An Environmental Research Abstract

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For the 727th-728th issues of Headlines Himalaya, we reviewed research papers from four sources and selected nine research papers from three countries. We selected five papers from Nepal and four from other Himalayan Countries (India and Bhutan).

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WINTERTIME AIR QUALITY ACROSS THE KATHMANDU VALLEY, NEPAL: CONCENTRATION, COMPOSITION, AND SOURCES OF FINE AND COARSE PARTICULATE MATTER

Md. Robiul Islam, Tianyi Li, Khadak Mahata, Nita Khanal, Benjamin Werden, Michael R. Giordano, Siva Praveen Puppala, Narayan Babu Dhital, Anobha Gurung, Eri Saikawa, Arnico K. Panday, Robert J. Yokelson, Peter F. DeCarlo, and Elizabeth. A. Stone

ACS Earth and Space Chemistry 6: 2955-2971

The Kathmandu Valley in Nepal experiences poor air quality, especially in the dry winter season. In this study, we investigated the concentration, chemical composition, and sources of fine and coarse particulate matter ($PM_{2.5}$, PM_{10}, and $PM_{10–2.5}$) at three sites within or near the Kathmandu Valley during the winter of 2018 as part of the second Nepal Ambient Monitoring and Source Testing Experiment (NAMaSTE 2). Daily $PM_{2.5}$ concentrations were very high throughout the study period, ranging 72–149 μg m^{-3} at the urban Ratnapark site in Kathmandu, 88–161 μg m^{-3} at the suburban Lalitpur site, and 40–74 μg m^{-3} at rural Dhulikhel on the eastern rim of the Kathmandu Valley. Meanwhile, PM_{10} ranged 194–309, 174–377, and 64–131 μg m^{-3}, respectively. At the Ratnapark site, crustal materials from resuspended soil contributed an average of 11% of $PM_{2.5}$ and 34% of PM_{10}. $PM_{2.5}$ was largely comprised of organic carbon (OC, 28–30% by mass) and elemental carbon (EC, 10–14% by mass). As determined by chemical mass balance source apportionment modeling, major $PM_{2.5}$ OC sources were garbage burning (15–21%), biomass burning (10–17%), and fossil fuel (14–26%). Secondary organic aerosol (SOA) contributions from aromatic volatile organic compounds (13–23% OC) were larger than those from isoprene (0.3–0.5%), monoterpenes (0.9–1.4%), and sesquiterpenes (3.6–4.4%). Nitro-monoaromatic compounds–of interest due to their light-absorbing properties and toxicity–indicate the presence of biomass burning-derived SOA. Knowledge of primary and secondary PM sources can facilitate air quality management in this region.

For further reading: https://doi.org/10.1021/acsearthspacechem.2c00243

DEFORESTATION CONTROLS LANDSLIDE SUSCEPTIBILITY IN FAR-WESTERN NEPAL

Alberto Muñoz-Torrero Manchado, Juan Antonio Ballesteros-Cánovas, Simon Allen, and Markus Stoffel

Catena 219: 106627

Landslides are a major problem in the Far-Western region of Nepal, where one of the highest densities of shallow landslides within the country is observed. However, there is still a lack of understanding around the relative impact of deforestation as a predisposing factor. Here, we use remote-sensing techniques and freely accessible satellite data to quantify the effects of deforestation and related agriculture practices in the assessment of landslide susceptibility. We use a new regional landslide inventory of 8,778 events dated between 1993 to 2018 to train and validate bivariate landslide susceptibility models, in which preceding land cover/land use is included as a predisposition factor. Our results show that the use of land-cover /land-use maps enhances the average probability of model success by 7.9%. Besides, we assess land-cover changes for a period of 1 to 10 years prior to each landslide event to analyze the relative incidence of changes related to deforestation and agricultural uses. The analysis suggests that agricultural practices and deforestation that occur 5–7 years preceding the landslide event have a significant influence on the landslide occurrence (+16%). Our results reveal that negligent anthropological land use practices can significantly enhance landslide risk.

For further reading: https://doi.org/10.1016/j.catena.2022.106627

WILDLIFE IN CLIMATE REFUGIA: MAMMALIAN DIVERSITY, OCCUPANCY, AND TIGER DISTRIBUTION IN THE WESTERN HIMALAYAS, NEPAL

Kanchan Thapa, Samundra Ambuhang Subba, Gokarna Jung Thapa, Karun Dewan, Bishnu Prasad Acharya, Dabal Bohara, Suman Subedi, Madhuri Thapa Karki, Bharat Gotame, Gautam Paudel, Shiv Raj Bhatta, Shant Raj Jnawali, and Sabita Malla

Ecology and Evolution 12: e9600

Anthropogenic land-use change continues to be predicated as a major driver of terrestrial biodiversity loss for the rest of this century. It has been determined that the effect of climate change on wildlife population will accelerate the rate and process of decline of global vertebrate populations. We investigated wildlife composition, occupancy, and activity pattern along the larger climate resilient forests that serve as microrefugia for a wide range of species under the escalating climate change. We used camera trap survey covering 250 km2 of climate microrefugia in Dadeldhura hills in far western region of Nepal. We used 62 trapping locations accumulating 1800 trap nights taking 98,916 photographs in 62 days-survey period during the summer season of 2020. We photographed 23 mammalian species with estimated species richness of 30 species (95% CI: 25–34) based on multi-species occupancy model. We estimated overall species occupancy ψ(SE(ψ)) to be 0.87 (0.09) in climatic microrefugia. While human activity predominated throughout the day, the majority of animals was found to exhibit nocturnal temporal patterns. Tiger and hyaena, two of the top predators, were newly discovered in the western Himalayan range of Nepal, with their discovery at the 34 highest elevations of 2511 meters and 2000m, respectively. In Nepal, high-altitude tiger range is characterized by tiger distribution above a 2000 m cutoff representing habitats in the physiographic zone of high mountains and above. Our findings establish a baseline and show that the climatic microrefugia that have been identified have high levels of species richness and occupancy, which characterize the Dadeldhura hill forest ranges as biologically varied and ecologically significant habitat. These areas identified as climatic microrefugia habitats should be the focus of conservation efforts, particularly efforts to reduce human disturbance and adapt to climate change.

For further reading: https://doi.org/10.1002/ece3.9600

CLIMATE CHANGE AND RIVER HEALTH OF THE MARSHYANGDI WATERSHED, NEPAL: AN ASSESSMENT USING INTEGRATED APPROACH

Reeta Singh, Sadhana Pradhanang Kayastha, and Vishnu Prasad Pandey

Environmental Research 215: 114104

Climate change alters the river flow regimes causing significant changes in the structure and function of an aquatic ecosystem, ultimately affecting river health. This study applied a customized framework consisting of 1-index, 4-components, 6-indicators, and 43-metrics, to assess river health for two seasons and future periods, in the Marshyangdi Watershed, Nepal. Hydrological, water quality, biological and physical conditions were assessed using simulated results from a hydrological model, physiochemical analysis of water samples, macroinvertebrates assemblages analysis, and physical habitat condition assessment, respectively. Climate change impact on river health was assessed based on projected climate (precipitation and temperature) based on regional climate models under representative concentration pathways (RCP) 4.5 and 8.5 scenarios until the mid-century. Results showed moderate river health condition in both the seasons and it's deterioration for future scenarios and periods. It reveals the need to formulate appropriate measures for the conservation of the river health.

For further reading: https://doi.org/10.1016/j.envres.2022.114104

PERCEPTION AND UNDERSTANDING OF CLIMATE CHANGE AND ITS IMPACT IN GANDAKI RIVER BASIN, CENTRAL HIMALAYA, NEPAL

Basanta Paudel, Prem Sagar Chapagain, Shobha Shrestha, Yili Zhang, Linshan Liu, Jianzhong Yan, Suresh Chand, Md. Nurul Islam, Tibendra Raj Banskota, Khagendra Raj Poudel, and Keshav Raj Dhakal

Atmosphere 13: 2069

Climate change is a global issue. Its impacts are recognized at different scales ranging from global to regional to local. Climate change particularly changes in temperature and precipitation has been observed differently in different ecological regions in Nepal Himalaya. The study area comprises five villages of three ecological regions in the Gandaki River Basin (GRB) of Nepal. Based on the observed climate data of a 30-year period from 1990 to 2020, the changes in temperature and precipitation of each ecological region are analyzed using the Mann–Kendall trend test and Sen's slope. The temperature trend was found to be increasing at the rate of 0.0254 °C per year (°C/a) between 1990 and 2020 in the Mountain region, by 0.0921 °C/a in the Hill region and 0.0042 °C/a in the Tarai region. The precipitation trend in the Mountain region is decreasing by −13.126 mm per year (mm/a), by −9.3998 mm/a in the Hill region and by −5.0247 mm/a in the Tarai region. Household questionnaire surveys, key informant interviews and focus group discussions were carried out to assess the perception of climate change and its impact. The farmers of the three ecological regions have perceived increasing temperature trends, but perceived variability in precipitation trends. Both snowfall and rainfall have varied. Snowfall has drastically decreased. Drought has increased. Extreme disaster events and impacts from such climate-induced events are experienced by 67.9% of respondents. A major impact of climate change is reported on cultivated crops with damage caused by increased insect and rodent pests. The impact of climate change is varied by ecological region. The comparative study of observed data and household data shows the need for a micro-level study so that a real situation can be captured and would be very much useful for policy formulation to combat climate change at a local scale.

For further reading: https://doi.org/10.3390/atmos13122069

India-Himalaya

THE IMPACT OF CLIMATE CHANGE AND POTENTIAL DISTRIBUTION OF THE ENDANGERED WHITE WINGED WOOD DUCK (ASARCORNIS SCUTULATA, 1882) IN INDIAN EASTERN HIMALAYA

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Journal for Nature Conservation 70: 126279

The White-Winged Wood duck (*Asarcornis scutulata*) is an endangered forest wetland bird currently on the verge of extinction due to an array of anthropogenic pressures. It has been reported that global climate change could affect the distribution of many bird species globally. Therefore, an understanding the potential distribution of the White-Winged Wood duck in future climate scenarios could facilitate the creation of immediate conservation plans and the mitigation of subsequent threats. This is the first ever study on the distribution of White-Winged Wood Duck (WWWD) where Representative Concentration Pathway (RCP) 8.5 scenario was used to forecast the distribution of the WWWD in the Indian Eastern Himalayan region in the 2050s and 2070s. The study revealed that 1.87 % of the total area of IEH has the high potential distribution of WWWD. The state of Assam alone includes 1.68 % of the highly potential habitat in the region. It was predicted that 436.61 km^2 of highly potential habitat would be lost by 2070. Changes in the annual temperature range, precipitation in the wettest months (June to

September), and precipitation decrease in the warmest quarter (October to December) would result in the loss of highly potential habitats. Under the influence of climate change, the habitat of WWWD in the eastern part of the region is likely to shift towards the western part. It was found that there will be a decline in potential habitat in the Indian states of Arunachal Pradesh, Assam, Nagaland, and Tripura located in the IEH under future climate scenarios. The potential of areas located at the Bhutan and Assam border would increase for supporting WWWD as this species' requires the average annual precipitation about 1000–1200 mm. However, the simultaneous anthropogenic activity would further destroy potential habitats in the future. The current study has provided baseline data on the potential distribution of WWWD in the IEH region for immediate conservation management plans.

For further reading: https://doi.org/10.1016/j.jnc.2022.126279

PHYLOGENETIC AND MORPHOLOGICAL ANALYSIS OF *GLOYDIUS HIMALAYANUS* (SERPENTES, VIPERIDAE, CROTALINAE), WITH THE DESCRIPTION OF A NEW SPECIES

Sourish Kuttalam, Vishal Santra, John Benjamin Owens, Melvin Selvan, Nilanjan Mukherjee, Stuart Graham, Anatoli Togridou, Omesh K. Bharti, Jingsong Shi, Kartik Shanker, and Anita Malhotra

European Journal of Taxonomy 842: 1-30

Gloydius is a widespread pitviper group occurring from Eastern Europe to Korea and Siberia, with only one known species, *G. himalayanus* (Günther, 1864), found south of the Himalayas. We provide combined genetic and morphological data for *G. himalayanus* from specimens collected from Himachal Pradesh, India. Bayesian Inference and Maximum Likelihood phylogenetic analysis were performed on four concatenated mitochondrial genes, along with a multi-locus coalescent analysis of these and five additional nuclear genes. Our results indicate that *G. himalayanus* from the Chamba Valley, in western Himachal Pradesh, are highly distinct from the remaining studied populations. Haplotype networks of each nuclear locus showed that *G. himalayanus* contains high haplotype diversity with low haplotype sharing between the Chamba Valley population and populations from further west. Principal component analysis and canonical variate analysis conducted on morphological data of live and museum specimens also highlight the morphological distinctiveness of the Chamba population and we herein describe this population as a new species, *Gloydius chambensis* sp. nov. Recent descriptions of other new species of snakes from this valley underscores its isolation and suggests that further herpetological investigation of the highly dissected landscapes of the western Himalayas is needed to assess the true diversity of the region.

For further reading: https://doi.org/10.5852/ejt.2022.852.2003

Bhutan-Himalaya

INTEGRATING ECONOMIC GROWTH WITH THE ENVIRONMENTAL INTENSITY OF HUMAN WELL-BEING: EVIDENCE FROM BHUTAN

B. Venkatraja

Climate and Development 14: 1-13

This paper studies whether the carbon intensity of human well-being has an Environmental Kuznets Curve (EKC) pattern with respect to economic growth in Bhutan using annual data from 1971 to 2018. Furthermore, it examines the short-term and long-term dynamics of the causal relation between emissions and growth in wealth and also whether recent trends of economic growth are carbon neutral. Econometric estimations, such as ordinary least squares, vector error correction model and variance decomposition, are applied alongside other appropriate

statistical tests. The findings show that, in Bhutan, the carbon intensity of human well-being increases with economic growth and fails to support the EKC hypothesis. Long-run causality was found running from the carbon intensity of human well-being to GDP per capita and also from population growth to GDP per capita. The econometric analysis also revealed that the increasing emission of carbon dioxide is being absorbed and its negative effects are negated through rising forest cover hence, Bhutan appears to be a carbon-neutral nation. This paper is a valuable contribution to the literature and has significant policy implications. Furthermore, it provides an integrated and sustainable growth model discourse to the rest of the world which is ailing with severe emissions and climate change.

For further reading: https://doi.org/10.1080/17565529.2022.2150046

COLLABORATIVE MODELING AND SIMULATION TO MITIGATE HIGH-ELEVATION RANGELAND DEGRADATION IN EASTERN BHUTAN

Tayan Raj Gurung, Christophe Le Page, and Guy Trébuil

Mountain Research and Development 42: D14-D24

The contribution of overgrazing to high-elevation rangeland degradation is a problem across the Himalayan region, and it leads to tensions among users. In the alpine areas of eastern Bhutan, 2 communities of settled and seminomadic herders have been engaged in enduring open conflict over access to a large natural pasture. To reestablish a communication channel between these communities, a participatory modeling and simulation process was implemented with the concerned stakeholders. A training workshop on this collaborative approach and its key tools, particularly computer-assisted role-playing games, was attended by research and extension officers and was immediately followed by a field workshop attended by 6 herders from each community. The participants used their empirical knowledge to improve the relevance of the spatial distribution of the land degradation problem on the proposed game board. They also established a link between the features and rules of the role-playing game and the actual circumstances of the rangeland. The gaming sessions allowed the participants to share their respective viewpoints on the land degradation process in a nonthreatening environment. The assessment of the field workshop identified multiple effects regarding awareness of the problem, participants' confidence, colearning, and mutual trust. This intervention enabled the emergence of social capital ahead of the preparation of major development-oriented interventions in the watershed. This study demonstrates the pertinence of using simple but relevant abstract models, codesigned with their users, to mitigate tensions between parties in conflict over the use of renewable natural resources.

For further reading: https://doi.org/10.1659/MRD-JOURNAL-D-21-00067

Highlight of the Issue

SWOT to Survey Earth's Water

The US National Aeronautics and Space Administration (NASA) in collaboration with the French space agency Centre National d'Etudes Spatiales (CNES) and contribution from the Canadian Space Agency and the U.K. Space Agency launched atop a SpaceX rocket from Space Launch Complex 4E in California on December 16, 2022 aiming to measure the height of marine and freshwater bodies across the globe's surface through the Surface Water and Ocean Topography (SWOT). The data from the satellite will provide vital information on fluctuation in water levels, streamlines, and inundation extents of flowing and stagnant water bodies for three years. In fact, information about more focused ocean topography along with ocean circulation helps to understand the degree of the ocean's

influence on climate change in addition to insights into the effects of global warming in water reservoirs. This can further improve models for forecasting flood and drought and potentially support in planning for mitigation of urgent challenges posed by climate change and sea level rise.

Further reading:

https://www.nasa.gov/press-release/nasa-launches-international-mission-to-survey-earth-s-water

https://www.nasa.gov/swot