwide. In order to place biological research in mountains in a bioclimatic context, the position of the high elevation climatic treeline and its global explanation play an important role. Examples will illustrate the central role of micro-climate (as contrasted by macro-climate) in the alpine belt. Among the important drivers of environmental change on treeline and the alpine world above, I will discuss temperature, seasonality, elevated CO₂, nitrogen deposition and land use. The immense biological richness of high alpine landscapes will be exemplified and illustrated by a quantitative assessment in the Swiss central Alps including most animal phyla found in mountains.

Keywords: alpine belt, biodiversity, climate, elevation, treeline

Plant-herbivore interactions in warming Arctic and mountain environments

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Abstract

I have been studying plant-herbivore interactions in high elevation and high latitude environments for almost 40 years, and continue to be fascinated by the diverse adaptations of species living in these cold and often harsh environments. Herbivores are central to the functioning of tundra and mountain ecosystems, influencing biodiversity and ecosystem resilience to environmental changes. However, the outcomes of plant-herbivore interactions are highly variable across time and space. The causes of this variation may be related to influences of human management, species diversity, disturbance history, climate and extreme weather, primary productivity, and other factors. I will discuss some of things we have learned from our research in the mountains of Yukon and British Columbia, and across the Arctic region. I will illustrate my remarks with our studies of collared pikas, *Gynaephora* moth caterpillars and mountain goats; and a few other species as well. I will also discuss some new collaborative studies, led by the Herbivory Network (<http://herbivory.lbhi.is>), that bring together scientists from around the world to investigate the role of herbivores in these rapidly changing cold ecosystems, by fostering research collaborations and facilitating multi-site comparisons and data synthesis.

Keywords: alpine, biodiversity, Canada, climate change, ecology

Mountain biodiversity under global change: state of knowledge and research opportunities

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Abstract

Increasing evidence that mountain biodiversity is important for human wellbeing globally and recent calls to “elevate mountains in the post-2020 agenda of the Convention on Biological Diversity” underline the relevance of mountain biodiversity for securing a sustainable future for all. Yet mountains ecosystems and their biodiversity are exposed to the same factors that drive biodiversity loss, ecosystem degradation, and major societal shifts in other biomes, including rapid changes in climate and large-scale changes in land use. Accordingly, urgent calls for action in sustainable development come from the mountain research and development community as it acknowledges the effects of global change on the essential capacity of mountain ecosystems and their biodiversity to support human populations locally and globally. Effective policies and management approaches are needed to safeguard the natural assets that are underpinning human wellbeing in mountains and beyond and ultimately “ensure the conservation of mountain ecosystems” (SDG 15.4). I will provide an overview of the current state of knowledge on mountain biodiversity under global change, discuss our understanding of the role of mountain biodiversity for sustainable development, and outline ongoing and future activities of the Global Mountain Biodiversity Assessment to support international and cross-disciplinary collaboration on the assessment, conservation, and sustainable management of mountain biodiversity.

Keywords: mountain ecosystems, mountain species, post-2020 Global Biodiversity Framework, sustainable mountain development

Impact of the shrinking Himalayas on the world largest mangrove forest Sundarbans

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Abstract

The Sundarbans is the world's largest continuous halophytic mangrove forest. It was created by the gradual deposition of silt carried by the Ganges from the Himalayas which is not much older than 7000 years. This mangrove forest lies on the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal. It is about 10,000 km² in southwest Bangladesh and West Bengal of India. Sundarbans has great importance for Bangladesh and India in many aspects, however; this forest has been suffering from the climate change. The impacts of Himalayan glaciers melting on the Sundarbans are discussed by various authors. In this paper, a review is made on this aspect. Usually, melting water from the Himalayan glaciers is good for the downstream areas including the Sundarbans. However, excess water due to glacial lake outburst floods (GLOFs) cause tremendous problems at the downstream even at far distance. Rivers supply freshwater to the Sundarbans are heavily silted for this reason and as a result this mangrove forest is not getting required amount of freshwater during dry season. This is especially true for Bangladesh part of Sundarbans although there are other reasons for the scarcity of dry season freshwater for this part of mangrove forest. It is great concern that if the Himalayan glaciers will retreat substantially, the entire Sundarbans (Bangladesh and India) will be polyhaline in nature that ultimately damage the present status of biodiversity of this mangrove forest.

Keywords: biodiversity, Glaciers melting, mangrove, polyhaline, siltation

Diversification of aquaculture and fisheries management in Bangladesh and impact of COVID 19 on aquaculture and fisheries

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Abstract

The fisheries sector of Bangladesh contributes 3.52% to the national GDP, 26.37% to the agricultural GDP and more than 1.35% to the total export earnings. The total production was 4.552 m.mt fish in 2019-2020. Fisheries sector contributes significantly 62.58 g/day/capita of animal protein in daily dietary requirement. Diversify aquaculture technologies Extensive, Semi-intensive, Intensive and highly intensive and diversify indigenous fish culture technologies are practiced in Bangladesh. Data and information was collected by mixed-method including online questionnaire surveys, direct and telephonic interviews, key informant interviews (KII) and focus group discussions (FGD) and secondary data collected from the Department of Fisheries (DoF) and online grey literature. Aquaculture and fisheries sector of country is severely affected by pandemic COVID-19. A positive impact on ecosystem and increased fish stock in open water and coastal area due to stop of industrial influents and decreased fishing pressure for a certain period. The demand of spawn, fry and food fish decreased at the rate of 16%, 18% and 20%, respectively. About (20-27) % fish farmer was not continued fish culture practice due to less demand and lower price of fish. All export and import based business were slowdown globally and nationwide lockdown situation imposed the supply chain, and processing and exporting of shrimp, crab and exportable fish item hampered in this pandemic period. About (18-21) % fisheries people somehow directly or indirectly related with fisheries sector are workless due to pandemic. So, an action plan is needed to recover aquaculture sector from the pandemic considering enhance production, economic, social and environmental sustainability.

Keywords: pandemic, supply chain, spawn, nursery, livelihood

Biodiversity protection across the Mt. Everest ecosystem

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Abstract

In 1983, village shikaris in Nepal's upper Arun Valley gave credible explanation that the Yeti was a rukh balu (tree bear) which, they said, was different from the larger bhui balu (ground bear). Rukh balus, they asserted, made hominoid-like footprints. Scientific taxonomy does not distinguish by where an animal lives. Yet, people who live with Nature know a great deal. In 1985, a scientific team investigated the hypothesis. We collected bear skulls. A comparative study followed at the Smithsonian Institution and the British Museum. The taxonomic explanation is both rukh and bhui balu are *Ursus arctos thibetanus*, the Himalayan Black Bear. But the important discovery is biodiversity. Tirtha B. Shrestha summarized this as: "From intact subtropic habitat through arctic heights, the Barun Valley is Nepal's last pure ecological seed." This led to a conference in 1986 in the Barun's alpine Saldima Meadows, creating a first implementation of the Biosphere Reserve concept in Makalu-Barun National Park & Conservation Area. The Nepal park started planning on the north slope of the Himalaya, adjacent to Makalu-Barun. In the Tibet Autonomous Region of China, this is the Qomolangma (Mt Everest) National Nature Preserve. This connects to five conservation areas in Nepal. Now, an aggregated protected area exists equal in size to Switzerland. So, the Yeti (while forever an enigma) has both a home and created people-based conservation from the highest place on Earth for the highest purpose on Earth: sustainable Life.

Keywords: black bear, Nepal, participatory conservation, Tibet, Yeti

Identifying imperiled fishes in the Eastern Himalaya Biodiversity Hotspot: Analysis of species ranges over 30 years in the Kaligandaki- Narayani River

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Abstract

As human population growth, economic development and environment change accelerate, data on the status of aquatic biodiversity in the Eastern Himalaya Biodiversity Hotspot (EHBH) are urgently needed. We used a Monte Carlo analysis to identify species with significant range reductions over three decades at 38 sites on Nepal's Kaligandaki-Narayani River (KNR). Relative to a null model under which all species were equally likely to lose individuals between time periods, ranges of 16 out of 83 species declined significantly across at least one time period, with two species, Hamilton's Baril (*Opsarius bendelisis*) and the Trout Barb (*Raiamas bola*) declining across both time periods. Mid-water minnows (family Cyprinidae) native to both lowlands and hills were most likely to experience range reduction. Range reduction and designation of conservation status by the International Union for the Conservation of Nature (IUCN) were not related, highlighting the need for local, long-term data collection to prioritize species for conservation. Our results highlight an urgent need for protection of *O. bendelisis* and *R. bola* populations to stem current declines, and suggest that lower-elevation sites represent greatest conservation value for KNR fishes, due to high overall biodiversity and frequency of species with declining ranges. Management of these sites across the EHBH should incorporate the network of terrestrial protected areas already established. Long-term data collection will be crucial to identify declining species before they disappear, update status according to the IUCN Red List, and ensure that large-scale extirpation does not follow in the wake of the environmental change now accelerating across the EHBH.

Keywords: conservation, cyprinidae, IUCN Red List, overfishing, species traits

Mixed-species bird flocks of the Hengduan mountains: Community structure and conservation

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Abstract

In considering conservation and management strategies for Himalayan bird communities, dependencies between species must be considered, including interactions in mixed-species flocks. We sampled bird communities including mixed-species flocks from Guangxi Province, southern China, west into Yunnan Province and into the Hengduan Mountains near the Sino-Burmese border. We visited 52 transects, placed in three habitats: inside relatively undisturbed nature reserves, in 'buffer' areas of degraded forest or timber plantations, and in intensive agriculture. We found a similar flock system in forests over a wide range of elevations, from 400 to 2900 m, led by closely-related fulvetta *Alcippe* species. Flocks became rare in agriculture; in buffer, they were mostly led by other species, with fulvetta-led flocks not found in seeded pine. We suggest that the fulvettas, although abundant birds, be targets for conservation plans because of their effects on other flock participants. One on-going project investigates how flock members match each other in their plumage characteristics in the extreme southwest of Yunnan. Another project studies a case of apparent flock-associated mimicry between the Greater Necklaced Laughingthrush (*Pterorhinus pectoralis*) and the Lesser Necklaced Laughingthrush (*Garrulax monileger*) in China and Nepal. These examples of behavioral interactions and/or co-evolution emphasize how conservation should be applied to flock systems as well as to individual species.

Keywords: co-evolution, community ecology, elevational gradient, keystone species, mixed-species animal groups

Potentially dramatic community turnover of Himalayan birds during the Late Pleistocene

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Abstract

Prevailing models for the high biodiversity in tropical mountains assume that organisms can survive through past climate change by performing short elevational movements to track suitable habitats. However, dramatic Pleistocene climatic oscillations could also lead to species turnover but have widely been ignored. Here, we used ecological niche modelling (ENM) of 288 passerine species in the Himalayas to test the effect of climate change during the last Interglacial Period (LIG), the Last Glacial Maximum (LGM) and the present day. The ENM analyses hindcasted species persistence through climate change from the LGM to the present day but likely showed a high degree of species turnover (e.g., 32.6-46.2%) from the LIG to the LGM. Further elevational dynamic reconstructions demonstrated that species might survive these two periods of climate change by upward and downward shifts, respectively. Statistical analyses of climatic variables showed increased climatic variability in the Himalayas during the LIG, which might have caused community turnover. The severe evolutionary consequence of the LIG climate in the Himalayas contrasts with the paradigm of the climatic optimum in Europe and North America and suggests potential geography-dependent effects of past climate change. More importantly, our results demonstrate that dramatic historical climate change might overwhelm the buffering effect of elevational heterogeneity, which should be considered when investigating the origin of tropical montane biodiversity.

Keywords: Himalayan birds, ecological niche modelling, tropical buffering effect, historical, climate change, community turnover

Effect of the altitudinal gradient on the generic composition of Alysiniinae (Hymenoptera, Braconidae) in the Swiss mountains (Alps, Switzerland)

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Abstract

Fauna inhabiting mountain habitats has always been of great interest to scientists thanks to its peculiarity and endemism. However, not all groups have been studied thoroughly and there is an obvious lack of taxonomic knowledge in several arthropod lineages. This is the case of the subfamily Alysiniinae (Hymenoptera, Braconidae) whose known fauna in high mountain areas is very reduced—for instance there are only a hundred species described in the Alps, whereas 407 species are known from Austria, France, Italy, and Switzerland. In the present report, preliminary data of the altitudinal diversity of Alysiniinae genera captured from three Swiss alpine slopes are provided. Sampling was carried out by altitudinal transects from the valley to the top, with sampling points being established every 500 m of altitude, approximately. The samples were carried out by sweeping net during the period of June-September 2016. Preliminary results show the presence of an altitudinal bias by genera. Moreover, an appreciable number of species, several of them unknown from Alpine areas so far, were observed. Future sampling of this endoparasitoid wasp group specialized on Diptera will provide better knowledge about the specific diversity and the community structure.

Keywords: Alysiniinae, biodiversity, Diptera endoparasitoid, elevation gradients, parasitoid of Diptera

Control of Wildlife Epidemic Diseases and Protection of Biodiversity in Qinghai-Tibet Plateau

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Abstract

The Qinghai-Tibet Plateau is called "the roof of the world" and "the third pole". The unique natural regional pattern and rich and diverse ecological system make this area become a rare wild animal and plant natural garden and plateau species gene bank, which has a significant barrier to our ecological security. However, under the combined influence of global change and human activities, the Qinghai-Tibet Plateau presents the problems of decreasing ecosystem stability and biodiversity. The key point of biodiversity protection is wildlife protection, and disease prevention and control are an important part of wildlife protection. This report expounds the interaction between wildlife epidemic diseases and biodiversity, analyzes the causes of wildlife epidemic diseases, and reveals the importance of "active monitoring" in the prevention and control of wildlife epidemic diseases, so as to provide theoretical basis and suggestions for cross-regional multi-country joint construction of biodiversity conservation in the Qinghai-Tibet.

Keywords: active monitoring, challenge, ecological security, spillover, one-health

How vulnerable are grasslands in the Terai and the Duars as tiger habitat for climate change and hydrological disturbances?

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Abstract

The Terai Arc Landscape and the Duars at the foot of the Nepalese, Indian and Bhutanese Himalayas are the most important conservation area of tigers. Here, the grasslands seem to play a pivotal role as the tigers hunt for deer in these geographical areas. However, the natural and anthropogenic influences on grassland dynamics in these landscapes are poorly understood. An international research project is set-up to characterise the temporal dynamics of the grasslands in the 23 nature reserves present. Particularly, the hydrology and river morphodynamics as abiotic factors become addressed as well as the pressures behind these two. This is not only a scientific, ecohydrological novelty but also crucial in combining preservation of the tiger habitat with sustainable water resources management in the Terai, the Duars and upstream Himalayas. The set-up of the project will be presented in which the interrelationships between river dynamics, groundwater, landcover and land-use, and grazing ungulates will be assessed. The dual approach will be presented: fundamental, multi-disciplinary research at Bardia National Park and the associated Karnali River in Western Nepal and applied research to identify essential similarities and differences in the current hydrological and ecological conditions of the grasslands in the 23 nature reserves present at the foot of the Himalayas. The concept of landscape stewardship is introduced as integrating environmental management approach.

Keywords: anthropogenic interventions, dynamics, habitat, nature management, water

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Keywords: anthropogenic interventions, dynamics, habitat, nature management, water

Faunal diversity of selected conservation areas in Indian Himalayan landscape

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Abstract

The great chain of Himalayan mountains extended across India, Nepal, Bhutan, China and Pakistan, forming a formidable barrier between Tibetan plateau to the north and alluvial plain of the Indian subcontinent to the south, constitute one of the most extensive mountain systems of Asia. Indian Himalaya harbors a rich diversity of both flora and fauna, among them many are endemic to the region. During the long-term monitoring studies undertaken under NMHS project for the fauna of selected landscape in Indian Himalaya, altogether about 30,777 species/subspecies have been reported representing about 30 % of the total fauna (1, 02,161 species) of the country. For the present study, seven landscapes falling in five Indian states have been selected are: Great Himalayan National Park (GHNP), Valley of Flowers (VOF), Kyangnosla Alpine Sanctuary (KAS) and Gnathang plateau (GP) Neora Valley National park (NVNP), Tawang district and Namdapha National Park (NNP). The result of the monitoring surveys and information available in earlier publications when pooled together resulted into a consolidated account of 3903 species/ subspecies belonging to 2226 genera and 438 families pertaining to 29 groups of animals including vertebrates 998 Invertebrates 2813 and Protozoa 92 from different selected sites of the Indian Himalayan landscape during the 2017 to 2020. It is estimated that still there are many gap areas particularly among the invertebrates groups, which are to be comprehensively dealt for the better understanding of the impact of climate change on biodiversity, conservation measures and sustainable utilization of the bio-resources in the region.

Keyword: fauna, Indian Himalaya, landscape, conservation areas, monitoring plots

Protected and conserved areas are core mechanisms to safeguard biodiversity with climate mitigation and adaptation co-benefits

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Abstract

The climate and biodiversity emergencies need urgent and effective attention. Countries must undertake urgent, sustained and deep reductions in global GHG emissions across all sectors, as called for by science, to limit global warming to 1.5°C. Protected and conserved areas are important sinks and reservoirs of greenhouse gases. Terrestrial protected areas currently store about 12% of terrestrial carbon stocks. They help maintain and restore ecological connectivity, and represent future climate refugia for species. There is emerging scientific evidence "that at least 30% or more of the world should be protected, conserved and restored in an interconnected way to safeguard biodiversity, stabilise the climate and provide a foundation for a sustainable relationship with the Earth". If effectively managed, Protected and Conserved Areas can not only safeguard biodiversity but also help society cope with climate change impacts by reducing the risks associated with climate-related hazards.

Keywords: carbon stocks, conservation, ecological connectivity, GHG emissions, IUCN

Canine distemper virus in tigers and leopards – a threat to big cats in the Himalayan region?

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Abstract

Since 2003, infection with canine distemper virus (CDV) has been responsible for the mortality of endangered Amur tigers (*Panthera tigris altaica*) and Far Eastern leopards (*P. pardus orientalis*) in Russia and is estimated to increase the fifty-year extinction probability of small tiger populations of 25 individuals by as much as 65%. There is now an urgent need to evaluate the CDV infection status in tigers and leopards in other range states to determine the potential threat to these vulnerable populations. Testing strategies based on the detection of pathogens (such as RT-PCR) are more useful for syndromic surveillance where infection is suggested by clinical presentation for agents like CDV that are associated with acute disease and short periods of shedding. Serological approaches represent a more effective strategy, particularly for species like tigers and leopards that are rarely handled, to detect population exposure for pathogens like CDV that evoke a strong and long-lasting humoral immune response in animals that recover from infection. A serum neutralisation assay has been developed using HEK293 cells expressing canine signalling lymphocytic activation molecule (SLAM-F1, the receptor used by CDV for cell entry) and a replication-deficient vesicular stomatitis virus pseudotype expressing haemagglutinin and fusion surface glycoproteins from the Onderstepoort strain of CDV. Serum samples collected opportunistically from tigers and leopards in Nepal and other range countries are being tested to assess whether these populations are exposed to CDV as a first step toward determining the potential threat that the virus might represent to these populations.

Keywords: extinction, morbillivirus, *Panthera*, pathogen, serum neutralization

Ancient Himalayan biodiversity as a tool for understanding Earth's evolution, and as an educational outreach opportunity

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Abstract

The Himalaya's ancient biodiversity is recorded in the fossils found in the rocks that make up much of the Himalayan Mountain belt. Much of my career has been spent reconstructing what the places that constitute today's Himalaya were like some 50 crore years ago, during the Cambrian period. This period of geological time is particularly important because there is a good record of sedimentary rocks that formed during that interval recorded in the 4 main "lithotectonic zones" of the Himalaya: major units of rock separated by fundamental geological faults. In the talk I will introduce the basic geological set up, the fossils that lived at that time, and explain why they are so significant scientifically for understanding the growth of the Himalaya following the much more recent collision of the subcontinent with Asia. Then I will address out past and on-going attempts at Geoscience Educational outreach to children in rural parts of the Indian subcontinent, including our book in Bengali on fossilized wood, *monishar pathorer bon*, and our current animation project "The Ocean on Top of Our Mountain".

Keywords: fossils, geoscience education, Sagarmatha, place-based stories

The journey through *Aneuretus simoni* Emery habitats in Sri Lanka: 1999-2017

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Abstract

The critically endangered *Aneuretus simoni* Emery, the single extant representative of the subfamily Aneuretinae, is an endemic ant to Sri Lanka. Its workers are characterized by 12-segmented antenna, triangular mandible, a petiole with a long and slender anterior peduncle and a node with well-differentiated dorsal and lateral swellings. Since its first record in 1893, the species had been reported from Peradeniya, Kandy, and several forest reserves and "Pompekelle" forest in Ratnapura District. Despite its record in 1956, it was not observed at "Pompekelle" in 1985. Our research on the species began in 1999 at Pompekelle, a 15-hectare forest ranging from 85-110 m asl and we rediscovered it in 2001. Ten locations were surveyed using simultaneous, multiple methods in 2004. Gilimale Forest Reserve was also surveyed six times in 2004 using similar methods, along ten, 100 m transects, yielding 3-6% of workers of the species. In 2006, 12% of workers was reported from a similar survey at Sinharaja Forest Reserve. It was discovered in 2010 from Kirikanda forest, with a nest density of 0.10-0.15 m⁻², using quadrat method. Additional nest surveys by quadrat method in two proposed forest reserves, Kalugala, and Kuluna Kanda and Wilpita "Aranya Kele", yielded 0.6, 0.93 and 0.13 m⁻² nest density values, respectively. In 2014, a similar investigation in Meethirigala Forest Reserve reported 0.2-0.8 m⁻² mean nest density of the species. During 2015-17, repeated surveys conducted at two elevations by laying 40 (1 x 1 m) quadrats in two, 100 m² plots in Indikada Mukalana Forest Reserve and Lenagala Forest Reserve revealed 0.04-0.12 m⁻² and 0.11-0.12 m⁻² mean nest density values, respectively. Records of environmental conditions at the habitats of the species suggested that surveys on the species should be conducted at forests with 21-30°C air temperature, 20-28°C soil temperature, 9.4-69% soil moisture, 4.3-25% soil organic matter and 0-6.5 cm mean depth of leaf litter in the future.

Keywords: ant sampling, forests in Sri Lanka, nest counting, nest density, occurrence

Recent invasive species in Nepal and a proposal for their management

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Abstract

In recent years, several invasive plants, insect pests, and plant diseases have invaded Nepal. Examples of invasive plants include: *Ageratina adenophora*, *Chromolaena odorata*, *Eichhornea crassipes*, *Ipomea carnea* ssp *fistulosa*, *Lantana camara*, *Mikania micrantha*, *Mimosa diplotricha*, and *Parthenium hysterophorus*; insect pests: *Phthorimaea (Tuta) absoluta*, *Spodoptera frugiperda*, and *Schistocerca gregaria*; and plant diseases: *Bhendi yellow vein mosaic virus*, *Tomato leaf curl virus*, *Chili veinal mottle virus*, *Bean common mosaic virus*, *Papaya ringspot virus*, and *Zucchini yellow mosaic virus*. Management options of invasive species include quarantine regulations to prevent their entry and to curtail their spread once established and control options through mechanical, cultural, chemical and biological means. Most of these species become invasive as they reach new territories without their natural enemies, which keep them under check in their centers of origin. Once these invasive species establish in the new territory, one of the best options available is biological control (except for plant diseases). Initiating biological control of invasive species in Nepal requires collaboration between National Agricultural Research Council, Plant Quarantine and Pesticide Management Centre, and universities such as Tribhuvan University, and Agricultural and Forestry University. Regulations for introduction, screening, evaluation, and approval of exotic biocontrol agents need to be instituted. Additionally, quarantine facilities for testing exotic natural enemies to be introduced need to be established with proper management structures. Such facilities exist in many countries, but not in Nepal. It is urgent to consider establishment of biological programs in Nepal to tackle the surmounting invasion of exotic pests.

Keywords: biological control, pests, quarantine, regulations

Biodiversity conservation and ecosystem services in the changing context: Some observations on science- policy integration

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Abstract

Today's society is faced with multiple environmental challenges. Climate change and biodiversity loss are the two top most environmental challenges that need urgent attention. Biodiversity loss is directly associated with decline of multitude of ecosystem services that are directly linked to human livelihood and well-being. Globally, about 25% of all assessed plants and animal species are threatened with extinction, i.e. about 1 million species, in the near future if urgent action is not taken. In Asia-Pacific, habitat degradation and fragmentation has caused decline in wild mammals and birds, affecting ecosystem service provisions. Climate-induced floods caused by melting of ice has posed a major threat to people's life and biodiversity in the Himalayan region. Addressing the biodiversity crisis and improving the provision of ecosystem services require evidence-based policies or science-policy integration. In this talk, I will share some of the major initiatives to address biodiversity loss and to improve the supply of ecosystem services at a global/regional level. In particular, I will focus on the assessment works of the Inter-governmental Platform on Biodiversity and Ecosystem Services (IPBES). Specific focus will be placed on recently completed global and regional (Asia-pacific) assessments of biodiversity and ecosystem services to highlight major findings and how they relate to biodiversity conservation in the Himalayan region. Finally, I will share a few remarks on science-policy integration for biodiversity conservation and ecosystem service provisions: what are some of the barriers and how they can be avoided, what can we learn from international experience for the Himalayan region?

Keywords: assessment, Asia-pacific, biodiversity loss, environmental challenge, IPBES

Climate integrated conservation planning in the Himalayas: an innovative approach for identifying climate refugia

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Abstract

The Himalayas, also referred to as the “Water towers of Asia” are being disproportionately affected by the global climate change. Thus, the climate integrated conservation planning has been increasingly recognized as the key strategy to secure biodiversity, ecosystem integrity as well as the lives and livelihoods of over a quarter of the global human population that depend on these mountain systems. One of the fundamental pre-requisites of such a conservation planning is to identify the climate change refugia, i.e., the areas that will remain suitable for and enable persistence of species in the face of climate change over time. In this presentation, I share an innovative methodology that was applied for grassland birds of the Canadian prairies. This approach involved species-specific tuning of key bio-climatic factors governing the distribution of focal species and the application of machine learning techniques to model their fundamental niche now and into the future (two time periods: 2050 and 2080), under the two of the most likely climatic scenarios (RCP 4.5 and RCP 8.5). In order to identify the location and extent of both *in situ* and *ex situ* refugia, we used species specific dispersal ability so as to account for the species’ ability to track climate velocity within the projected bioclimatic space of focal species. We also compared the current protected area prioritization with the projected climate change refugia to guide management decisions. The results highlight the need for taking into account of future climate-change refugia for effective conservation planning to protect threatened species over the next century.

Keywords: Climate change, grassland, birds, fundamental niche, species distribution modelling.

Diversity of aphids (Hemiptera: Aphidomorpha: Aphididae) in the Himalaya

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Abstract

Aphids, a group of hemipterans are obligatory phytophagous insects and have distribution throughout the world. Many species are pests of agricultural, horticultural and forest plants and vectors of plant pathogens. The Himalaya, a hot spot zone in India, has many favorable plant species for aphid infestation and many of them are endemic. At present 818 species in 216 genera and 15 subfamilies, are known from different zones of the Himalaya. About 398 aphid species are endemic in the Himalaya. So far, 542 species in 177 genera in Northwest Himalaya, 481 species in 148 genera in eastern Himalaya, 60 species in 27 genera in Central or Nepal Himalaya are known. In Pakistan part of Northwest Himalaya 269 species in 107 genera and in Bhutan part of eastern Himalaya 91 species in 55 genera are also known. Members of the subfamily Aphidinae are dominant with 467 species in 111 genera having 209 endemic species. All 9 species of the subfamily Aiceoninae are endemic in the Himalaya. There are 76 gall inducing aphid species and these are dominant in Northwest Himalaya. Morphology of many galls is very species specific. Primary and secondary hosts of many species have been explored. Primary host ranges of the gall inducing species are narrow and specific. The Parasitoid and predator complexes are also rich and about 50% parasitoids of aphids here are endemic.

Keywords: aphid galls, diversity and distribution, endemism, host plants, predators and parasitoids

Fish diversity of Tarai Nepal: Need of conservation and sustainable use of native species

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Abstract

The aim of this paper is to elucidate the present situation of native fish genetic resources of the Tarai of Nepal. The information in the present paper was obtained through articles published in journals, reports and magazines. Our results showed that the fish and fishery of native fish species in Tarai is declining due to exploitative anthropogenic activities, climate change, population increase, encroachment of wetlands, rampant use of agricultural inputs, urbanization, modern infrastructure development, pollution, undermine fish genetic resources and lack of innovation towards the natural resource management etc. However, there has been impressive 'game changing' works using some native species such as Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*) and Bhakur (*Catla catla*). Other fishes, which are native to Tarai, Nepal such as farming of *Channa striatus*, *C. marulius*, have been proven to be highly successful in India, Thailand Bangladesh and other countries. Besides, these there are several other native species having potential to be develop as cultivable species such as *Wallago attu*, *Anabas testudineas*, *Tor putitora*, *Labeo dero* etc. and so many catfishes (*Clarias batrachus*, *Heteropneustis fossilis*, *Mystus* spp). It is likely that provincial governments, metropolitan and rural municipalities along with federal governments could bring new policies, strategic and action plans by which native fish genetic resources of Tarai could be conserved and used for food, nutrition, income and job opportunities to millions of local communities using modern technologies, business and enterprising approaches.

Keywords: Climate change, encroachment, federal, policies, provinces

Vertebrate palaeontology of the Tibetan Plateau

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Abstract

Mammals living in the high Tibetan Plateau must endure extreme coldness (hypothermia), low oxygen (hypoxia), high UV radiation, and depending on location, severe aridity. These harsh environments have served as major drivers of evolution during the Cenozoic that produced a low productivity, low diversity, high endemism community. While broadly similar to faunal assemblages in North China and Central Asia, Tibetan faunas often show initiation of cold-adapted lineages that predate Ice Age megafauna. Our “out of Tibet” hypothesis thus postulates that cold-tolerant species in Pliocene high Tibet were pre-adapted to conditions that were to become widespread during the subsequent Pleistocene Ice Age and Tibet had thus become a cradle for Ice Age megafauna. The best examples of the “out of Tibet” scenario include the Tibetan woolly rhinoceros (*Coelodonta thibetana*), Tibetan sheep (*Protovis*), Asian hunting dog (*Sinicuon*), and ancestral snow leopard (*Panthera blytheae*). Our “Third Pole to North Pole” linkage of an extinct Pliocene Tibetan fox, *Vulpes qiuzhudingi*, with the late Pleistocene and extant arctic fox, *V. lagopus*, is a subset of the “out of Tibet” hypothesis. One of the iconic Tibetan mammals, the endemic Tibetan antelope (*Pantholops*) has the longest residence in Tibet going back to the late Miocene, suggesting a long history of perfecting its adaptations to cold environments.

Keywords: mammals, Cenozoic, Miocene, Pliocene, Tibetan Plateau

Ants (Hymenoptera: Formicidae) in Jammu and Kashmir

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Abstract

The study presents a comprehensive overview of ant species recorded in Jammu and Kashmir. The species inventory is based on literature and museum collections combined with unpublished data from the field surveys since 2008. In total, there are 198 ant species and subspecies representing 54 genera and seven subfamilies known from Jammu and Kashmir. Jammu and Kashmir is biogeographically complex and diverse, the flora and fauna has passed through various stages during geomorphological evolution of this region. This region has been colonized at different times by Malayan, Afrotropical, Mediterranean, Central Asian and Temperate elements. Rigorous environment has further acted upon this mosaic of geographical forms leading to extinction of species, breaking up of distributional ranges and eventually induction of genetic variations with or without speciation. This work constitutes a synthesis of what is known about the ants of Jammu and Kashmir. The intent of this work is to facilitate future research of the Jammu and Kashmir ant fauna by providing the first comprehensively researched species inventory. Since most collection to date has been conducted in a small number of locations, it is likely that many more species of the ants await discovery in the region.

Keywords: distribution, diversity, Himalaya, inventory, species richness

Fish diversity of Ramgarh and Bakhira Lakes: present status for conservation and sustainable exploitation

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Abstract

Regular survey of Ramgarh Tal (Gorakhpur) and Bakhira Lake (Sant Kabir Nagar) conducted during March 2013-February 2015> The study revealed presence of 42 native and 5 exotics species of finfishes (total 47) belonging to 9 orders, 17 families and 33 genera in Ramgarh Tal. Cypriniformes dominated with 17 species, followed by Siluriformes 12, Perciformes 7, Clupeiformes 3, Synbranchiformes 3, Osteoglossiformes 2, Mugiliformes 1, Beloniformes 1 and Tetradontiformes 1. Present conservation status of these taxa being 1 DD (Data deficient), 2 Endangered (EN), 37 Least concerned (LC), 5 Lower risk-near threatened (LR-nt), 1 Not evaluated (NE), 01 Vulnerable (VU). The existence of 54 native species of teleosts belonging to 9 orders, 20 families and 40 genera were recorded in Bakhira Lake while none of the exotic species was encountered in this water body which is a protected water body since 1991. Cypriniformes dominated with 21 species, followed by Siluriformes 11, Perciformes 9, Clupeiformes 3, Synbranchiformes 2, Osteoglossiformes 2, Mugiliformes 1, Beloniformes 1 and Tetradontiformes 1. Present conservation status of these taxa being 2 species Data deficient (DD), 1 Endangered (EN), 44 Least concerned (LC), 4 Lower risk-near threatened (LR-nt), 2 Not evaluated (NE) and 1 Vulnerable (VU) in this lake. Both the lakes harbour good quantities of small indigenous freshwater fishes (SIFs) contributing towards nutritional security of the local poor communities as they fetch lower price in the markets of both the districts.

Keywords: Fish germplasm resources, freshwater bodies, eastern Uttar Pradesh, India.

Diversity, distribution and significances of *Gazalina* species (Lepidoptera: Notodontidae) in Nepal

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Abstract

Least research has been done on the toxicity of moths except their taxonomy, distribution and ecology. *Gazalina* species reported in Nepal has toxic hairs which on contact to human eyes causes severe infection. This moth belongs to the family Notodontidae under the subfamily Thaumetopoeinae. Three species of *Gazalina* have been recorded in Nepal that includes *G. chrysolopha*, *G. apsara* and *G. transversa*. Of them, *G. chrysolopha* is the most popular species which can be seen attracted to bright white lights in urban areas. The distribution range of these moths is still least known including their habitat preferences and life stage phenology. Its distribution so far has been restricted to the mid mountain districts with none of its recorded information is available from the Tarai region. These moths start appearing from the mid of July representing high density in September to the first week of October. Few unusual records of this moth have also been made in March and April which is a rare case. A detail study on the distribution, ecology, life stages and other related facts to this moth can be significantly valuable for the foresters, entomologists and professionals who are engaged in ophthalmological researches in the country. This study presents updated information of *Gazalina* species of Nepal which is based on the field study and publications made by few researchers in the past.

Keywords: distribution, moths, notodontidae, processionary, taxonomy, thaumetopoeinae

Vector borne disease and its control strategy

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Abstract

Maintaining the quality of life and economic well-being of people highly related with public health. Food, clothing, shelter, basic literacy, and, most importantly, primary health care is among the fundamental essentials. When any one or all of them are missing or insufficient, a state of extreme underdevelopment prevails. Human health is essential for development of nation and the World Health Organization (WHO) estimates that approximately half of the world's population is affected by one or more vector-borne diseases each year. Mosquitoes are an effective biological vector of Malaria, Filariasis, Dengue Fever, Yellow Fever, and a variety of other arboviruses all over the world. The implementation of an integrated vector control programme is a critical and successful component in the fight against vector-borne diseases. Controlling vectors has been attempted in endemic nations via environmental management, personal protection, reproductive manipulations, various biological agents, and various plant products. The use of the right technology in the right site can significantly lower the vector population below the threshold level, but an integrated operation with good community engagement is the ideal option.

Key words: Environmental management, filariasis, mosquito, public health, WHO

HLA gene polymorphism among the Indian Kami population from sub-Himalayan region of West Bengal, India

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Abstract

Study of HLA among the Indian Gorkhas has revealed that they are genetically closer to Mongoloid population (Debnath and Chaudhuri 2006). However, the major limitation of the previous study is that Gorkhas are not a homogenous population rather they are constituted by three ethnic groups viz. Kiratis, Newaris, and Tagadharis having unique ancestry. Thus, the cumulative studies of Gorkhas may not be free from biases. Therefore, the present study was undertaken to understand the HLA profile and genetic affinity of the Kami population (Tagadhari) from the Gorkha community. A total of 158 individuals belonging to the Kami population from sub-Himalayan West Bengal, India was included in the study. First field HLA typing was performed by PCR-SSP method and allele assignment was performed by Ready Gene software. The PyPopWin32 software was used for the estimation of Hardy Weinberg equilibrium, gene frequency, and haplotype estimation. Hierarchical Cluster analysis (HCA) and Principal component analysis (PCA) were carried out in the R software. The most frequent alleles observed at A locus was A*11 (31.01%) A*24 (21.84%), A*33 (19.62%), at B locus B*15 (23.42%), B*35 (13.92%) B*40 (18.67%) and at DRB1 locus DRB1*15 (41.14%), DRB1*14 (14.87%) and DRB1*07 (9.18%). Both HCA and PCA analysis revealed that the Kami population lies within the cluster of populations from the Indian subcontinent. Even though the Kami population belongs to the Indian Gorkha community they are more closely related to the Indo-Aryan population and not to the Mongoloid population as claimed earlier.

Keywords: allele, Darjeeling, human leukocyte antigen, Kami, West Bengal

Meliponiculture industry in Nepal: challenges and opportunities

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Abstract

Literature records indicate that ethnic people from different areas of Nepal practice meliponiculture. However, ethnobiological knowledge and beekeeping practices remain poorly documented. There is no published information on their identity or natural history and no record of traditional knowledge about them. I investigated stingless bees in Nepal through field surveys and ethnographic research across the Terai and Pahad regions (21 districts and 12 zones) and identified a single species, provisionally identified as *Tetragonula iridipennis* Smith (Hymenoptera: Apidae, Meliponini), in nine districts and seven zones. Nesting biology, local indigenous nomenclature, uses, traditional management practices, and knowledge of its behavior were documented for the first time from the country. In addition, the relative cultural importance of this species for each ethnic community (Chhetri, Brahmin, Tharu, and Kirat) that participated in the study was determined. Nests of *T. iridipennis* were found inside the cavities of medium to very large canopy trees of economic and cultural importance, such as trees used as timber and animal feed. I documented eighteen specific uses of bee products in food, medicine, crafts, and religious beliefs, which people largely exploit through an extractive management practice. Niche models suggest a broad distribution of *T. iridipennis* in southern Nepal. Finally, the current status and future directions for conservation and sustainable use of the stingless bee in the country was discussed.

Keywords: *Tetragonula*, relative cultural importance, ethnobiology, distribution, conservation

A prospective study of snakebite in a tertiary care hospital in Southwestern Nepal

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Abstract

Snakebite is a neglected public health problem in Nepal, too. We aim to characterize snakebites from mid- and far-western Nepal by conducting a prospective, cross-sectional, and descriptive study of snakebite patients admitted in Bheri Hospital during May to December 2017. Out of 476 admitted snakebite patients, 139 (29%) developed clinical features of envenomation (with 91% neurotoxicity resulting in 8% CFR, 9% hemotoxicity causing no fatalities), 3 (1%) dry bites, and 334 (70%) developed no signs of envenomation. All amount to hospital-based annual incidence of 19 snakebites, 6 venomous snakebites, and 0.4 snakebite deaths per 100,000 people, respectively. This incidence is comparable to previous studies in other parts of Nepal. A patient who developed neurotoxicity died during treatment due to shortage of antivenom. The venomous snake specimens brought by patients were *Bungarus caeruleus* (34%) and *Naja naja* (5%). The composition of offending snakes is different from those reported from southeastern Nepal. Notably less amount of antivenom was used in BH than those reported from other parts of Nepal. Fourteen percent of patients developed antivenom related anaphylaxis, which is within the range of 3.8–21% reported from previous studies in Sri Lanka. A total of 62% of patients applied tourniquet and 9% followed traditional healers adopting multiple non-recommended practices before hospitalization. Appropriate use of ventilation is essential to prevent hypoxia which is the eventual cause of elapid snakebite deaths. To identify snakes involved in bites, a co-ordination between medical personnel and snake experts is essential.

Keywords: Antivenom, envenomations, hemotoxicity, neurotoxicity, snakebite incidence

Ticks and tick-borne pathogens in China

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Abstract

Ticks are ubiquitously distributed arthropods to transmit various pathogens to animals and even human, which led to a huge lost in husbandry and threatens to human health. To keep a persistent surveillance on tick-borne pathogens and thus to obtain critical information for biosafety, we collected >7,000 ticks from 8 provinces during 2017-2019. The ticks were molecularly classified into 8 species. Viral metagenomic analysis revealed diverse viruses concerning chu-, rhabdo-, nairo-, flavi-like, Ifla-, hepe-, and parvoviruses. Above 37.74% of the viral reads in domestic animal ticks were related to the RNA viruses. The geographic location seems to significantly influence the viral families. The viral diversity of *R. microplus* was significantly different from that of other *Rhipicephalus* spp. Ticks from dog surface harbored vertebrate viruses from *Circoviridae*, plant viruses from *Virgaviridae*, phages from *Microviridae* and insect viruses from *Baculoviridae*, and giant viruses from *Mimiviridae* which may reflect the ecological characteristics of the dogs and their ticks. 16S rRNA gene amplicon sequencing indicated that ticks from Gansu and Yunnan provinces contained significantly less α -diversity on microbiota than that of other provinces (Henan, Shanxi, Hebei and Qinghai). Ticks from goats preserved more species than that of camels. Moreover, *Haemaphysalis longicornis* from Yunnan demonstrated lower α -diversity than that from Henan and Shanxi. Moreover, pathogenic species including *Coxiella burnetii*, *Rickettsia japonica*, *Bartonella schoenbuchensis*, *Anaplasma phagocytophilum* and *Ehrlichia chaffeensis* were detected in the tick samples and showed high diversity according to different provinces and organs. This result provided important information for the control of ticks and tick-borne diseases.

Keywords: bacteria, diversity, pathogens, ticks, virome

Carbonated tiger: the relationship between above-ground biomass carbon stock and tiger population density and occupancy in the Terai Arc Landscape, Nepal

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Abstract

Healthy natural forest provides provisioning ecosystem services for maintaining and/or enhancing carbon stock while providing potential habitats for wildlife including tiger. This study, the first of its kind, assessed relationship between above-ground biomass carbon stock (AGBCS), and tiger density and occupancy probability in protected areas, corridors, and forest connectivity blocks. We used published dataset on converged posterior tiger density estimates from Chitwan National Park; and AGBCS measured at several sampling plots. We used a simple stratify and multiply approach to derive carbon stock maps based on habitat categories and management regimes from satellite (Landsat TM) and sampled plots carbon stock data. We found a significant negative relationship between above-ground carbon mass and tiger density in Chitwan National Park and tiger occupancy at the landscape level. Within protected areas, we found highest mean above-ground biomass carbon stock in high density mixed forest (~222 tC/ha) and low in degraded scrubland (~73 tC/ha). Similarly, we found: (1) high tiger density ~ 0.06 individuals per 0.33 km² in the riverine forest and lowest estimates (~0.00) in high-density sal forest; and (2) predictive tiger density of 0.0135 individuals per 0.33 km² hoards 0.43 tC/ha in Chitwan National Park. Comparing between habitat categories, carbon conservation through forest restoration, as in riverine habitat (forest and grassland) or low transitional state biomass (degraded scrubland) provides opportunities to generate win-win solution, sequester more carbon and provide better habitat for tiger.

Keywords: density estimate, forest carbon, *Panthera tigris tigris*, occupancy

Mammalian diversity and conservation challenges in Gaurishankar Conservation Area, Nepal

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Abstract

Understanding the mammalian diversity is one of the first steps for protected areas management. Proper taxonomic identification of mammalian fauna is essential for initiating long-term conservation management and species action plans. The human-induced land-use change modifies the habitats and significantly impacts the distribution of mammalian taxa and ecological systems. Here, we present the mammalian diversity checklist of Gaurishankar Conservation Area based on direct observation, field reports, key interviews, focal group discussion, and a literature review. Seventy-six species of mammals belonging to eight orders and twenty-six families are known to occur in the region. Of these, only 31 species are of confirmed occurrence and are based on direct observation and camera traps records. The remaining 45 species listed in the checklist are based on interviews and literature. Most of the lower animal taxa of the order Chiroptera and Rodentia are based on interview and literature survey and needs further studies to confirm their existence. A higher number of species belong to the order Carnivora (25 species), followed by Chiroptera (20 species) and Rodentia (12 species). Large infrastructure development such as the construction of hydropower, road, anthropogenic activities, and increasing human-wildlife interactions in Gaurishankar Conservation Area are the major conservation challenges. A more robust taxonomic study particularly focusing on lower animal taxa, as well as land-use change as a result of human footprints, is warranted considering the ecological gradients and topography in the region.

Keywords: checklist, family, mammals, order, species

Molecular identification and phylogenetic relationship of alien deer species in Jeju Island, South Korea

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Abstract

The introduced alien and invasive species may have long-term effects on native biodiversity. Therefore, molecular identification and phylogenetic relationship are required to understand their origin and changes in genetic structure through time and space. To identify the introduced cervid in Jeju, South Korea and their phylogenetic relationship we collected 21 tissue samples from road kill and from the World Natural Heritage Headquarter in Jeju on special request. The Mitochondria DNA Cytochrome B (*CytB*) gene sequences were analysed, which reveal five distinct groups of *CytB* haplotypes including two haplotypes of sika deer (*Cervus nippon*) and three haplotypes of red deer (*Cervus elaphus*). Phylogenetic analysis was performed using maximum likelihood tree, which showed two haplotypes of *C. nippon* are distinguished into two sub clades representing *C. n. yakushimae* native sika to Japan and *C. n. taiouanus* native to Taiwan. Similarly, three haplotypes of *C. elaphus* found in Tibet, main land China and Sichuan province. These results revealed two species of cervid (*C. nippon* and *C. elaphus*) introduced in Jeju Island South Korea from Japan, Taiwan and China. Our study provided molecular identification, which solved taxonomic controversies of introduced *C. elaphus* and *C. nippon* in Jeju Island. Moreover, the phylogenetic study suggested their native home range and geographical origin. In conclusion two species of alien deer (*C. nippon* and *C. elaphus*) are currently exist in natural ecosystem of Jeju Island, South Korea.

Keywords: alien species, *CytB*, phylogenetic study, red deer, sika deer

Molecular phylogeny of swallowtail butterflies (Lepidoptera: Papilionidae) based on mitochondrial cytochrome c oxidase I (COI) gene from Bangladesh

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Abstract

Swallowtail butterflies (Papilionidae) are among the best-known insects in the world. Mitochondrial cytochrome c oxidase I (COI) gene from nine species under four genera of swallowtail butterflies was sequenced and submitted to NCBI's nucleotide sequence database GenBank. Basic local alignment search tool (BLAST) analysis showed that the COI gene sequences of these nine butterflies matched those of respective species from different geographical areas (99-96% similarity). The sequences were then analyzed and the interspecific genetic divergence among swallowtail species was between 0.01%-0.15%. Phylogenetic tree constructions using the maximum likelihood (ML) and haplotype analysis based on the TCS network were performed. Phylogenetic tree analysis showed that the species of swallowtail butterflies were originated from a common ancestor where *Papilio polytes*, *Papilio nephelus*, *Papilio demoleus*, *Papilio memnon* and *Papilio polymnestor* belonged to a cluster. On the other hand, *Graphium agamemnon*, *Atrophaneura varuna* and *Pachliopta aristolochiae* belonged to another cluster. In phylogenetic tree, *Graphium doson* was more divergent than the other species. In haplotype analysis, considerable genetic diversity was also observed among the nine species of swallowtail butterflies. Both phylogenetic and haplotype analyses showed that *Graphium doson* was genetically most divergent among the swallowtail butterflies studied in the present study. This result indicates that *Graphium* spp. might be the good model system to uncover many biological processes like color vision and image processing in organisms.

Keywords: butterfly, DNA barcode, evolutionary history, *Graphium* spp., identification

Morphological and molecular characterization of *Tylencholaimus notrus* Khan *et al.*, 1989 with first reports of its male and comments on the geographical distribution of the genus *Tylencholaimus* De Man, 1876 (Dorylaimida: Tylencholaimoidea)

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Abstract

Nematodes are a worm-like, microscopic, widespread, and primitive group of animals among invertebrates. *Tylencholaimus* is a soil-inhabiting nematode taxon, belonging to the superfamily Tylencholaimoidea (Dorylaimida) and mostly occur in undisturbed soil, and can be used to assess soil health. Khan *et al.* (1989) described *Tylencholaimus notrus* from India whereas, Peña-Santiago and Coomans (1996) restudied the type material and differentiated it from *T. obscurus* based on some morphological differences and presence of males. We recorded three populations of this species representing thirty-three females and one male (first record) from India. A comparative study has also been done using LM and morphometrics data, and no intraspecific variations have been observed within populations, and agree with the type population. Baqri and Bohra (2001) described *T. nagauriensis* from Rajasthan, India only based on the presence of labial disc. Erum *et al.* (2009) redescribed *T. nagauriensis* from Pakistan and restudied the type material and observed that perioral disc is absent. In our present specimens have no perioral disc, and hence, *T. nagauriensis* is here regarded as a junior synonym of *T. notrus*. Male having 22 µm long spicules, 3 ventromedian supplements; tail short, conoid with rounded terminus. Our first molecular data (18S and 28S rDNA gene sequences) of this species shows a narrow relationship within *Tylencholaimus* as well as with other members of Tylencholaimidae. Till date, a total of ninety-five populations representing sixty-two species of the genus *Tylencholaimus* have been recorded worldwide, and present distribution data reflects that species of the genus predominantly occur in the tropical and subtropical regions.

Keywords: Tylencholaimid, synonym, species distribution, phylogeny, India

Morphometric analysis to understand the diversity and evolution of genus pika (*Ochotona*)

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Abstract

Pikas are specific to microhabitat and microclimate on higher peaks, alpine and remote area of Eurasia, Himalaya, Tibetan Plateau and its periphery, and Northwest of North America. The wide range of habitat in harsh climate and remote area always makes the taxonomical work in pika more interesting and incomplete. In this study 22 craniodental measurements of 226 skulls representing 24 species of pikas were thoroughly observed using a digital caliper, all measurements were log-transformed and analyzed using principal component analysis (PCA) implemented in SPSS v17.0 for comparative craniodental measurement. *O. rufescens* has the longest (SKL), the widest (SKW) skull, the longest length of auditory bulla (LAB), and length of maxillary tooth (LUCT). Similarly, *O. gloveri* had the longest palatal length (PL), *O. royllii* had longest diastema (DIAST), *O. collaris* had widest interorbital breadth (IOB) and *O. macrotis* had the longest nasal bone length (NBL). Moreover, *O. thomasi* had the smallest and the narrowest skull with the least breadth of IOB, length of lower cheek tooth (LLCT). *Ochotona huanlognensis* had the smallest PL, *O. sp. 1* had the smallest diastema, *O. syrinx* had the smallest LAB and *O. thibetana* has the smallest nasal bone. The PCA delimited the four subgenus and 22 species supporting the results phylogenetic studies. However, two sympatric species: *O. macrotis* and *O. royllii* have very close craniodental measurement but they display differences in their fur coloration. The result suggests morphometric analysis is useful tools to assess the species diversity and evolution in genus *Ochotona*.

Keywords: PCA, sympatric species, species diversity, skull, taxonomy

Assessment of the spatial invasion risk of intentionally introduced alien plant species (IIAPS) under environmental change in South Korea

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Abstract

Predicting the regions at risk of invasion from IIAPS is an integral horizon-scanning activity that plays a crucial role in prevention, control, and eradication of invasive species. Here, we quantify the spatial distribution area and invasion risk of IIAPS using a species distribution model under different levels of environmental change in South Korea. From the model predictions, the current average spatial extent of the 10 IIAPS is 33,948 km², and the individual spatial extents are estimated to change by -7% to 150% by 2050, and by -9% to 156% by 2070. The spatial invasion risk assessment shows that, currently, moderate-to-high invasion risk is limited to coastal areas and densely populated metropolitan cities (e.g., Seoul, Busan, and Gwangju), but that the area with this level of risk is expected to spread toward the central and northern regions of the country in the future, covering 86.21% of the total area of the country by 2070. These results demonstrate that the risk of invasion by IIAPS is estimated to enlarge across the whole country under future environmental changes. The modeling system provided in this study may contribute to initial control and strategic management of IIAPS to maintain the dynamic ecosystems of South Korea.

Keywords: climate change, intentionally introduced alien plants, invasion risk, land cover change, spatial distribution

Traditional practices and use of indigenous knowledge in fisheries management among selected tribes of Nagaland, India

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Abstract

Traditional fishing practice is an age-old practice among tribal communities of Nagaland, India and some practices of fishing are still recognized as sacred and practiced widely. Traditional fishing gears which are used in fishing activities largely depend on factors such as mode of activity, topography, fishing season, material used in the manufacture, size, function, aquatic body physiography and number of manpower engaged in fishing. It is generally made from indigenous materials such as cane, cotton twine, metallic rods and hooks, bamboo, wooden branches, stones, etc. A unique way of traditional fishing practice which has been a part of the Naga culture since time immemorial is community fishing that symbolizes their socio-cultural life. It is not only about the great fish hunt, but it also has some other pertinent community issues. It spreads the message of universal brotherhood and community participation for better societal goals, including formulating relevant village policies following consensus from the members. It is viewed as an event to re-establish human associations with the river ecosystem, to offer obeisance to the river God and seek the blessings of mother nature. The mass fishing event practiced by the Ao and Sumi tribes is best viewed as a classic example of community fishing in Nagaland. Community supplications, arrangement of logs, beating of logs, use of poisonous vine prepared by piscicidal plants and their parts for poisoning and stupefying fishes during community fishing are generally followed. The principle bioactive compounds present in the plant parts such as leaves, seeds, kernels and bark have varying potencies and modes of action. In present times, the nature of traditional practices and indigenous knowledge associated with fishing are being lost due to modernization. Nagaland has no or rather limited documentation on such knowledge of fishing practices. Hence, it is now important to record and understand this age-old practice passed down through oral transmission or folktales from generation to generation.

Keywords: great fish hunt, indigenous knowledge, fishing practice, Nagaland, traditional fishing gears

Wandering flying fox colonies require priority in biodiversity conservation programs of Nepal

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Abstract

Indian flying fox (*Pteropus giganteus* Brünnich, 1782) are the largest among the bats at Indian subcontinent. They are herbivores, feed on ripe fruits, leafs, twigs and nectar, predominantly of wild floral resource. We recorded about two and half dozen of *P. giganteus* colonies across Nepal. Colony size of the *P. giganteus* in the colonies estimated from a (few) hundred to above five thousand. Roost sites of the colonies are locating in the vicinity of highly urbanized or human managed areas. A colony of Flying fox at Pokhara has collapsed two years ago due to urbanization. Similary, A new colony of flying fox has recorded at Belbari Municipality of Morang district since six month ago. The locals claimed they have no historical experience of such colonies in their Palika. The wandering colonies of flying fox evidenced the risk of roost collapse is severe in Nepal's environment. Furthermore, the colonies are losing public goodwill due to Covid-19 pandemic. The stress on *Pteropus bats* is global concern for zoonotic dispersal and viral spillover. Intensive study is urgent to understand cause and consequences of flying fox frustration in the Nepal's environment.

Keywords: *Pteropus*, colonies, habitat collapse, bat virus, Nepal

Biochemical analysis of Hilsa fish *Tenualosa ilisha* (Hamilton, 1822) in relation to multivariate regression analysis: a review

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Abstract

Biochemical analysis of mesodermal cells of Hilsa, *Tenualosa ilisha* (Hamilton, 1822) was done during its fingerling stage and adult period as well. The analysis depicted variations in its composition with the life cycle stages. Analysis of amino acid showed presence of greater concentration of arginine ($P < 0.01$), and methionine ($P < 0.01$) during fingerling stage. While adult stage showed greater concentration ($P < 0.01$) of leucine and isoleucine as well. Monounsaturated fatty acids were greater ($P < 0.01$) during adult stage. Multivariate regression analysis revealed a significant relationship ($P < 0.001$) of different biochemical parameters with the adult stage of Hilsa. Multiple correlation coefficient ($R = 0.96858$) had been significant. Coefficient of multiple determination ($R^2 = 0.93815$) had also been significant. ANOVA showed the multivariate regression analysis was significant ($P < 0.001$).

Keywords: multivariate, regression analysis, ANOVA, mesodermal cells, Hilsa fish

Investigation on population abundance and diversity of soil-dwelling arthropods in Rajshahi University Campus (RUC), Bangladesh

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Abstract

Measuring population abundance and diversity are important components of many ecosystems for conservation biology. The present study was done to assess the population abundance and diversity of soil-dwelling arthropods in Rajshahi University Campus, Bangladesh from November 2017 to April 2018. A total number of 438 individuals of soil-dwelling arthropods were examined during the study. Twenty-three species of soil-dwelling arthropods were identified belong to the class Insecta (19 species, 76.71%), Arachnida (2 species, 12.79%) and Myriapoda (2 species, 10.50%) under 10 orders and 20 families. Among the species, the most dominant species was *Monomorium minimum* (n= 67) followed by *Eccoptoptera cupricollis* (n= 56), and their relative abundance (RA) was 15.30% and 12.79% respectively. The lowest population abundance was *Entomobrya sp.*, *Reduvius personatus* and *Forficula auricularia* (n= 1, RA= 0.23%). There were 2 very common (VC), 4 common (C), 6 fairly common (FC), 5 rare (R) and 6 very rare (VR) species. The maximum diversity was recorded from the order Coleoptera (8 species, 37.67%) followed by the order Hymenoptera (3 species, 28.77%), and the order Hemiptera was 4 species but the percentage was (4.11%) less than Hymenoptera. Among the 20 families, Formicidae was the most dominant taxa comprised with 28.77% of total captured populations followed by family Carabidae (12.79%) and Gryllidae (12.33%). Diversity indices of Shannon (H'), Simpson (1-D) and Margalef (D_{Mg}) were 2.41, 0.92 and 3.62 respectively. Menhinick richness (D_{Mn}), Berger-Parker dominance (d) and Pielous evenness index (J') were 1.10, 0.15 and 0.77 respectively. As the soil-dwelling arthropods populations are excellent bio-indicator, a review of their population's status at regular intervals may provide important biological information about the ecological condition in Rajshahi University Campus (RUC), Bangladesh.

Keywords: arachnids, diversity indices, insects, pitfall trap, relative abundance

Population density of *Chitala chitala* fry in relation to the physico-chemical parameters of Muhuri River of Tripura, North-east India

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Abstract

In order to identify the wild resource of *Chitala chitala* several physico-chemical parameters of Muhuri river of Tripura, a state of North-east India was analyzed to find out a relationship with the population density of *Chitala chitala* during its fry stage. The relationship was evaluated through multivariate regression analysis. The results showed that amongst different parameters considered in the regression analysis, only seven particular physico-chemical parameters have had a significant relationship ($P < 0.001$) with fry stage. The parameters showing significant relationship had been water temperature, rainfall, water velocity, depth of the river, pH, DO₂ and HCO₃ as well. However, the other parameters such as CO₂, CO₃, DOM, Salinity, Silicate etc either had a very low impact or no significant impact at all. Multiple correlation coefficient (R) had a significant relationship ($P < 0.001$). Coefficient of multiple determination (R²) also had a significant relationship ($P < 0.001$). ANOVA depicted that the regression analysis was significant ($P < 0.001$).

Keywords: *Chitala chitala*, Muhuri River, wild resource, multiple correlation coefficient, physico-chemical analysis

Functional and structural regeneration of hard tissues based on developmental principles

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Abstract

Understanding the developmental signaling regulations during tissue and organ development is important to reveal the underlying mechanisms of morphogenesis and regeneration. In the present study, we employed the genome wide screening of spatiotemporal specific expression patterns, and screened the novel molecules, which would be related with hard tissue formation. Then we examined the molecular and cellular mechanisms of candidate molecules in formation of dental hard tissues such as dentin, palate, alveolar bone, and enamel, using a range of functional evaluation systems including in vitro and in vivo disease experimental animal models. For the dentin and enamel formation, ER-stress related molecules were selected and applied into in vitro organ cultivation and pulpal cavity formation methods. In addition, the alveolar and periodontal ligament formation, dental follicle specific genes were selected and applied in to in vitro cell cultivation and periodontal diseases models. Overall, the applications of tissue and stage specific signaling through regulating the signaling pathways and cellular events in dental hard tissue formation would reveal that proper modulations of inflammation and cellular secretion which would be the key for proper hard tissue regenerations. We also propose that the purpose-dependent selection and application of developmental regulation genes and signaling pathways are important for the functional and structural regeneration of specific tissues and organs.

Keywords: gene expression, functional evaluation, molecular mechanism, morphogenesis, organ development

Human-elephant conflict in the adjoining areas of Koshi Tappu Wildlife Reserve, Eastern Nepal

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Abstract

Human-Elephant Conflict (HEC) has worsened in the past decade and has had its influence till now. This study was conducted in the eastern buffer zone of Koshi Tappu wildlife Reserve (KTWR) and aimed to explore the elephant occurrence, impact of human-elephant conflict on humans and also explore the relationship of HEC with farming practice using a questionnaire and sign survey. Overall nineteen signs of elephant were reported during the study period out of which seventeen footprints and two fresh dung were recorded which revealed the occurrence of wild elephants near water bodies and agricultural field. Variables such as nearest forest and water sources showed a significant association between conflicts. This study reported seventy-four incidents of crop damage, fifty-eight incidents of property damage, and only a case of human casualty during three years. Total economic loss from crop damage was US\$ 80.850 per household (HH) and property damage was US\$ 81.296 per household (HH) in three years. Traditional farming practice such as paddy, maize, wheat increases the higher chances of elephant attacks. This shows that crop raiding pattern of elephant is crop specific. Hence, understanding the ecological behavior of elephants and reducing the human interference inside the reserve would be the most useful method to reduce conflict.

Keywords: human-elephant conflict, occurrence, farming practice, Koshi Tappu Wildlife Reserve

Effects of habitat structure and invasive alien plant species on bird assemblages in Jalthal Forest, Eastern Nepal

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Abstract

Invasive alien plant species (IAPS) are recognized to have an impact on faunal diversity. The Jalthal forest is one of the most invaded forests in eastern Nepal's Terai. This study aimed to find out the effects of IAPS cover on the occurrence of birds. By dividing the IAPS cover into three classes (Low, Medium, and High) outer one km strip of the forest was sampled. A total of 89 points were deployed for the point count survey of birds. Generalized linear model (GLM) was done to understand the relation of the diversity and abundance of birds with environmental variables. A total of 86 species of birds belonging to 13 orders and 41 families were recorded. The insectivorous birds had the highest species richness. Wooded grassland had the highest diversity of birds. Bird species richness and abundance decreased significantly when the distance to the nearest water source, IAPS cover, and shrub cover increased. The sal (*Shorea robusta*) forest was found to be the most preferred habitat type; however, the preference of habitats by feeding guilds was conditional. Jalthal forest is Nepal's only forest of its kind, and it is heavily infested by IAPS, more research into biodiversity and the effects of IAPS on biodiversity is in this forest required

Keywords: invasive species, bird diversity, feeding guild

Distribution records of Dormer's bat *Scotozous dormeri* (Dobson, 1875) in Nepal

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Abstract

Dormer's bat is endemic to South Asia and distributed in tropical, semi-arid or arid climatic zone in India, Pakistan, Bangladesh and Nepal. They are totally insectivores in nature and play an important role for the natural control of pests and other harmful insects. Roost search and mist netting were conducted during early evening to 22:00 o'clock in three sites and the species was identified by field-based morphology like medium size of body pale gray brown color in dorsal side, buffy white in ventral surface and face is necked and uniform mid-brown in color. A total of five individuals of *Scotozous dormeri* were recorded from east to west Nepal and the range of fore arm between 34.4-36.00 mm. An individual was observed from cavity of wooden pillar in a wooden house at Ramjhoda, Sunsari District. Two individuals each were trapped in Morange River, Morang District in the east and Hattikhauwa, Dang District in the west. Three localities of the species record lie in the dry and arid sub-tropical area. This study records second to fourth locality records of the species distribution to Nepal.

Keywords: endemic, pest control, Roost, Mist netting, dry and arid sub-tropical area

Prevalence of gastrointestinal parasites in bovines along the elevation gradients of Chitwan Annapurna Landscape, Nepal

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Abstract

Gastrointestinal (GI) parasitic infection is a serious problem in livestock management in Nepal which may vary with age, sex, feeding types, habitat types, and interaction with other domestic and wild animals. As a consequence of environmental change, it is anticipated that temperature and precipitation variation in altitudinal gradients will influence parasite communities and their hosts with unpredictable impacts. This study aimed to explore the pattern of prevalence and factor affecting GI parasites in bovines along the altitudinal and environmental gradients of Chitwan Annapurna Landscape. A total of 600 samples were collected from different six blocks and examined microscopically in 2019-2020. The presence of cysts, oocysts and eggs of parasites in faecal samples were detected morphometrically using standard qualitative and quantitative methods. Out of 600 faecal samples of cattle and buffaloes examined, 62.8% were found positive for one or more species of GI parasites. The prevalence of parasitic infection was significantly higher in cattle (68.7%, n=?) as compared to that of buffaloes (62.8%, n=, p=0.007). A total of 19 species (5 protozoans, 14 helminths) were reported. The prevalence of GI parasites was significantly lower with increasing annual rainfall, elevation, distance from the forest, and distance from the water resources (p=0.0001) but significantly higher as increasing temperature (p=0.001). The calf (p=0.028) and sub-adults (p=0.028) were significantly infected than adults. More than 80% of the herders used veterinary drugs for deworming, but even there was more infection of GI parasites in cows and buffaloes. They argued the infection due to common foraging grounds and water sources. Hence, GI parasites are the problem in cattle and buffaloes of the Chitwan Annapurna Landscape. Hence, regular health checkups, deworming, cleanliness of the sheds, and water resources are suggested regularly.

Key words: cattle, faeces, helminths, oocyst, protozoans

Diversity of order lepidoptera (butterflies) in Anand, Gujarat

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Abstract

Butterflies are the most fascinating than most other invertebrates existing in animal kingdom. They have been referred to as 'Flagship' and 'honorary birds'. They are valuable in terms of pollination, apart from this they are important food chain components of birds, reptiles, spiders, and predatory insects; they are also the good indicators of environmental quality and the habitat where they are being found. Biological diversity is the base for upholding the ecosystems and the functional aspects of the species that provide goods and services for human well-being. They are highly temperature sensitive organisms with specific nutritional requirement. Species abundance reaches the peak in the months during August to November. A decline in species abundance was observed in the months of December to January and continued up to the end of May. We found total of 52 species of butterflies. Out of which, 6 species from family Papilionidae, 15 species from family Nymphalidae, 17 species from family Pieridae, 13 species from family Lycaenidae and 1 species from family Hesperidae. At genus level we encountered 3 genus of family Papilionidae, 7 genus of family Pieridae, 9 genus of family Nymphilidae, 13 genus of family Lycanidae and 1 genus of family Hesperidae.

Keywords: biodiversity, puddling, temperature, richness and abundance

Scanning the horizon: Planning for greater one-horned rhinoceros (*Rhinoceros unicornis*) conservation in the face of climate change

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Abstract

Over the last few decades, climate change has emerged as a serious threat to biodiversity conservation, which is likely to be intensified in the future, given that global temperature continues to increase. Greater one-horned rhinoceros is a rare wildlife species restricted to a few protected areas in India and Nepal. In Nepal, habitat loss and poaching remain the critical threats for rhinoceros, likely adverse impacts of climate change may jeopardize its conservation success. In this study, we used a combination of qualitative and quantitative research methods such as key informant interviews, stakeholders' consultation workshop, ensemble species distribution modelling, and expert elucidation. The key findings of this study suggest that rhinoceros in Nepal will face a 'moderate' level of climate change vulnerability and nearly 35% of the current habitat is likely to become unsuitable in the next 50 years due to the combined effects of climate and land use changes. Likewise, we have identified 20 adaptations actions for rhinoceros conservation in Nepal and prioritized them. Out of these actions, identifying and protecting climate refugia, restoring the existing habitats through wetland and grassland management, creating artificial highlands in floodplains to provide rhinoceros with refuge during severe floods, and translocating them to other suitable habitats received higher priority. The findings of this study are expected to guide adaptation planning for rhinoceros conservation in Nepal. We further recommended empirical research to provide better insights on the likely consequences of climate change, so that these adaptation actions can be refined in the future following adaptive management principles.

Keywords: adaptation planning, biodiversity, climate refugia, translocation, vulnerability

Stabilities of soil nematode communities with different vegetation types in Dachigam National Park, India.

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Abstract

The above ground vegetation have been documented to be strong drivers of the soil food web structure and functioning in terrestrial habitats. However, how the vegetation type affects the stability of soil food web is not well known. In the Dachigam National Park, we selected four types of vegetation: grassland (GL), marshy land (MR), forest (FR) and cropland (CL) to investigate the nematode community assemblage and structure. The results showed that the characteristics of soil nematode communities differed markedly among the vegetation types. Compared to GL, FR and CL; MR had higher abundance of total and bacterivore nematodes. While fungivores were higher in GL, MR and FR as compared to CL. In contrast, herbivores were higher in CL. Omnivore nematode abundance was unaffected by vegetation type whereas, predators were least abundant in CL. The Shannon–Wiener diversity index (H'), Simpson index (λ), Chao 1 generic richness and Pielou's evenness index (J') were higher in the GL, MR and FR as compared to CL. The values of the maturity index (MI), maturity index 2-5 (MI2-5), and summed maturity index (SMI) were significantly ordered in the similar manner (GL>MR ≈ FR>CL). Channel index indicated bacterial decomposition pathway in GL and Fungal in MR, FR and CL. The nematode faunal profile depicted GL as the most structured ecosystem compared to MR, FR, and CL. Results suggest the importance of the bottom-up effect of vegetation type in regulating the soil food web structure, function, and stability, which has important implications for sustainable management of vegetation cover.

Keywords: diversity, faunal profile, food-web, habitat, vegetation

Expanding our knowledge of Nepalese ants: new records and worker-based keys for the predatory subfamily Dorylinae

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Abstract

Ants (Family: Formicidae) are one of the most successful and dominant insect groups found in all terrestrial environments. The subfamily Dorylinae is particularly interesting in that most of the species are nomadic and predatory, carrying out large raids on other ants, wasps and termites. The subfamily is found throughout the world's tropics and subtropics. This study provides a synoptic overview of Nepalese Doryline ant genera, reports new faunal records for the country and presents new worker-based identification keys. Ant surveys were carried out in Shivapuri-Nagarjun National Park, Ranibari Community forest and Tribhuvan University Campus using pitfall trapping, baiting and hand collecting from 2019 to 2021. The surveys expand Nepal's ant records to five Doryline ant genera (*Aenictus*, *Cerapachys*, *Dorylus*, *Ooceraea* and *Parasyscia*) represented by 10 species, an increase from the previous records of four genera and five species. One genus, *Parasyscia*, and three species, *Aenictus fergusonii*, *A. hodgsonii*, and *Parasyscia wightii* are new records for Nepal. Two species, *Aenictus* NP-01 (*laeviceps* group) and *Aenictus* NP-02 (*ceylonicus* group) are likely to be new for science. Worker-based identification keys to the Dorylinae subfamily in Nepal are illustrated with head in full-face and habitus in profile view images. The authors hope that this study will spark local interest in Nepalese ant research.

Keywords: army ants, formicoid clade, new species, predatory ants, synoptic review

Land use/ land cover changes in the Chitwan Annapurna Landscape, Nepal

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Abstract

This study evaluates land use/cover changes in the Chitwan Annapurna Landscape, Nepal between 2000-2020 using satellite images. Spatial and temporal changes of land use/cover changes are quantified by using Landsat images. The images were classified into eight different classes and the accuracy assessment was performed by calculating actual accuracy, producer's accuracy, user's accuracy and kappa coefficient based on ground-truthing points for 2020 and google map and topographic maps for images of 2010 and 2000 respectively. The land cover analysis showed that the study area was composed of water bodies (1.97%), barren area (1.76%), grassland (1.73%), riverine forest (1.93%), sal forest (15.4%), cropland (28.13%), developed area (4.13%) and mixed forest (44.95%) and there were the synergic temporal changes in land cover from 2000 to 2020. The classification of the images of 2000, 2010 and 2020 had 81%, 81.6% and 84.77% overall accuracy respectively. Our study showed a clear scenario of spatio-temporal changes of land use/cover from 2000 to 2020. As reliable and recent data are lacking for the Chitwan Annapurna Landscape in Nepal, the present findings can be used as a baseline information for the development of proper management plans to protect wildlife habitats and forecasting possible future changes, if needed.

Keywords: accuracy assessment, habitat change detection, image classification, Landsat image, remote sensing

**Seasonal variation in ectoparasitic mite *Tropilaelaps mercedesae*
Anderson and Morgan, 2007 in Apistan treated and untreated
colonies of *Apis mellifera* in Kathmandu, Nepal**

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Abstract

Tropilaelaps mercedesae is an ectoparasitic mite that may cause shattering effects on honey bees. This study carried out from May to October 2017 describes the development of *T. mercedesae* infestation in adult, brood and debris of honey bee (*Apis mellifera*) colonies in Kathmandu, Nepal. *A. mellifera* colonies were treated with the Apistan (Group A) and some naturally infested colonies were remained untreated (Group B). Sensitivity to Apistan varied throughout the study period. The highest rate of infestation in Group A was observed during October (0.625% in adults, 8.375% in brood and 25.75% in debris) while the least rate of infestation was seen during May (0% in adult, 2% in brood and 3.25% in debris). In Group B colonies, the highest infestation was observed in October in adult and debris as 2.5% and 67.625 respectively. It was 21.75% in brood in September while the least infestation was observed in May (0.5625% in adult, 2.75% in brood and 3.25 in debris). The difference between the mean values of the mites in broods of two colonies was not significantly different ($p=0.089$, $df= 6$). The Apistan was found to be effective in controlling the mites in adult bees ($p=0.0067$, $df= 6$) which underscores its role in maintaining the colony health but must be used judiciously. The population of the mites was found to be positively correlated with humidity while negatively correlated with temperature. During summer season, the number of mites remained low while the number increased during autumn when there was much brood rearing.

Keywords: honey bee, infestation, miticide, seasonal fluctuation, honey bee health

People's perception towards livestock depredation by snow leopard *Panthera Uncia* (Schreber, 1775) in Lower Mustang, Annapurna Conservation Area, Nepal

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Abstract

Livestock depredation has become a challenge in central Asia throughout the range of the Snow Leopard. This study focused on livestock depredation and perception of people on snow leopard in lower Mustang using semi-structured open-ended questionnaire (135 households) to find the type of livestock depredation and people's perception towards livestock depredation by Snow Leopard. Among all the respondents, 82% keep their livestock in simple stone walled corral, 14% in wired fence corral and 4% in predator proof corral. Among all the livestock, 62.71% owned were goats and least 1.16% owned were horse. The highest livestock kill by Snow Leopard was found to be goat (71.41%). Generalized linear model showed that number of livestock loss increases with increase in number of livestock owned. Livestock depredation was highest in winter and lowest in spring with less economic loss as compared with winter season. Total 88% of respondents protect their livestock in corrals at night. Total 52% of the respondents agreed with compensation scheme for mitigation measure followed by predator proof corral (25%), insurance (14%), predator deterrent fox light (8%) and others (20%). Only 8% of the respondents were known about predator deterrent fox light as mitigation measure. Snow Leopard conservation efforts such as insurance scheme and income generating program are recommended for the mitigation of Human-Snow Leopard conflict. Current study is beneficial to the local communities and the concerned authorities to make conservation plans and policies to mitigate Human-Snow Leopard conflict and their long-term coexistence.

Keywords: snow leopard-herder interaction, livestock depredation, opinion, conservation

Environmental drivers of grassland in Bardia National Park: historic and annual remotely sensed imagery shows changes in the habitat of megafauna

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Abstract

In the Terai, both natural and cultural grasslands serve a viable role for rhinos and the prey of tigers. They are crucial but vulnerable for encroachment of woody species. Highly dynamic river systems drain the Himalayas and provide disturbances that maintain floodplain grasslands at the foot of the Himalayas. We aimed to establish the relation between environmental drivers (discharge, channel dynamics, precipitation and forest fires) and space-time dynamics of grasslands. We created two annual time series of land cover with the use of field and remotely sensed data (LANDSAT imagery) for the western part of Bardia National Park, Nepal. Additionally, we analysed aerial photographs of 1964 and the pattern of grassland patches. Successional setbacks of grassland along the eastern branch of the Karnali River correlate with the magnitude of yearly peak discharges within the floodplain. However, this relationship is absent after 2009 due to a westwards shift of the main discharge channel of the Karnali River with an expansion of alluvial tall grasslands as consequence. That hydromorphological processes in the floodplain have become more static since 2009 is supported with an observed decrease in water coverage (-53%) in the dry season, a decreased response of vegetation and the decreased morphodynamics of river channels. Over the long term, grasslands patches declined and saw a transition to forest, probably due to decreased anthropogenic disturbances. As also fluvial disturbances decreased, other sources of disturbances are more paramount to prevent encroachment of grassland and avert cascading effects for grassland-dependent fauna.

Keywords: disturbance regimes; grasslands; megafauna; land cover dynamics; remote sensing

Role of ants (Hymenoptera: Formicidae) in the predation of *Belenois solilucis* eggs in organic agriculture production systems at Rashad, Sudan

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Abstract

Organic farming is becoming more popular as there is a greater demand for pesticide-free food. Pest control in organic agricultural production necessitates a set of skills, including the identification of effective predators and land use practices. Predation by selected Coleopteran, Dipteran, and Hemipteran insects and Araneae is well established, whereas predatory roles of ants (Hymenoptera: Formicidae) have received little attention in the Rashad district, Sudan. The study was carried out to assess the predation rates of *Belenois solilucis* eggs and the impact of type of land use around the properties on these rates. An experiment involving predation tests on *Belenois solilucis* eggs and fauna sampling was conducted in 18 areas of organic agriculture in the Rashad district. The study showed that ants can reduce the egg population by 26.8% per day. At the same time, other predator taxa, primarily Coleoptera, from Coccinellidae and Staphylinidae families, removed only 13% of the eggs. Ant species with the greatest recruiting power were found to be *Axinidris acholli*, *Tapinoma carininotum*, and *Technomyrmex moerens*. Ant genera such as *Linepithema*, *Dorymyrmex*, and *Camponotus* ants were also frequently observed. The proportion of planted area within a 500-meter radius, in addition to the interaction of other landscape categories, had a minor influence on predation, but only when the predators were not ants. The landscape has no effect on predation by predators in general, including ants, or on ant predation in particular.

Keywords: biodiversity, biological control, disturbance, land use, population

Abundance and species richness of bumblebees in Budigandaki River Valley of Central Nepal

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Abstract

Bumblebees are a significant group of pollinators for many agricultural crops and wild plants in central temperate Himalaya region. Despite the fact that our understanding of these insects has grown in recent decades, several geographic areas remain understudied, and new information about their faunas is scarce. This study was conducted to explore the Bumblebees in Budigandaki River Valley of Chitwan Annapurna Landscape region. Field survey was carried from June to November, 2019 across the altitudinal gradients (500 -3500 m asl.). The data were collected following accessible walking trails and specimens were captured using sweeping net. We identified total of 8 subgenera and 12 species of *Bombus* from our study sites. The *Bombus haemorrhoidalis* (subgenus- Orientalibombus) was the most abundant species and foraged highest 14 plant families in our study area. The most visited plant species by bumblebees was *Jasminum humile*. Foraging frequency of bumblebee was found to be positively correlated with temperature (+ 0.140262142) while negatively correlated with altitude (-0.194598483) and relative humidity (-0.036246158). Our study indicates species richness of *Bombus* species in study area is influenced by the variation host plants and variation.

Keywords: altitude, *Bombus*, foraging, plant, specimens

Assessment of heavy metal concentrations in water and fish of Bagmati River, Nepal

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Abstract

Heavy metals are considered toxic to all types of flora, fauna and environment. Excessive concentrations of heavy metals are detrimental and may even cause death of living beings. In this study, levels of heavy metals [copper (Cu) and cadmium (Cd)] were determined in water and gills and muscles of two fish species (*Schistura beavani* and *Puntius* spp.) collected from five different study sites in Bagmati river. To investigate the relationship between the mean concentration of the metals in water and fish tissues, the collected samples were acid digested by wet method and analyzed using Atomic Absorption Spectrophotometer. The average concentration of Cu was 0.168, 0.195 and 0.129 ppm while Cd was 0.047, 0.060 and 0.033 mg/L in water, gills and muscles of fishes respectively. The mean concentration of both metals was high in the examined fish gills. The study reported the positive relation of metals in water and fish tissues that suggests the accumulation of metals in the fish tissues. In spite of the contamination of Bagmati river by heavy metals, the level of the metals in fish muscle (the edible part) did not exceed the recommended permissible limit and the fish is considered safe for human consumption.

Keywords: AAS, bioaccumulation, Cadmium, Copper, correlation

Distribution and habitat utilization of Himalayan goral (*Nemorhaedus goral*) in Dailekh District, Karnali Province, Nepal

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Abstract

The study was conducted aiming at determining the distribution and habitat utilization of Himalayan goral (*Nemorhaedus goral*) in Dailekh District, Karnali Province, Nepal in January/February 2020. Line transects of 0.5 - 1.0 km was laid on the field to assess the status and distribution of this species. Direct observation of goral, fecal pellets in different habitat types and records of other topographic variables were used to find out distributions and habitat utilization of Himalayan goral. Interviews and a questionnaire survey with locals were used to assess level of threat. A total of five individuals and 122 fecal deposits of goral were recorded. Results suggested an uneven distributed pattern of goral. The survey through sign showed that gorals were distributed from 700 m to 1250 m asl, in study area. Five habitat types were used by the goral: cliff rock area, mixed hardwood forest, Pine Forest, *Quercus* Forest, *Sal-Terminalia* forest. The highest number of Himalayan goral was recorded on cliff rock area followed by *Quercus* forest and *Sal-Terminalia* forest. Presence of goral declined with the vicinity of villages and increased with distance to nearest village. Gorals also preferred south facing steep slopes and top of cliffs. Himalayan goral was recorded in areas with a highly rugged and steep terrain. Himalayan gorals are facing a serious local threat of poaching for meat. Other threats include habitat destruction, fragmentation and various anthropogenic activities such as fire, wood collection, fuel wood collection, overgrazing.

Keywords: distribution, Himalayan goral, habitat utilization, Karnali, threats

Morphological and molecular characterization of gastrointestinal parasites of wild water buffalo of Chitwan National Park

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Abstract

Gastrointestinal (GI) parasitic infections caused mainly by protozoa and helminths are most prevalent in Asiatic wild water buffalo (*Bubalus arnee*), an endangered species. The microscopy-based identification of GI parasites can be further strengthened at species level, which shows the importance of molecular-based identification. A coprological survey of GI parasites of translocated wild water buffaloes was done in Chitwan National Park. Fresh dung samples (n=25) were collected from wild water buffaloes and analyzed using sedimentation and flotation techniques for morphological identification of parasite cyst, oocyst and eggs. Nine different GI parasites were recorded of which *Entamoeba* species (20, 80%) were the most common. The presence of *Entamoeba* spp. was further validated using PCR analysis and DNA sequencing. The overall infection rate was 96%, of which 88% and 84% were due to protozoa and helminths respectively. The identified other protozoan parasites were *Eimeria* (2, 8%), *Balantidium* (1, 4%), and *Cryptosporidium* (15, 60%) and helminths were *Oxyruid* (17, 68%), *Strongyloides* (7, 28%), *Strongyle* (9, 36%), *Eurytrema* (2, 8%), and *Paramphistomum* (1, 4%). The PCR assays were conducted for *Entamoeba* by using 18S ribosomal gene specific primers. All microscopic positive samples gave amplification product at 550 bp. The PCR positive samples were performed sequencing, which enabled the more precise identification. Sequence analysis showed that it was *E. bovis* and was separated from those of other *Entamoeba* species in phylogenetic analysis by the Neighbor Joining method. This is the primary report for the molecular detection of *E. bovis* in translocated wild water buffalo in Nepal.

Keywords: *Bubalus arnee*, *Entamoeba bovis*, PCR, sequence

Species diversity of reptiles in Palpa, Nepal

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Abstract

The study was conducted in the five different habitats in Palpa, Nepal from May 2016 to April 2019. The purpose of the study was to document and measure the richness, abundance, and diversity of the reptile in this district. Data were collected by quadrat, visual encounter and opportunistic survey methods randomly in the habitat of agricultural field, forest, human habitat, riparian, and wetland of this district. In each habitat type, 20 cell quadrates were placed and altogether 100 quadrates in each site seasonally. In total, 554 individual species belonging to 9 families, 26 genera, and 34 species were recorded. The richness of reptiles species was high in the agricultural field and forest ($S=24$) but lower in wetland ($S=6$). The abundance was more in human habitat than in other habitats. Shannon diversity index (H') of reptile was 2.51 and 0.99 in forest and wetland respectively. Similarly, the Simpson index in reptiles (λ) was high in forest (0.87) and low in wetland (0.57). Pielou evenness (J) of individuals among the species was 0.29 in forest and 0.54 in a wetland. The values indicate that the diversity of reptiles were more diverse in forest as compared to the wetland. Information on reptile's diversity helps to control insect pests, detect environmental pollution, maintain healthy ecosystems, and aid future research.

Keywords: agricultural fields, diversity indices, forests, human habitats, riparian, wetlands

Evaluation of antagonistic activity of *Trichoderma* spp. against *Meloidogyne* spp.

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Abstract

Root knot nematode, *Meloidogyne* spp. is a major plant parasitic nematode in vegetable crops, worldwide including Nepal. Biological control of root knot nematodes by soil antagonistic fungal microorganism such as *Trichoderma* spp. is one of the potential non-chemical agents of plant disease control. The aim of the present study is to evaluate different *Trichoderma* isolates against *Meloidogyne* spp. Thirty-five *Trichoderma* isolates were collected from soil of Kathmandu valley and coded with their location. *In vitro* assay was performed by preparing conidial suspension for different *Trichoderma* isolates and were tested in Petri dish against second stage juveniles of *Meloidogyne* spp. Seven *Trichoderma* isolates; K11, Ba9, K13, To7, Ba5, To9, Ki10 showed a good nematocidal effect on larval mortality (ranging from 70-50% in 24 hrs) of the second stage whose effectiveness varies with the time of exposition. This result indicates the potentiality of *Trichoderma* spp. as a nematophagous fungi and also in selection of antagonistic *Trichoderma* sp. towards controlling nematodes.

Keywords: biological control, nematocidal effect, *Trichoderma* spp., root knot nematode

Distribution, abundance and habitat evaluation of Asian vultures in Kaligandaki Corridor, Western Nepal

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Abstract

This study was conducted aiming to assess the distribution, abundance and habitat evaluation of Asian vultures in Kaligandaki Corridor, Nepal. Method includes point observation using the birding route, visit of nesting/roosting sites and fixed-point survey. Questionnaire survey was also done to identify people's perception towards the status and threats on vultures. A total of 99 vulture individuals of five species were observed in total 19 points along the Kaligandaki River Corridor (57 individuals in twelve different points during the summer visit and 42 individuals in nine different points during the winter visit). Remarkably only the two species, White-rumped vulture and Red-headed vulture were recorded at Khaireni Community Forest with total of 63 individuals (37 individuals in summer and 26 in winter). Vulture sightings and abundance were relatively higher during summer than in winter. White-rumped Vulture was the most abundant species and Red-headed Vulture was least abundant species recorded in both seasons in the study area. Only the nests of *G. bengalensis* were observed at Khaireni Community Forest. *Bombax ceiba* was found to be the most commonly used tree species. Vultures were found highest in the forest habitat and least in the rocky/barren land habitat. Distance to water, distance to forest and distance to agricultural land showed positive association with abundance of vulture in summer whereas distance to settlement land and distance to Vulture Safe Feeding Sites showed positive association to abundance of vulture during winter. Food scarcity and habitat loss were major threats for population decline of vultures in the area. For the long-term vulture conservation, community-based conservation programs, awareness campaigns and provision of economic incentives to local people should be carried in all of its range areas by government authority and concern organization.

Keywords: conservation, safe feeding sites, vultures, vulture restaurant

Effects of the invasive water hyacinth on globally threatened waterbird abundance and diversity at Lake Cluster of Pokhara Valley, Nepal

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Abstract

Invasive species is one of the major drivers for changing ecosystem structure and function including their impacts on biodiversity, habitat alteration, and nutrient cycling. Out of 27 invasive plant species in Nepal, water hyacinth (*Eichhornia crassipes*) is rapidly distributed in Lake Cluster of Pokhara Valley (LCPV) in the last few decades. We studied the impacts of water hyacinth on waterbird abundance and diversity in the LCPV. We found low waterbird abundance in the water hyacinth present (HP) areas relative to the areas where water hyacinth was absent (HA). The occurrence of birds based on feeding guilds also varied between water hyacinth presence and absence habitat. Mainly, piscivorous birds were more abundant in HA areas than HP areas whereas insectivorous and omnivorous birds had greater abundance in HP areas than in HA areas. Threatened waterbird abundance and richness were greater in areas with greater water depth and overall bird abundance, but declined in HP areas. Degraded water quality also was identified in HP areas. Our findings can be used as a baseline by lake managers, researchers and policy makers to develop strategies to remove or manage water hyacinth in LCPV to improve waterbird conservation.

Keywords: *Eichhornia crassipes*, feeding guilds, impacts, invasive plants, water quality

Behavior analysis and modeling of white-rumped vulture (*Gyps bengalensis*) by using Markov chain modeling

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Abstract

Behavior of animal is guided by various internal and external environmental factors. Memory, hormones, and sense organs of any higher groups of vertebrates help to adapt physiologically and morphologically in the changing environment. Here, we observed critically endangered white-rumped vulture (*Gyps bengalensis*) in wild and identified three general behavior patterns during breeding season and analyzed it by the application of Markov Chain Modeling. The model projects the entire probability ratios for each behavior pattern. It is a holistic approach which predicts the exact behavior state from N possible behavior pattern which are loosely connected to each other. It is the first model applied to study vulture behavior opening new area of research in this discipline. Our method will be helpful to conserve vulture population in wild.

Keywords: breeding, diclofenac, endangered species, foraging, and roosting

Home ranges and habitat use of mountain hawk eagle in the Himalayas of Central-West Nepal

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Abstract

We present the first ever study on the home ranges and habitat utilization of Mountain Hawk Eagle *Nisaetus nipalensis* in South Asia. In 2019, we deployed GPS transmitters on three individuals in the southern foothills of the Annapurna Himalaya Range, Nepal. We monitored the adult female for 246 days (n = 9,581 fixes), the adult male for 99 days (n = 694 fixes) and the newly fledged juvenile for 63 days (n = 342 fixes). Adult female covered a larger area (MCP = 18.1 km²) than the adult male (11.7 km²). Core areas of the adult male (K95% = 12.7 km²; K50% = 3.0 km²) was larger than the adult female (K95% = 7.2 km²; K50% = 1.9 km²). Distance travelled per day by the adult female was 9.2 ± 5.1 km/day, adult male was 4.3 ± 3.1 km/day and the juvenile male was 0.4 ± 0.3 km/day respectively. Adult female travelled the longest distance (23.9 km) in a single day compared to adult male (12.6 km) and newly fledged juvenile (1.4 km). Over all, forest area covered by Mountain Hawk Eagle (regardless of its age and gender-wise) for K50% and K95% was 56.94% and 51.44% respectively, for agricultural land 42.03% and 47.70% respectively, while other areas were shrub land, grassland and water resources. K50% and K95% of Mountain Hawk Eagle revealed that 63.55% and 73.95% of forest were broad-leaved forest while remaining were needle-leaved forest. Further, 73.85% and 63.62% area of forest was closed type. Forest loss/change, timber oriented and biodiversity overlooked forest management system in Nepal needs to be addressed to conserve this species.

Keywords: Annapurna Himalaya range, core area, forest, habitat utilization, *Nisaetus nipalensis*

Current and future predicted distribution range of Indian Flying Fox *Pteropus medius* Temmink, 1825 roosting colonies in Nepal

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Abstract

Four species of fruit bats constitute a single family Pteropodidae in Nepal, Indian Flying Fox *Pteropus medius* is the largest of all. The known roosting colonies of the species are distributed within an elevation range of 75 to 1322 m asl. Impact of global warming on flying fox in Australia and India has been evident. It has been apparent that climate change will not only impact the roosting habitat but also the foraging habitat of bats. We collated 41 occurrence coordinates of *P. medius* roosting colonies throughout Nepal. We used 19 bio-climatic variables as candidate environmental variables and removed the highly correlated variables ($r > 0.75$). We built habitat suitability models using an ensemble approach of Maximum Entropy, Boosted Regression Trees, and Random Forest. The model validation was done using Area Under Curve and True Skilled Statistics. The current potential distribution of the species covers an area of 42235 km² (28.6% of the country's total area). Min Temperature of Coldest Month (bio 6), Precipitation of Coldest Quarter (bio 19) and Mean Diurnal Range (Mean of monthly (max temp - min temp)) (bio 2) are more influencing predictors. In the future climate scenarios, the distribution range expand in Representative Concentration Pathways (RCP) 4.5 while contract in RCP 8.5. In overall, the range contraction at RCP 8.5 2070 is about 5% of the area at the present scenario. The range expansion towards the northern latitude and in the higher elevations is insignificant.

Keywords: ensemble model, global warming, influencing predictors, pteropodidae, range contraction

Soil nematodes as indicator of change in land use, for replacement of native temperate forests cover with derived land use in Pir-Panjal Mountain Range of Western Himalayas

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Abstract

Soils are one of the most diverse and densely inhabited environments on earth and its biota is responsible for essential ecosystem services. But the phenomenon of environmental degradation due to inappropriate land use and replacement of native vegetation by human interferences is a worldwide problem. Such modifications in above ground land use confer many alterations in below ground soil ecology, which is a growing concern for the crash of biodiversity and functioning of terrestrial ecosystems. Here we studied nematodes - a key component and bio-indicators of soil biodiversity in native temperate forest and its derived land uses (scrubland, grassland, and cropland) of Pir-Panjal mountain range in western Himalayas. We hypothesized a major decrease in abundance, diversity, stability, food web structure and ecosystem services with conversion of native forest to derived land uses. Following identification and enumeration of nematodes to genus level, relative abundance of trophic assemblages, diversity, faunal profile and carbon footprint were determined. The results indicated that the conversion of land use is the main driver of nematode community as we found highest nematode abundance in natural forest rather than in derived land uses. Functionally nematode trophic groups except herbivores from natural forest were typically distinct from the derived land uses. Alpha diversity showed mixed results with higher in scrubland than forest, lower in grassland than forest, and no significant difference between cropland and forest. Results from NMDS revealed that samples from scrubland, grassland and cropland forming isolated clusters apart from forest samples. Sigma maturity index and soil faunal profile suggested that replacement of natural forest with grassland and cropland was accompanied with disturbance of belowground nematode food web complexity. Composite metabolic footprint do not showed any effect of land use but functional and trophic shifts in metabolic footprint are found. Overall, we demonstrated that the conversion from native temperate forest to anthropogenic land use lowered soil nematode abundance, altered soil nematode communities, changing their structure and function and lowering their diversity.

Keywords: diversity, ecosystem services, food web, maturity index, metabolic footprint

Diversity and habitat association of birds in Seti River Basin, Tanahun Nepal

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Abstract

Seti River basin has potential habitat of the birds; but, there is a lack of information about birds and their association with different habitat. The data was collected by using point count method. A total of 205 species, belonging to 50 families and 16 orders were reported from the Seti River basin. Order Passeriformes is the largest order (n=143 species), whereas Family Muscicapidae is the largest family (n=29 species). Among the reported species 51.21% were not a migrant, 32.68% were full migrant, 15.60% were altitudinal migrant. This area also supported the two critically endangered, five endangered, one vulnerable and four near threatened birds. The population trend of most of the species were stable (47.32 %) whereas 33.18 % were in decreasing trend. We reported more than 83.90% forest birds followed by 5.36% Wetland, 4.87% Scrubland, 4.39% Grassland and 0.97% Rocky area dependent birds.

Keywords: endangered, grassland, wetlands, passeriformes, vulnerable

Diversity and abundance of water-birds at Rani Tal in Shuklaphanta National Park, Nepal

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Abstract

Wetlands are the most productive and biologically diverse and very fragile ecosystems. The loss and degradation of wetlands adversely affect the waterbird community. Bird's survey is one of the best methods to find out the species distribution, abundance, and diversity. The survey method was conducted by the point count method. It started early morning and evening at five points in two seasons (summer and winter) in a year. A total of 23 waterbird species belong to nine families in the winter season and 15 species belong to seven families in the summer 2021. Ardeidae was the most dominant family with 7 species of birds. Among the recorded birds, 9 species were migratory and 14 species were residents along with two globally vulnerable species (*Leptoptilos javanicus* and *Aythya ferina*) and three near threatened species (*Aythya nyroca*, *Vanellus duvaucelli* and *Anhinga melanogaster*). The species diversity was more in winter (2.31) than summer (2.20) whereas evenness was more in summer (0.53) than winter (0.42).

Keywords: ardeidae, point count method, threatened birds, vulnerable species, wetland

Physico-chemical and protozoan detection of tap and well water in Baneshwor, Chhetrapati and Tripureswor, Kathmandu Valley, Nepal

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Abstract

Drinking water safety is a sensitive issue and its quality has to be monitored from time to time. Microbial study has been done but protozoan detection is rare. The present study was taken to compare the water quality (both chemical and protozoa), that was easily assessable to the consumers. Field survey showed that people were using both tap i.e. supplied by Kathmandu Upatyaka Khane Pani Limited (KUKL) and well water. Supplied water was taken as treated and well water as untreated. There were 120 tap and 60 well water sample from different house in Baneshwor, Chhetrapati and Tripureswor, Kathmandu valley collected and transported by standard methods. Random sampling was adopted for study during July to December, 2020. Physico-Chemical and Protozoan analysis of water sample was conducted in laboratory of KUKL. For collection of samples, 1000 ml capacity of bottle was used and capped tightly. The samples were examined by routine parasitology using light microscope. There were cases of abnormal water parameter in both types. In 12.77% samples protozoa was detected with *E.histolytica* 7.77%(fourteen samples), *B. coli* 1.11% (two), *P. caudatum* 5.5% (ten), *G. lamblia* 10% (eighteen), *A. proteus* 7.77% (fourteen). All the five protozoa were present in samples having beyond acceptable values of iron ($p=0.0005$) and ammonia ($p=0.0000$).

Keywords: ammonia, drinking water, iron, protozoa, survey

Effects of agricultural land use pattern on amphibians in Rapti Municipality, Chitwan, Nepal

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Abstract

Amphibian diversity, abundance, and richness are abundant in the agro-ecosystem. The aim of this study was to determine the effect of agricultural land use patterns on amphibian diversity and abundance. The study area is a part of Rapti Municipality's agricultural field, was separated into four blocks. Each block was further divided into four habitats: uncultivated land, three crop rotations without vegetable cultivation, three crop rotations with vegetable cultivation, and agricultural land near the forest based on cropping pattern and intensification. A nocturnal, time-constrained visual encounter survey of amphibians was conducted along transects (100×4 m) for 30 minutes at different strata of blocks. A total of 12 species of amphibians belonging to four families were recorded. The species diversity index was higher ($H = 1.79$) in agricultural land near forest whereas least ($H = 1.589$) in three crop rotations with vegetables cultivation. The total abundance of amphibians was highest (620) in three crop rotations without vegetable cultivation and lowest (234) in three crop rotations with vegetable cultivation along different strata. There was significant relation between species diversity and different agricultural land use patterns ($F = 8.039$, $df = 3, 12$, $p = 0.004$) whereas abundance of amphibians was not significant ($F = 0.6408$, $df = 3, 12$, $P = 0.5816$). Thus, agricultural land use patterns effect on amphibians. To conserve amphibians, information should be shared among farmers, and also steps to minimize the use of pesticides and chemical fertilizers.

Keywords: anurans, conservation, farmlands, frogs

Human factors contributing to the death of King Cobra – *Ophiophagus hannah* (Cantor, 1836) Kaski, Nepal

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Abstract

Lack of information about human King Cobra conflict and its conservation need prompted us to carry out this study on retaliatory killing of King Cobra. Understanding its threats is essential for effective conservation measures. Semi-structured questionnaire was administered in person at point where King Cobra were observed in Kaski. A total of 144 respondents were asked on factors responsible for human King Cobra Conflict, knowledge on other snakes, snakebite management method, and prevention of snake and snakebite. Older people are more likely to kill King Cobra ($r_{s(144)} = .265, p < .01$). Higher the years of education lower was the percentage of intention to kill ($r_{s(144)} = -.264, p < .01$). Sex of respondents had significant difference in their response for size or length of King Cobra as fear provoking factor ($\chi^2_{(1)} = 7.9, p < .01$). Responses on color as fear factor had significant association with percent intention to kill King Cobra ($U=1369.5, p<.0.01$). We suggest conducting awareness campaign about snakes and snakebite management to all people, irrespective of age, sex, occupation, and education level.

Keywords: fear, first aid, snakebite, snake human conflict, survey

Species distribution modelling of wild bee species: a case study in Shivapuri–Nagarjun National Park, Nepal

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Abstract

The Shivapuri–Nagarjun National Park (SNNP) is home to different wild bee species. However, scanty data obtained from natural history collections, literature, and recent surveys in the SNNP are the only sources of information on the wild bee. Habitat degradation and fragmentation are threatening its numbers. Unfortunately, the range of this species has yet to be determined. In light of the foregoing, the primary goal of this study is to estimate and map the potential habitat for wild bee species in SNNP. Observation points of *Nomada mutabilis*, *Thyreus decorus*, *Thyreus himalayensis*, *Thyreus histrio*, and *Xylocopa violacea* were developed in the Species Distribution Modelling (SDM) Program using presence-only data of wild bees' occurrences, as well as highly correlated environmental variables obtained from (worldclim.org), were excluded, and land use classes from Sentinel – 2 satellite MSI imagery of resolution 10m. The total more suitable and suitable areas calculated using Maxent for *Nomada mutabilis* were 11.1 sq. km and 35.45 sq. km, *Thyreus decorus* were 25.2 sq. km and 46.18 sq. km, *Thyreus himalayensis* were 13.73 sq. km and 31.62 sq. km, *Thyreus histrio* were 15.28 sq. km and 30.52 sq. km and *Xylocopa violacea* were 7.54 sq. km and 14.42 sq. km of total area respectively. The strategy works by determining the areas of acceptability around each wild bee species and providing a possible surface for them. SNNP could be the possible potential landscape for bee fauna. As a result, a thorough scientific investigation of insect pollinators is required to understand their impact on the environment and other relevant issues.

Keywords: *Nomada mutabilis*, *Thyreus decorus*, *Thyreus himalayensis*, *Thyreus histrio*, *Xylocopa violacea*

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