An Environmental Research Abstract

Headlines Himalaya

March 15 - March 31 (2021) No. 643-644 Editorial Team: Lila Paudel and Bimal Sharma

For the 643rd - 644th issues of Headlines Himalaya, we reviewed journal articles from five sources and selected 10 researches from five countries. We selected one research from Nepal and nine researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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BHUTAN ***VEGETATION STRUCTURE OF WETLANDS IN EASTERN HIMALAYAN HIGHLANDS OF GASA, BHUTAN***

Nepal-Himalaya

SUITABILITY OF HABITATS IN NEPAL FOR DACTYLORHIZA HATAGIREA NOW AND UNDER PREDICTED FUTURE CHANGES IN CLIMATE

Bikram Shrestha, Spyros Tsiftsis, Deep Jyoti Chapagain, Chhatra Khadka, Prakash Bhattarai, Neelima Kayastha Shrestha, Marta Alicja Kolanowska, and Pavel Kindlmann

Plants 10: 467

Dactylorhiza hatagirea is a terrestrial orchid listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and classified as threatened by International Union for Conservation of Nature (IUCN). It is endemic to the Hindu-Kush Himalayan region, distributed from Pakistan to China. The main threat to its existence is climate change and the associated change in the distribution of its suitable habitats to higher altitudes due to increasing temperature. It is therefore necessary to determine the habitats that are suitable for its survival and their expected distribution after the predicted changes in climate. To do this, we use Maxent modelling of the data for its 208 locations. We predict its distribution in 2050 and 2070 using four climate change models and two greenhouse gas concentration trajectories. This revealed severe losses of suitable habitat in Nepal, in which, under the worst scenario, there will be a 71–81% reduction the number of suitable locations for *D. hatagirea* by 2050 and 95–98% by 2070. Under the most favorable scenario, this reduction will be 65–85% by 2070. The intermediate greenhouse gas concentration trajectory surprisingly would result in a greater reduction by 2070 than the worst-case scenario. Our results provide important guidelines that local authorities interested in conserving this species could use to select areas that need to be protected now and in the future.

Further readings: https://doi.org/10.3390/plants10030467

India-Himalaya

APPLICATION OF REMOTE SENSING IN ALPINE GRASSLANDS COVER MAPPING OF WESTERN HIMALAYA, UTTARAKHAND, INDIA

Arvind Pandey, Gajendra Singh, Sarita Palni, Naveen Chandra, JS Rawat, and Ajit Pratap Singh

Environmental Monitoring and Assessment 193: 166

Grasslands are the world's most extensive terrestrial ecosystem, which provides a variety of services for humans, such as carbon storage, food production, crop pollination, pest regulation, and are a major feed source for livestock. However, grasslands are today one of the most endangered ecosystems due to land-use change, agricultural intensification, land abandonment, as well as climate change. Grasslands are an integral part of human societies across the globe, which are broadly known as tropical savannah and temperate grasslands. In the Himalayan region, grasslands are found in more than 55% of the area and different climatic conditions lead to different varieties of grasslands like *Danthonia* grasslands, *Kobresia* sedge meadow, etc. Grasslands deal with the spatial and temporal distribution of heterogeneous landscapes, which support a high diversity of various species. Owing to very rugged terrain and inaccessibility, the information on the extent of alpine grassland and percent

grass cover (%) across the meadows is limited. Therefore, the present attempt was made to assess the current status of grassland in the alpine region of Uttarakhand above 3000 m asl. LANDSAT-8 (OLI and TIRS sensors) satellite data were used to delineate the grasslands using normalized difference vegetation indices (NDVIs) of the alpine region with the help of over 179 ground truth points out of which 50 points are testing points and 129 points are training points. Grass covers (%) were also assessed in the whole alpine region of Western Himalaya of Uttarakhand which nearly consists of over 75 meadows by using random plots (1 × 1 m, total 10 per site) in each meadow. Overall, 89.52% accuracy was achieved based on 50 randomly selected testing points. A total of 4949.25 sq. km area is under the different percentage of grass cover in the alpine region of Uttarakhand, Western Himalaya. *Danthonia* grasslands below 4000 m and *Kobresia* sedge meadows above 4000 m elevation are dominant in the state. In the alpine region, over 1056 sq. km grassland area have less than 10% grass cover indicating higher degraded and cold desert areas and only 565.69 sq. km area have more than 60% grass cover, which is highly favorable for rich biodiversity and grazing.

For further reading: https://doi.org/10.1007/s10661-021-08956-9

PREDICTING THE POTENTIAL DISTRIBUTION OF A CRITICALLY ENDANGERED MEDICINAL PLANT *LILIUM POLYPHYLLUM* IN INDIAN WESTERN HIMALAYAN REGION

Anurag Dhyani, Rakesh Kadaverugu, Bhagwati Prasad Nautiyal, and Mohan Chandra Nautiyal

Regional Environmental Change 21: 30

Climate change presents a serious threat to endangered plant species within a restricted habitat. *Lilium polyphyllum* D.Don ex Royle is a species indigenous to the coniferous forests of the Western Himalaya. However, over exploitation, due to its high medicinal properties and demands of industry, has resulted in a steep decline of its natural habitats. Consequently, the species is listed as critically endangered on the IUCN Red List. The present study was carried out in the Western Himalayan region using the maximum entropy model (MaxEnt) to predict the potential distribution of *L. polyphyllum* in respect of IPCC future climatic scenarios. The modeling used mutually least correlated bioclimatic variables and topographic data over 53 occurrence locations. Future scenarios include IPCC Representative Concentration Pathways (RCPs) 2.6 and 8.5 (representing less harmful and harsh climatic conditions) for the years 2050 and 2070. The main predictor variables contributing to the habitat are the precipitation of the driest month (52.7%), elevation (13.9%) and temperature seasonality (7.8%). Current potential habitats for *L. polyphyllum* have been located in the north-west and south-east regions of the Western Himalaya. Future climate change scenarios predict that the potential habitats of this species will shrink by 38–81% in these regions and moreover the habitats will shift towards the south-east, making Himachal Pradesh and Uttarakhand state of India as favourable habitats in the future. These findings assist in the identification of the potential conservation areas and provision of protection against climate change.

For further reading: https://doi.org/10.1007/s10113-021-01763-5

EFFECTS OF SPATIAL RESOLUTION ON WRF V3.8.1 SIMULATED METEOROLOGY OVER THE CENTRAL HIMALAYA MEASUREMENT AND MODELLING OF PARTICULATE POLLUTION OVER KASHMIR HIMALAYA, INDIA

Jaydeep Singh, Narendra Singh, Narendra Ojha, Amit Sharma, Andrea Pozzer, Nadimpally Kiran Kumar, Kunjukrishnapillai Rajeev, Sachin S. Gunthe, and V. Rao Kotamarthi

Geoscientific Model Development 14: 1427-1443

The sensitive ecosystem of the central Himalayan (CH) region, which is experiencing enhanced stress from anthropogenic forcing, requires adequate atmospheric observations and an improved representation of the Himalaya in the models. However, the accuracy of atmospheric models remains limited in this region due to highly complex mountainous topography. This article delineates the effects of spatial resolution on the modeled meteorology and dynamics over the CH by utilizing the Weather Research and Forecasting (WRF) model extensively evaluated against the Ganges Valley Aerosol Experiment (GVAX) observations during the summer monsoon. The WRF simulation is performed over a domain (d01) encompassing northern India at 15 km × 15 km resolution and two nests (d02 at 5 km × 5 km and d03 at 1 km × 1 km) centered over the CH, with boundary conditions from the respective parent domains. WRF simulations reveal higher variability in meteorology, e.g., relative humidity (RH = 70.3 %–96.1 %) and wind speed (WS = 1.1–4.2 m s^{-1}), compared to the ERA-Interim reanalysis (RH = 80.0 %–85.0 %, WS = 1.2–2.3 m s^{-1}) over northern India owing to the higher resolution. WRF-simulated temporal evolution of meteorological variables is found to agree with balloon-borne measurements, with stronger correlations aloft (r = 0.44–0.92) than those in the lower troposphere (r = 0.18–0.48). The model overestimates temperature (warm bias by 2.8 °C) and underestimates RH (dry bias by 6.4 %) at the surface in d01. Model results show a significant improvement in d03 (P = 827.6 hPa, T = 19.8 °C, RH = 92.3 %), closer to the GVAX observations (P = 801.4 hPa, T = 19.5 °C, RH = 94.7 %). Interpolating the output from the coarser domains (d01, d02) to the altitude of the station reduces the biases in pressure and temperature; however, it suppresses the diurnal variations, highlighting the importance of well-resolved terrain (d03). Temporal variations in near-surface P, T, and RH are also reproduced by WRF in d03 to an extent (r>0.5). A sensitivity simulation incorporating the feedback from the nested domain demonstrates the improvement in simulated P, T, and RH over the CH. Our study shows that the WRF model setup at finer spatial resolution can significantly reduce the biases in simulated meteorology, and such an improved representation of the CH can be adopted through domain feedback into regional-scale simulations. Interestingly, WRF simulates a dominant easterly wind component at 1 km × 1 km resolution (d03), which is missing in the coarse simulations; however, the frequency of southeasterlies remains underestimated. The model simulation implementing a high-resolution (3 s) topography input (SRTM) improved the prediction of wind directions; nevertheless, further improvements are required to better reproduce the observed local-scale dynamics over the CH.

Further reading: https://doi.org/10.5194/gmd-14-1427-2021

MEASUREMENT AND MODELLING OF PARTICULATE POLLUTION OVER KASHMIR HIMALAYA, INDIA

Mudasir Ahmad Bhat, Shakil Ahmad Romshoo, and Gufran Beig

Water, Air, & Soil Pollution 232: 120

Ground and satellite measurements of particulate pollution play an important role in determining the particulate pollutant-Aerosol Optical Depth (AOD) relationship. The daily observed PM_{10} and $PM_{2.5}$ concentration varied from 11–757 μg/m^3 and 8–630 μg/m^3 with the mean concentrations of 137 ± 119 μg/m^3 and 86 ± 90 μg/m^3, respectively. The long-term mean annual PM_{10} and $PM_{2.5}$ levels are several times higher than the WHO permissible limits. The 1377 satellite-derived AOD observations from the Moderate Resolution Imaging Spectrometer, ground-based particulate matter (PM) and meteorological observations from 2013–2017 were analysed to develop two-variate linear model (TVM) (AOD versus PM_{10} or $PM_{2.5}$) and multi-variate regression models (MVMs) (AOD + meteorological parameters versus PM_{10} or $PM_{2.5}$) for estimation of the ground level PM_{10} and $PM_{2.5}$ in the Kashmir Himalaya, India. The model evaluation showed that the PM predication estimates are significant at 99% confidence level for all the models. The TVM predicts daily PM_{10} concentration better than $PM_{2.5}$ explaining 82% and 74%

variance in the observed data, respectively. By adding meteorological data to the regression analysis, there is an improvement of 5% and 11% in R^2 for PM_{10} and $PM_{2.5}$ estimates which inter alia reduced the RMSE by 11.8% and 20.47%, respectively. Estimation of the particulate pollution, utilising satellite-based AOD, observed PM and meteorology, would encourage satellite-based air quality monitoring in the data-scarce Himalaya. However, it is suggested that more studies are required to improve the operational prediction of PM pollution by incorporating satellite observations of other pollutants, and processes in the model using advanced approaches.

For further reading: https://doi.org/10.1007/s11270-021-05062-x

CONTRIBUTION OF CEDRUS DEODARA FORESTS FOR CLIMATE MITIGATION ALONG ALTITUDINAL GRADIENT IN GARHWAL HIMALAYA, INDIA

Mehraj A. Sheikh, Munesh Kumar, N. P. Todaria, Jahangeer A. Bhat, Amit Kumar, and Rajiv Pandey

Mitigation and Adaptation Strategies for Global Change 26: 5

The climatic and non-climatic stresses impacted adversely to the functioning and productivity of the forests, resulting in disturbing the existing carbon flow in the atmosphere. *Cedrus deodara* occurs in pure forest stands throughout the Western Himalayas and has high biomass and soil carbon sequestration potential. The present study aims to provide the contribution of the *Cedrus deodara* forests under the current stresses for climate mitigation by analysing the three elevation ranges of the Dhanaulti forest division of Garhwal Himalaya, India. The results report that soil organic carbon (SOC) was adversely and bulk density favourably related with elevation. Moreover, SOC as CO_2eq also decreased significantly with an increase in soil depths. Biomass carbon for various parts of the plant was also estimated for the three elevations of the *Cedrus deodara* forests. The trend in total carbon stock (bole, branch, twig, foliage and soil) decreased significantly with an increase in altitude. The carbon stock of *Cedrus deodara* forests was maximum (545 t ha^{-1}) at upper altitude (2350 m.a.s.l) and minimum (330 t ha^{-1}) at a lower altitude (2050 m.a.s.l). The difference in litter production between the seasons is significant with maximum production in summer followed by rainy and winter seasons. This study provides inputs for greenhouse gas (GHG) estimation for national communication to various platforms. The information on the soil is crucial for understanding about the ecology of the forests assisting prediction of functioning and productivity of forests.

For further reading: https://doi.org/10.1007/s11027-021-09941-w

TWO DECADAL CHANGES IN THE MAJOR IONS CHEMISTRY OF MELT WATER DRAINING FROM DOKRIANI GLACIER, CENTRAL HIMALAYA, INDIA

Shipika Sundriyal, Uday Bhan, S. Selvakumar, Rajesh Singh, and D. P. Dobhal

Journal of the Geological Society of India 97: 308-314

Present study aims to understand the hydrochemical changes in proglacial meltwater stream emerging from the termini of Dokriani Glacier, central Himalaya, India. The major ion concentration of melt water between the years 1994–2015 has been reassessed to infer the glacial/subglacial weathering induced ionic release from Dokriani glacier system. The results from meltwater data collected during post-monsoon period (October 2015) shows that Ca^{2+} is more dominant cation followed by Mg^{2+}, K^+, Na^+ and SO_4^{2-} is most dominant anion followed by HCO_3^- and Cl^-. Scatter plot between Ca^{2+} + Mg^{2+} vs total cations shows the overall dominance of carbonate weathering

whereas Na^{+}+K^{+} vs total anions shows high positive relation suggesting domination of both carbonate and silicate weathering. By comparison, the ionic concentration for the year 2015 suggests a significant increase since 1994; however, the discharge weighted concentrations could provide more detailed estimates. An increasing trend in major cations viz. calcium (Ca^{2+}) and magnesium (Mg^{2+}) while the bicarbonate (HCO_3^{-}), sulphate (SO_4^{2-}) and nitrogen (NO_3^{-}) has been observed as major anion. Further, the source of Cl^{-}, NH_4^{+}, and NO_3^{-} in the meltwater stream is mainly derived from the atmospheric precipitation, anthropogenic, and weathering process. The process of carbonate weathering and dissolution of rock is ascertained as the one which regulates the melt water chemistry.

For further reading: https://doi.org/10.1007/s12594-021-1682-6

AVIAN DIVERSITY IN FOREST, AGRICULTURE AND WATER STREAM HABITATS OF DEHRADUN VALLEY, UTTARAKHAND, INDIA

Kamal Kant Joshi, Dinesh Bhatt, and Ashish Kumar Arya

Biodiversity Data Journal 9: e61422

The Western Himalaya is recognised for its biological diversity and ecological values. An attempt was made to understand the avian diversity distribution in Forest, Agriculture and Water stream habitats of Dehradun (Western Himalaya) Uttarakhand. A total of two hundred and thirty one species belonging to 54 families were encountered during the survey. Out of these, one endangered species (Egyptian Vulture, *Neophron percnopterus*) and three near-threatened species Alexandrine Parakeet (*Psittacula eupatria*), Black-necked Stork (*Ephippiorhynchus asiaticu*) and River Lapwing (*Vanellus duvaucelii*) and one vulnerable species Woolly-necked Stork (*Ciconia episcopus*) were sighted. Three avian species, Mistle Thrush, Sulphur-bellied Warbler and White-rumped Munia. have been recorded as isolates in the study area. The presence of these species indicates the habitats extension in Dehradun District of Uttarakhand. The present study provides significant records in the study site and provides a baseline data for future study with reference to conservation in Dehradun Region.

For further reading: https://doi.org/10.3897/BDJ.9.e61422

China Himalaya

TWO NEW SPECIES OF *DIPLODERMA* HALLOWELL, 1861 (REPTILIA: SQUAMATA: AGAMIDAE) FROM THE HENGDUAN MOUNTAIN REGION IN CHINA AND REDISCOVERY OF *D. BREVICAUDUM* (MANTHEY, WOLFGANG, HOU, WANG, 2012)

Kai Wang, Wei Gao, Jiawei Wu, Wenjie Dong, Xiaogang Feng, Wenjing Shen, Jieqiong Jin, Xiudong Shi, Yin Qi, Cameron D. Siler, and Jing Che

Zootaxa 4941: 1-32

Recent studies have highlighted the underestimated diversity of the genus *Diploderma* Hallowell, 1861 in the Hengduan Mountain Region in Southwest China, but much of the region remains poorly surveyed for reptile diversity. In this study we describe two new species of *Diploderma* from the upper Jinsha and middle Yalong River Valley, based on evaluations of morphological, genetic, and distribution data. The two new species are morphologically most similar to *D. angustelinea* and *D. vela*, but they can be diagnosed from both recognized taxa

and all remaining congeners by a suite of morphological features, particularly the distinct coloration of gular spots. Additionally, both new species either render other recognized species paraphyletic or are allopatric with respect to their morphologically similar congeners. Furthermore, we rediscover *D. brevicaudum* in the wild for the first time, which was known from historical museum specimens only. We estimate the phylogenetic position of *D. brevicaudum* within the genus *Diploderma* based on mitochondrial genealogy, and we provide an expanded diagnosis and comparisons against closely related congeners and provide a detailed description of coloration in life based on newly collected specimens. Our discoveries of the new *Diploderma* species further highlight the urgent conservation needs of the currently neglected hot-dry valley ecosystems in the Hengduan Mountain Region of China.

For further reading: https://doi.org/10.11646/zootaxa.4941.1.1

Bhutan-Himalaya

VEGETATION STRUCTURE OF WETLANDS IN EASTERN HIMALAYAN HIGHLANDS OF GASA, BHUTAN

Pema Tendara and Kitichate Sriditha

Science Asia 47: 78-85

The study was conducted on the unexplored wetland vegetation of the eastern Himalayan highlands of Gasa District, Northern Bhutan. A random quadrat sampling of 1×1 m^2 method was used to assess the presence absence of species, including shrubs, trees, mosses, ferns, and climbers, that were occurring adjacent to plots. Altogether, 201 taxa from 81 families, distributed in 149 genera, were recorded. Among the total species, 6 bryophytes, 20 monilophytes, 2 gymnosperms, and 173 angiosperms species were found. The most abundant life forms represented were herbaceous (62%) and shrub (29%), followed by tree (7%) and climber (2%). The four unique vegetation structure (represented in schematic profile diagrams) of habitats: fresh water meadow, seasonally flooded basin of flat, shallow fresh marsh, and poor fen, were found. The study suggests protecting ecotone (a transition zone between the wetland and surrounding uplands) as part of the measures to protect wetlands and their vegetation in the Himalayas.

Further reading: 10.2306/scienceasia1513-1874.2021.007

Highlight of the Issue

One Decade of Fukushima Disaster

An unstoppable nuclear disaster unveiled in Fukushima on March 11, 2011 when a huge earthquake followed by tsunami caused Fukushima Daichii nuclear plants to fail. With the successive meltdown of three nuclear reactors, radioactive steam, leakage and seepage of thousands of litres of contaminated water resulted in uncontrolled release of radioactive substances. Immediately after the earthquake, reactor 1 started leaking radioactive gases (xenon) and melted completely within a few hours. The steam of evaporated water formed highly volatile mixture of hydrogen and oxygen which reacted with zirconium alloy of fuel rod, melting the bottom of reactor pressure vessel. On the next day, March 12 hydrogen explosion completely tore the building apart. The direction of wind caused the radioactive substances to blow towards the Pacific, but later northwest of the site was also covered.

With the loss of 20,000 lives by then, major parts of Japan was contaminated with caesium, which could affect possibly for the next 300 years. Coming to 2021, a decade later from the incident, Fukoshima Daichii still seeks complete recovery from the radioactive contamination. A study on Hiroshima survivor shows young aged female are more prone to cancer as twice as much as male at present.

Further reading:

https://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident.aspx

https://www.britannica.com/event/Fukushima-accident