An Environmental Research Abstract

Headlines Himalaya

June 1 – June 15 (2021) **No. 653 - 654** **Editorial Team: Anuj Dangol and Sajan Dulal**

For the 653rd – 654th issues of Headlines Himalaya, we reviewed researches from five sources and selected 10 researches from four countries. We selected one research from Nepal and nine researches from other Himalayan countries (India, China, and Pakistan).

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CONTRASTING LIPID BIOMARKERS IN MOUNTAIN RIVERS IN THE NEPAL HIMALAYAS: ORGANIC MATTER CHARACTERISTICS AND CONTRIBUTION TO THE FLUVIAL CARBONPOOL

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Geoscience Frontiers 12: 101231

The Nepal Himalayas is the source of many glacial and spring-fed river systems crisscrossing the mountainous terrain. There is an increasing recognition of small mountain rivers (SMRs) to have a significant combined export of dissolved and particulate organic carbon to the global carbon flux. We analyzed flu-vial sediments from two SMRs and compared the results with two large mountain rivers (LMRs) in Nepal. We investigated the organic matter (OM), its compositional variability, and seasonal export using a suite of lipid biomarkers, namely *n*-alkanes, *n*-alkanoic acids, *n*-alkanols, and sterols. The SMRs indicated a similarity in lipid distribution and were affected by a strong seasonal variability. The LMRs showed a distinct contrast in the distribution of lipids in suspended sediments. Bedload sediments in SMRs were derived from diverse sources with weak terrigenous dominance all-year-round compared to the sus-pended load. Functional lipids (*n*-alkanoic acids and *n*-alkanols) were the major constituents in SMR sediments, indicating better preservation. In contrast, n-alkane concentration dominated over other fractions in suspended sediments retrieved from LMRs. The biomarker trends differentiate SMRs from LMRs with lower transformed/degraded OM in SMRs. A common observation was the strong presence of even carbon compounds in short-chain *n*-alkanes in SMR bedload sediments and their predominance in suspended sediments in LMRs. Such an unusual trend is attributed to specific biomarker sources from the catchment and ongoing processes in fluvial systems. Topsoil colonized by fungal species under moist acidic conditions and autochthonous bacteria contributes to the organic matter pool in shallow SMRs. In LMRs, the contribution from thermally mature sedimentary hydrocarbons and the diagenetic reduction of *n*-alkanoic acids to *n*-alkanes are additional contributors to the allochthonous carbon pool. The differences in lipid concentrations, their distribution, seasonality, and the size of rivers suggest differential preservation/degradation of the organic matter pool and their importance in contributing to the carbon budget.

Further reading: https://doi.org/10.1016/j.gsf.2021.101231

India -Himalaya

POPULATION ECOLOGY AND HABITAT SUITABILITY MODELLING OF *QUERCUS SEMECARPIFOLIA* SM. IN THE SUB-ALPINE ECOSYSTEM OF GREAT HIMALAYAN NATIONAL PARK, NORTH-WESTERN HIMALAYA, INDIA

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South African Journal of Botany 141: 158-170

Quercus semecarpifolia Sm. is a multipurpose, ecologically and economically important tree species of the sub-alpine ecosystem in the Indian Himalayan Region, forming a major part of the forests between 2800 and 3700 m amsl. Because of various natural and anthropogenic factors, populations of several forest species are dwindling in the region. This warrants the study of the population status, regeneration pattern, physicochemical properties of

soil, and habitat suitability model of *Q. semecarpifolia* in the sub-alpine ecosystem of the Great Himalayan National Park (GHNP). In total, 37 populations, representing 4 habitats and 8 aspects between 2803 and 3613 m amsl and with 20–65° slope, were sampled to determine the species richness, density, total basal area, Species Diversity Index (H'), Concentration of dominance (Cd), and profile of the species. Among the populations, total tree density of *Q. semecarpifolia* ranged from 40 to 840 Ind ha^{-1}, with a total basal area of 0.01–122.58 m^2 ha^{-1}, total shrub density of 240–1810 Ind ha^{-1}, total herb density of 13.8–162.3 Ind m^{-2}, total sapling density of 10–670 Ind ha^{-1}, and total seedling density of 10–700 Ind ha^{-1}. H' of trees ranged from 0.03 to 1.84, that of saplings between 0 and 2.44, of seedlings between 0 and 0.36, of shrubs between 0.43 and 2.28, and of herbs between 1.07 and 3.33. Cd for trees ranged from 0.00 to 1.00, that for saplings from 0.00 to 1.00, for seedlings from 0.00 to 1.00, for shrubs from 0.43 to 2.28, and for herbs from 0.07 to 3.33. Most individuals were in the range 73.6–94.5 cm circumference at breast height, and the least were in the ranges 136.6–157.5 cm and ≥ 220.6 cm. Seedlings and saplings were relatively very high in number. Tree density showed a positive correlation with total nitrogen ($p \leq 0.01$, $r = 0.35$, n = 37) and a negative correlation with pH ($p \leq 0.01$, $r = -0.13$, n = 37). The MaxEnt model calibration test for *Q. semecarpifolia* yielded satisfactory results ($AUC_{mean} = 0.899 \pm 0.02$). The BIO19 (precipitation in the coldest quarter) variable was the most influential and contributed 76.7% to the habitat model. The model identified an area of 145 km^2 as suitable for reintroduction of the species in the GHNP. Frequent monitoring of species populations, standardization of propagation protocol for mass multiplication, awareness among the inhabitants, and establishment in in-situ and ex-situ conditions are recommended.

Further reading: https://doi.org/10.1016/j.sajb.2021.04.022

HIMALAYAN BLUE PINE DEDUCED PRECIPITATION RECORD FROM COLD ARID LAHAUL–SPITI, HIMACHAL PRADESH, INDIA

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Frontiers in Earth Science 9: 645959

Ecologically Himalayan blue pine (*Pinus wallichiana* A. B. Jackson) is the most sensitive tree-species found across the high mountain ranges of Himalaya with deciphering tree-line for the region. Earlier studies showed the potential of Himalayan blue pine to reconstruct the past climate for extending observational data back to the centuries from orography-dominated Himalaya. However, tree-growth of the blue pine is largely found modulated by temperature in the western Himalayan region. In the present study, we attempted the first time to develop precipitation records using Himalayan blue pine chronology from cold arid Lahaul–Spiti, Himachal Pradesh, India. The blue pine chronology extends back to AD 1578 and showed significant relationship with the climatic variables. The bootstrap correlation analyses revealed previous year December to current year July precipitation plays significant role in tree-growth advancements. The previous year December to current year July (pDcJuly) precipitation has been reconstructed back to the AD 1730 for the Lahaul–Spiti region. The recorded individual and multi-year periods of low and high precipitation are consistent with existing hydro-climatic records from the western Himalaya. The five driest and wettest individual years are 1732, 1737, 1970, 2008, 1785, and 1730, 1771, 1758, 1734, 1736, respectively. The spatial correlation between gridded precipitation and reconstructed pDcJuly precipitation is significant for the region close to the sampling site. The study based on the Himalayan blue pine tree-ring chronology addressed its dendroclimatic utility for the semi-arid Lahaul–Spiti region and would be valuable to understand climatic variability over the past three centuries. The strong resemblance of the species with the Himalayan cedar growth patterns showed its promising viability to develop a network of multispecies for more robust climatic reconstruction in the future.

Further reading: https://doi.org/10.3389/feart.2021.645959

FUTURE GLACIAL LAKE OUTBURST FLOOD (GLOF) HAZARD OF THE SOUTH LHONAK LAKE, SIKKIM HIMALAYA

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Geomorphology 388*:* 107783

The Teesta basin in Sikkim Himalaya hosts numerous glacial lakes in the high altitude glacierized region, including one of the largest and the fastest-growing South Lhonak Lake. While these lakes are mainly located in remote and unsettled mountain valleys, far-reaching glacial lake outburst floods (GLOFs) may claim lives and damage assets up to tens of kilometers downstream. Therefore, evaluating GLOF hazard associated with current and potential future glacier-retreat-driven changes is of high importance. In this work, we assess the future GLOF hazard of the South Lhonak Lake by integrating glacier and hydrodynamic modeling to calculate the lake's future volume and hydraulic GLOF characteristics and impacts along the valley. We identify the increased susceptibility of the lake to potential avalanche impacts as the lake grows in the future. Here we model six avalanche scenarios of varying magnitudes to evaluate the impact-wave generated in the lake and overtopping flow at the dam. Avalanche simulations indicate that the frontal moraine is susceptible to overtopping. The overtopping flow hydraulics is evaluated along the channel assuming no erosion of the moraine. Further, we consider three lake-breach scenarios to model GLOFs originating from the lake, flow propagation, and its downstream impacts. The uncertainty in the breach parameters including breach width and time of failure are calculated to estimate the upper and the lower hydraulic limits of potential future GLOF events. Further, the uncertainty in the flow hydraulics was evaluated using dynamic flood routing of six GLOFs that originate from the lake. Hydrodynamic GLOF modeling resulted in a predicted peak discharge of 4311 m^3s^{-1}, 8000 m^3s^{-1}, and 12,487 $m^3s^{-1}$for breach depths of 20 m, 30 m, and 40 m respectively. The large-potential scenario suggests that maximum flow depth and flow velocity at Chungthang, a town proximally located to a major hydropower station built-in 2015, could reach up to 25–30 m and 6–9 m s^{-1}, respectively. Mapping infrastructure exposed to GLOFs in the Teesta valley shows that many settlements and assets located along the river channel at Chungthang are potentially exposed to future GLOFs, indicating the need to conduct a full environmental impact assessment and potentially undertake GLOF risk mitigation measures.

Further reading: https://doi.org/10.1016/j.geomorph.2021.107783

HYDROLOGICAL PROJECTIONS OVER THE UPPER INDUS BASIN AT 1.5 °C AND 2.0 °C TEMPERATURE INCREASE

Rida Sehar Kiani, Shaukat Ali, Moetasim Ashfaq, Firdos Khan, Sher Muhammad, Michelle S. Reboita, and Abida Farooqi

Science of The Total Environment 788: 147759

We analyse an ensemble of statistically downscaled Global Climate Models (GCMs) to investigate future water availability in the Upper Indus Basin (UIB) of Pakistan for the time horizons when the global and/or regional warming levels cross Paris Agreement (PA) targets. The GCMs data is obtained from the 5th Phase of Coupled Model Inter-Comparison Project under two Representative Concentration Pathways (RCP4.5 and RCP8.5). Based on the five best performing GCMs, we note that global 1.5 °C and 2.0 °C warming thresholds are projected in 2026 and 2047 under RCP4.5 and 2022 and 3036 under RCP8.5 respectively while these thresholds are reached much earlier over Pakistan i.e. 2016 and 2030 under RCP4.5 and 2012 and 2025 under RCP8.5 respectively. Interestingly, the GCMs with the earliest emergence at the global scale are not necessarily the ones with the earliest emergence over Pakistan, highlighting spatial non-linearity in GCMs response. The emergence of 2.0 °C warming at global scale across 5 GCMs ranges from 2031 (CCSM4) to 2049 (NorESM) under RCP8.5. Precipitation generally exhibits a

progressive increasing trend with stronger changes at higher warming or radiative forcing levels. Hydrological simulations representing the historical, 1.5 °C and 2.0 °C global and region warming time horizons indicate a robust but seasonally varying increase in the inflows. The highest inflows in the baseline and future are witnessed in July. However, the highest future increase in inflows is projected in October under RCP4.5 (37.99% and 65.11% at 1.5 °C and 2.0 °C) and in April under RCP8.5 (37% and 62.05% at 1.5 °C and 2.0 °C). These hydrological changes are driven by increases in the snow and glacial melt contribution, which are more pronounced at 2.0 °C warming level. These findings should help for effective water management in Pakistan over the coming decades.

Further reading: https://doi.org/10.1016/j.scitotenv.2021.147759

SPATIAL VARIATION IN POPULATION-DENSITY OF SNOW LEOPARDS IN A MULTIPLE USE LANDSCAPE IN SPITI VALLEY, TRANS-HIMALAYA

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Plos One 16: e0250900

The endangered snow leopard *Panthera uncia* occurs in human use landscapes in the mountains of South and Central Asia. Conservationists generally agree that snow leopards must be conserved through a land-sharing approach, rather than land-sparing in the form of strictly protected areas. Effective conservation through land-sharing requires a good understanding of how snow leopards respond to human use of the landscape. Snow leopard density is expected to show spatial variation within a landscape because of variation in the intensity of human use and the quality of habitat. However, snow leopards have been difficult to enumerate and monitor. Variation in the density of snow leopards remains undocumented, and the impact of human use on their populations is poorly understood. We examined spatial variation in snow leopard density in Spiti Valley, an important snow leopard landscape in India, via spatially explicit capture-recapture analysis of camera trap data. We camera trapped an area encompassing a minimum convex polygon of 953 km^2. Our best model estimated an overall density of 0.5 (95% CI: 0.31–0.82) mature snow leopards per 100 km^2. Using AIC, our best model showed the density of snow leopards to depend on estimated wild prey density, movement about activity centres to depend on altitude, and the expected number of encounters at the activity centre to depend on topography. Models that also used livestock biomass as a density covariate ranked second, but the effect of livestock was weak. Our results highlight the importance of maintaining high density pockets of wild prey populations in multiple-use landscapes to enhance snow leopard conservation.

Further reading: https://doi.org/10.1371/journal.pone.0250900

China Himalaya

ACROSS THE GREAT DIVIDE: REVISION OF THE GENUS *EUPETAURUS* (SCIURIDAE: PTEROMYINI), THE WOOLLY FLYING SQUIRRELS OF THE HIMALAYAN REGION, WITH THE DESCRIPTION OF TWO NEW SPECIES

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Zoological Journal of the Linnean Society 2021: zlab018

The woolly flying squirrel, *Eupetaurus cinereus*, is among the rarest and least studied mammals in the world. For much of the 20th century it was thought to be extinct, until it was rediscovered in 1994 in northern Pakistan. This study outlines the first taxonomic and biogeographical review of the genus *Eupetaurus*, which until now has contained only a single species. Careful review of museum specimens and published records of *Eupetaurus* demonstrates that the genus occurs in three widely disjunct areas situated on the western (northern Pakistan and north-western India), north-central (south-central Tibet, northern Sikkim and western Bhutan) and south-eastern margins (north-western Yunnan, China) of the Himalayas. Taxonomic differentiation between these apparently allopatric populations of *Eupetaurus* was assessed with an integrative approach involving both morphological examinations and molecular phylogenetic analyses. Phylogenetic reconstruction was implemented using sequences of three mitochondrial [cytochrome *b* (*Cytb*), mitochondrially encoded 12S and 16S ribosomal RNA (12S, 16S)] and one nuclear [interphotoreceptor retinoid-binding protein (*IRBP*)] gene fragment. Morphological assessments involved qualitative examinations of features preserved on museum skins and skulls, supplemented with principal components analysis of craniometric data. Based on genetic and morphological comparisons, we suggest that the three widely disjunct populations of *Eupetaurus* are each sufficiently differentiated genetically and morphologically to be recognized as distinct species, two of which are described here as new.

Further reading: https://doi.org/10.1093/zoolinnean/zlab018

Pakistan -Himalaya

THE ROLE OF TECHNOLOGY INNOVATION, RENEWABLE ENERGY AND GLOBALIZATION IN REDUCING ENVIRONMENTAL DEGRADATION IN PAKISTAN: A STEP TOWARDS SUSTAINABLE ENVIRONMENT

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Renewable Energy 177: 308-317

The present study aims to analyse the role of technological innovation, globalization, and renewable energy to reduce environmental degradation in Pakistan by using the time series data from 1980 to 2018. The study used the quantile autoregressive distributed lag (QARDL) model for empirical estimation. According to the analysis, economic growth is positively and significantly associated with carbon dioxide emissions. The study also validates the EKC hypothesis in the case of Pakistan. Moreover, we found that technological innovation and renewable energy are negatively associated with the environmental degradation. This relationship is significant at all the quantiles. Our analysis shows that globalization is also an important source to bring an increase in CO_2 emissions in Pakistan. Our empirical analysis also supports the negative role of cleaner energy for mitigating emissions in the short-term. The results from Granger causality also reveal the bidirectional causality from GDP, Innovation, and renewable energy to carbon dioxide emissions, however, there exists a unidirectional causality from GDP to globalization for Pakistan. The study provides useful policy directions for the policymakers in Pakistan.

Further reading: https://doi.org/10.1016/j.renene.2021.05.101

NONLINEAR RECURRENCE QUANTIFICATION OF THE MONSOON-SEASON HEAVY RAINY-DAYS OVER NORTHWEST HIMALAYA FOR THE BASELINE AND FUTURE PERIODS

Sandipan Mukherjee

Science of The Total Environment 789: 147754

Indian summer monsoon has the characteristics of nonlinear dynamical systems. This study verifies the hypothesis that monsoon-season heavy rainy-day climatology over northwest Himalaya would exhibit certain degree of determinism, and expected to modify in its future state due to warming. Hence, recurrence quantification analysis (RQA) leading to quantification of recurrence rate (RR) and determinism (DET) are used. The monsoon-season heavy rainy-day climatologies are computed by area averaging heavy rainy-day (i.e. any day having rainfall ≥35.5 mm) of northwestern Indian Himalaya of Uttarakhand (UK), Himachal Pradesh (HP), and Union Territory of Jammu, Kashmir and Ladakh (JKL). Nonlinear characteristics are identified for a baseline period of 1970–2005 using APHRODITE data, and a bias corrected ensemble data for the future period of 2041–2099 produced using five CORDEX experiments under two warming scenarios, RCP 4.5 and 8.5. The heavy rainy-day climatology during 1970–2005 is having a correlation dimension of 1.5 indicating fractal geometry of the system in phase space. Similarly, occurrences of diagonal lines in the recurrence plots of baseline period over JKL, HP, and UK indicated the system is governed by a nonlinear chaotic attractor. A higher recurrence rate during 1970–2005 over HP (RR = 0.123, DET = 0.83) indicated greater determinism than JKL (RR = 0.119, DET = 0.78) and UK (RR = 0.121, DET = 0.75). Mean prediction time of the nonlinear dynamical trajectories controlling heavy rainy-day climatology of 1970–2005 is noted to be higher over UK. Furthermore, the RQA patterns under warmer climates of RCP 4.5 and 8.5 during 2041–2099 over UK and JKL indicate gradual reduction in the deterministic structures in the phase space. Therefore, it can be inferred that the nonlinear dynamical system governing the monsoon-season heavy rainy-day climatology is expected to lose determinism over certain regions of northwestern Himalaya under warmer climates of RCP 4.5 and 8.5.

Further reading: https://doi.org/10.1016/j.scitotenv.2021.147754

THE HOST RANGE AND RISK ASSESSMENT OF THE STEM-BORING WEEVIL, *LISTRONOTUS SETOSIPENNIS* (COLEOPTERA: CURCULIONIDAE) PROPOSED FOR THE BIOLOGICAL CONTROL OF *PARTHENIUM HYSTEROPHORUS* (ASTERACEAE) IN PAKISTAN

Philip Sebastian Richard Wey, Abdul Rehman and Kazam Ali

Insects 12: 463

Parthenium, or *Parthenium hysterophorus*, has extended its range in Pakistan throughout Punjab and into Khyber Pakhtunkhwa, the Federally Administrated Tribal Areas, Azad Jammu and Kashmir, and Sindh Provinces. Without control measures against parthenium, the negative impacts of this weed will go unchecked having deleterious effects on native biodiversity, human and animal health, as well as crop productivity. The weevil *Listronotus setosipennis* was obtained and imported from the Plant Health and Protection of the Agricultural Research Council (ARC-PHP), in Cedara, South Africa, in April 2019. A total of 22 plant species or cultivars in the Asteraceae family were assessed during no-choice oviposition tests in Pakistan. During these tests, the only plant species accepted for oviposition were the 10 cultivars of *Helianthus annuus* that are grown in Pakistan. All cultivars were thus tested for development of *L. setosipennis* from egg to adult. Only three cultivars were able to support some larval development, but at such low levels that it is unlikely to be the basis of a viable population. To support this, a risk assessment was conducted to ascertain the probability of *L. setosipennis* being able to sustain viable populations in the field, the results of which concur with native (Argentina) and introduced (Australia) field host-range information where *L. setosipennis* has never been recorded as a pest of sunflowers. The results of laboratory-based host-range trials, together with host records from its native and introduced range, indicate that *L. setosipennis* is sufficiently specific to parthenium and is thus suitable for release in Pakistan.

Further reading: https://doi.org/10.3390/insects12050463

Highlight of the Issue

STUDY ON VENUS WILL EXPLORE ITS ATMOSPHERE AND LIFE SUSTAINING POSSIBILITY

Under about fourteen days after National Aeronautics and Space Administration (NASA) declared two automated missions on Venus, the European Space Agency (ESA) has reported another mission for Venus. On June 10, 2021 the ESA announced an orbital mission called EnVision for research on Venus, whose earliest dispatch is possible in 2031. The mission's fundamental goal is to discover the association between the geographical action on Venus and its atmosphere. Ultra violet and high-resolution infrared spectrometers will be used to retrieve information of surface and gases in the atmosphere. The atmosphere of Venus contains carbon dioxide and its cloud is made up of sulphuric acid, which causes it to reflect a lot of light. So it looks brighter than other planets. Despite the fact that Mercury is the principal planet in the close planetary system, Venus is a lot sultrier. NASA has shown that normal surface temperature of Venus is 475 degrees Celsius, while that of Mercury is 221 degrees Celsius. Researchers say there is a great deal of warmth and temperature in Venus due to the fact that the warmth is consumed because of the thick climate and carbon dioxide. There is a nursery impact because of the thick barometrical layer of carbon dioxide on Venus. This mission will examine if Venus is still geologically active.

Further reading:

https://www.bbc.com/news/science-environment-57416589

http://www.esa.int/Science_Exploration/Space_Science/ESA_selects_revolutionary_Venus_mission_EnVision

https://solarsystem.nasa.gov/planets/venus/overview