

Headlines Himalaya

December 16 – December 31 (2020)

No. 631-632 Editorial Team: Meena Sharma and Pratistha Shrestha

For the 631st -632nd issues of Headlines Himalaya, we reviewed researches from eleven sources and selected 18 researches from five countries. We selected 7 researches from Nepal and 11 researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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PAKISTAN

RESISTANCE TO INSECTICIDES AND SYNERGISM BY ENZYME INHIBITORS IN AEDES ALBOPICTUS FROM PUNJAB, PAKISTAN

LANDSCAPE VARIABLES AFFECTING THE HIMALAYAN RED PANDA *AILURUS FULGENS* OCCUPANCY IN WET SEASON ALONG THE MOUNTAINS IN NEPAL

Kanchan Thapa, Gokarna Jung Thapa, Damber Bista, Shant Raj Jnawali, Krishna Prasad Acharya, Kapil Khanal, Ram Chandra Kandel, Madhuri Karki Thapa, Saroj Shrestha, Sonam Tashi Lama, and Netra Sharma Sapkota

PLoS ONE 15: e0243450

The Himalayan red panda is an endangered mammal endemic to Eastern Himalayan and South Western China. Data deficiency often hinders understanding of their spatial distribution and habitat use, which is critical for species conservation planning. We used sign surveys covering the entire potential red panda habitat over 22,453 km² along the mid-hills and high mountains encompassing six conservation complexes in Nepal. To estimate red panda distribution using an occupancy framework, we walked 1,451 km along 446 sampled grid cells out of 4,631 grid cells in the wet season of 2016. We used single-species, single-season models to make inferences regarding covariates influencing detection and occupancy. We estimated the probability of detection and occupancy based on model-averaging techniques and drew predictive maps showing site-specific occupancy estimates. We observed red panda in 213 grid cells and found covariates such as elevation, distance to water sources, and bamboo cover influencing the occupancy. Red panda detection probability \hat{p} (SE) estimated at 0.70 (0.02). We estimated red panda site occupancy (sampled grid cells) and landscape occupancy (across the potential habitat) Ψ (SE) at 0.48 (0.01) and 0.40 (0.02) respectively. The predictive map shows a site-specific variation in the spatial distribution of this arboreal species along the priority red panda conservation complexes. Data on their spatial distribution may serve as a baseline for future studies and are expected to aid in species conservation planning in priority conservation complexes.

For further reading: <https://doi.org/10.1371/journal.pone.0243450>

GROWTH PERFORMANCE OF PLANTED POPULATION OF *PINUS ROXBURGHII* IN CENTRAL NEPAL

Achyut Tiwari, Nita Thapa, Sugam Aryal, Prabina Rana, and Shankar Adhikari

Journal of Ecology and Environment 44: 31

Climate change has altered the various ecosystem processes including forest ecosystem in Himalayan region. Although the high mountain natural forests including treelines in the Himalayan region are mainly reported to be temperature sensitive, the temperature-related water stress is an important growth-limiting factor for middle elevation mountains. And there are very few evidences on growth performance of planted forest in changing climate in the Himalayan region. A dendrochronological study was carried out to verify and record the impact of warming temperature tree growth by using the tree cores of *Pinus roxburghii* from Batase village of Dhulikhel in Central Nepal with sub-tropical climatic zone. For this total, 29 tree cores from 25 trees of *P. roxburghii* were measured and analyzed. A 44-year long tree ring width chronology was constructed from the cores. The result showed that the radial growth of *P. roxburghii* was positively correlated with pre-monsoon (April) rainfall, although the correlation was not significant and negatively correlated with summer rainfall. The strongest negative correlation was found between radial growth and rainfall of June followed by the rainfall of January. Also, the

radial growth showed significant positive correlation with that previous year August mean temperature and maximum temperature, and significant negative correlation between radial growth and maximum temperature (T_{max}) of May and of spring season (March-May), indicating moisture as the key factor for radial growth. Despite the overall positive trend in the basal area increment (BAI), we have found the abrupt decline between 1995 and 2005 AD. The results indicated that chir pine planted population was moisture sensitive, and the negative impact of higher temperature during early growth season (March-May) was clearly seen on the radial growth. We emphasize that the forest would experience further moisture stress if the trend of warming temperatures continues. The unusual decreasing BAI trend might be associated with forest management processes including resin collection and other disturbances. Our results showed that the planted pine forest stand is sub-healthy due to major human intervention at times. Further exploration of growth climate response from different climatic zones and management regimes is important to improve our understanding on the growth performance of mid-hill pine forests in Nepal.

For further reading: <https://doi.org/10.1186/s41610-020-00171-w>

SEASONALLY STABLE TEMPERATURE GRADIENTS THROUGH SUPRAGLACIAL DEBRIS IN THE EVEREST REGION OF NEPAL, CENTRAL HIMALAYA

Ann V. Rowan, Lindsey I. Nicholson, Duncan J. Quincey, Morgan J. Gibson, Tristram D.L. Irvine-Fynn, C. Scott Watson, Patrick Wagnon, David R. Rounce, Sarah S. Thompson, Philip R. Porter, and Neil F. Glasser

Journal of Glaciology 67: 170 - 181

Rock debris covers ~30% of glacier ablation areas in the Central Himalaya and modifies the impact of atmospheric conditions on mass balance. The thermal properties of supraglacial debris are diurnally variable but remain poorly constrained for monsoon-influenced glaciers over the timescale of the ablation season. We measured vertical debris profile temperatures at 12 sites on four glaciers in the Everest region with debris thickness ranging from 0.08 to 2.8 m. Typically, the length of the ice ablation season beneath supraglacial debris was 160 days (15 May to 22 October)—a month longer than the monsoon season. Debris temperature gradients were approximately linear ($r^2 > 0.83$), measured as -40°C m^{-1} where debris was up to 0.1 m thick, -20°C m^{-1} for debris 0.1–0.5 m thick, and -4°C m^{-1} for debris greater than 0.5 m thick. Our results demonstrate that the influence of supraglacial debris on the temperature of the underlying ice surface, and therefore melt, is stable at a seasonal timescale and can be estimated from near-surface temperature. These results have the potential to greatly improve the representation of ablation in calculations of debris-covered glacier mass balance and projections of their response to climate change.

For further reading: <https://doi.org/10.1017/jog.2020.100>

NATURAL AND ANTHROPOGENIC CORRELATES OF HABITAT USE BY WILD UNGULATES IN SHUKLAPHANTA NATIONAL PARK, NEPAL

Sabhyata Lamichhane, Gopal Khanal, Jhamak Bahadur Karki, Chandramani Aryal, and Suman Acharya

Global Ecology and Conservation 24: e01338

Wild ungulate herbivores are crucial for maintaining terrestrial ecosystems and restoring population of top predators like tiger. Thus, it is essential to understand wild ungulates-habitat relationships to devise an effective strategy to conserve their population and top predators like tiger that depend on them. We have limited understanding about the ungulates and their habitat in sub-tropical lowlands. In this study, we conducted transect based occupancy surveys in December 2016 across 30 geographic grid cells of 3 km × 3 km spanning 270 km². We used the occupancy modelling approach that accounts for the imperfect detection to test multiple hypotheses concerning ecological and anthropogenic correlates of site use pattern of five wild ungulate species in Shuklaphanta National Park, Nepal. The model-average estimates showed that proportion of site use was highest for spotted deer (0.83 ± SE 0.29) followed by blue bull (0.53 ± SE 0.22), hog deer (0.37 ± SE 0.12), swamp deer (0.23 ± SE 0.17), and lowest for barking deer (0.14 ± SE 0.05). While the proportion of forest had a positive influence on blue bull and barking deer, the proportion of grassland had a positive influence on spotted deer and swamp deer. Water availability positively influenced site use of barking deer. Human disturbance had a strong negative influence on the distribution of hog deer but blue bull had a positive association with human activities. Similarly, fire had a strong positive influence only on the habitat use of swamp deer. Overall, our results showed that these five wild ungulate species vary in their site use responses to natural habitat and anthropogenic factors suggesting that the consideration of species-specific habitat requirements is important for their conservation and management.

For further reading: <https://doi.org/10.1016/j.gecco.2020.e01338>

METHANE EMISSION FACTORS AND CARBON FLUXES FROM ENTERIC FERMENTATION IN CATTLE OF NEPAL HIMALAYA

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Science of the Total Environment 746: 141184

This study presents a first estimate of the country-specific enteric methane (CH₄) emission factors (EFs) and the net CH₄ fluxes for the local and improved cattle breeds (LCB and ICB) in Nepal using the IPCC Tier 2 methodology. The country-specific herd structure, morphological and feed characteristics data of cattle were collected from the field survey. In LCB, adult males had the highest mean live body weights (BW_s) ranging from 222 ± 42 kg in the Hill to 237 ± 36 kg in the Plain region, while for improved cattle, adult females had the highest BW of 334 ± 45 kg in the Hill to 308 ± 38 kg in the Plain regions. Weight gains of ICB were higher than the LCB. Local calves gained BW_s of 97 ± 20 g day⁻¹, while improved calves gained a weight of 202 ± 41 g day⁻¹. The CH₄ EFs ranged from 13 ± 3 to 46 ± 9 kg CH₄ head⁻¹ yr⁻¹ for different age-groups of the LCB, while for the ICB, the EFs ranged from 14 ± 3 to 75 ± 15 kg CH₄ head⁻¹ yr⁻¹. Overall, the EFs were 33 ± 7 and 46 ± 9 kg CH₄ head⁻¹ yr⁻¹ for LCB and ICB, respectively. The estimated enteric EFs of cattle in the Hill and Plain regions were not statistically different ($p > 0.05$), but a significant difference existed between the breeds (LCB and ICB; $p < 0.05$). The net CH₄ flux was 254 ± 51 Gg yr⁻¹ from enteric fermentation in cattle of Nepal using the country-specific EFs, about 15% higher than using the default EFs (221 ± 66 Gg yr⁻¹). We underline that the emission estimation, deploying the country-specific EFs, will be more accurate, contributing to reduce the uncertainties in the national GHG inventories and supporting the mitigation actions.

For further reading: <https://doi.org/10.1016/j.scitotenv.2020.141184>

HABITAT OCCUPANCY AND THREAT ASSESSMENT OF GHARIAL (*GAVIALIS GANGETICUS*) IN THE RAPTI RIVER, NEPAL

Bijaya Neupane, Bichit Kumar Singh, Prabin Poudel, Saroj Panthi, and Namrata Devi Khatri

Global Ecology and Conservation 24: e01270

Gharial (*Gavialis gangeticus*) is one of the most highly threatened fauna of fresh water ecosystems in the world. Yet, information about the species habitat characteristics influencing its distribution and threats to its existence are still lacking in Nepal. This study identified the most important habitat characteristics associated with gharial presence and existing threats in the Rapti River of Nepal. An opportunistic search method was adopted for field surveys conducted in November and December of 2018. As part of the survey, Global Positioning System (GPS) coordinates were recorded for each sighting location and gharial behavioral activity was captured from photographic documentation. Habitat characteristics were recorded at stations spaced at 500 m intervals along the river in addition to locations where gharial was sighted. Data were collected moving downstream on each side of the river (left and right banks), which included both stations and sighting locations that comprised a total of 200 sampling points. Habitat factors associated with the presence of gharial were analyzed using a combination of MS Excel, ArcGIS and the R Binomial distribution model with logit link function. The dependent variable was the presence or absence of gharial at sampling points and the independent variables included six unique habitat characteristics: riverbank location, river width, mid-river depth, riverbank substrate type, riverbank slope and observed anthropogenic threats. Relative whole-site ranking was used to identify the most prominent threats to conservation. During the survey, 53 gharial individuals were recorded where 62% were found basking while 38% were found swimming or submerged underwater. A majority of individuals were sighted on the south side (left bank) of the Rapti River (31 out of 53 sightings), at river widths of 51–100 m (34 out of 53 sightings) and at mid-river depths of 1–2 m (28 out of 53 sightings). Other important factors were riverbank substrate type where most of the gharials were found basking in the sandy bank (25 out of 53 individuals), flat riverbank topography (42 out of 53 individuals), and at locations with no observed anthropogenic threats (41 out of 53 individuals). Among the six habitat variables examined, no significant differences in the probability of gharial sightings were found for five variables (river side, observed human threats, substrate type, river width and mid river depth) while only one habitat variable, topography, exhibited significant differences in the probability of gharial sightings ($\chi^2_{4,195} = 38.782$; $p < 0.001$). Pollution by industrial toxic wastes, domestic sewage and natural habitat modification due to monsoon flash floods were the major threats to gharial and their habitat. Although the Rapti River currently supports a significant gharial population, conservation efforts need to be increased in the future from authorities responsible for their stewardship in order to maintain and enhance their numbers through both habitat protection and abundance of prey (fish).

For further reading: <https://doi.org/10.1016/j.gecco.2020.e01270>

ANATOMY OF DISASTER RECOVERIES: TANGIBLE AND INTANGIBLE SHORT-TERM RECOVERY DYNAMICS FOLLOWING THE 2015 NEPAL EARTHQUAKES

Jeremy Spoon, Chelsea E. Hunter, Drew Gerkey, Ram B. Chhetri, Alisa Rai, Umesh Basnet, and Anudeep Dewan

International Journal of Disaster Risk Reduction 51: 101879

The April/May 2015 Nepal earthquakes and aftershocks had catastrophic impacts on rural households living in biophysical extremes. Recoveries from natural hazards that become disasters have tangible and intangible short- and long-term dynamics, which require linked quantitative and qualitative methods to understand. With these premises in mind, we randomly selected 400 households in two accessible and two inaccessible settlements across two of the highest impacted districts to assess variation in household and settlement recoveries through tangible impacts to infrastructure and livelihood and intangible impacts to place attachment and mental well-being. We conducted household surveys, in-depth interviews, and focus groups over two ten-week intervals at 9 months and 1.5 years after the earthquakes and returned at 2.5 years to share and contextualize results. Previously, we used non-metric multidimensional scaling ordination to illustrate associations among recovery indicators, demographics, and adaptive capacity domains composed of multiple variables. Results indicated that socio-economic status, hazard exposure, livelihood, and displacement influenced recovery outcomes the most. Here, we triangulate and broaden those findings with 797 surveys, 40 interviews, eight focus groups, and eight research return workshops to illustrate the tangible and intangible dynamics of short-term recoveries through three interconnected and multi-faceted thematic sections: 1) inequality; 2) hazards, livelihood, and displacement; and 3) place, uncertainty, and mental well-being. Our contributions include: 1) providing a linked quantitative and qualitative dataset with a random sample collected at two short-term post-disaster time intervals; 2) illustrating how inequalities shape tangible and intangible recovery dynamics; and 3) documenting linkages between recovery and nascent transformations.

For further reading: <https://doi.org/10.1016/j.ijdr.2020.101879>

India-Himalaya

INVENTORY AND SPATIAL DISTRIBUTION OF GLACIAL LAKES IN ARUNACHAL PRADESH, EASTERN HIMALAYA, INDIA

Suraj Mal, Atul Kumar, Rakesh Bhambri, Udo Schickhoff, and R. B. Singh

Journal of the Geological Society of India 96: 609-615

The present study generates a glacial lake inventory of Arunachal Pradesh, Eastern Himalaya, India using Landsat 8 Operational Land Imager (OLI) images (2016-2018). The study reveals that there are in total 1532 ($> 0.001 \text{ km}^2$) glacial lakes, covering an area of 93.7 km^2 . Glacier erosion lakes are the most dominant type with 1268 glacial lakes (82.8%) and an area of 76.8 km^2 (~82%). About 50% of the lakes are located in the four districts of eastern Arunachal Pradesh, while ~16% in the three districts of central and ~33% in the four districts of western Arunachal Pradesh. The western Arunachal Pradesh has mixed patterns of glacial lakes types, whereas the erosion lakes dominate the eastern and central Arunachal Pradesh. The current inventory can serve as a baseline database for understanding glacial lake-related flood hazard studies in Arunachal Pradesh.

For further reading: [10.1007/s12594-020-1610-1](https://doi.org/10.1007/s12594-020-1610-1)

TREE-RING BASED MINIMUM TEMPERATURE RECONSTRUCTION ON THE SOUTHEASTERN TIBETAN PLATEAU

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Quaternary Science Reviews 251: 106712

Increases in the annual minimum temperature (Tmin) has been more obvious than the increase in the annual mean temperature in the southeastern Tibetan Plateau (TP) over the past few decades; however, annual Tmin variability over the long-term in the southeastern TP has received scant attention. Here, we present a 413-year long tree-ring width chronology (TRW), which is composed of 22 site chronologies at high altitudes at the Hengduan Mountains on the southeastern TP. Climate-tree growth relationship analysis revealed that annual Tmin was the climatic factor that influenced radial tree growth in the area the most ($R = 0.74$, $P < 0.001$). Accordingly, we reconstructed the annual Tmin over the 1600-2012 AD period on the southeastern TP. The linear regression model between TRW chronology and annual Tmin accounted for 54.3% of the total variance in actual Tmin during the common period, 1960-2012. The close coupling of warm and cold episodes with other temperature reconstructions from surrounding regions indicated the reliability of our reconstruction. In addition, the comparison of reconstructed series with Climate Research Unit gridded data demonstrated that our reconstruction could represent the large-scale variability in annual Tmin on the TP. Furthermore, the Tmin variability exhibited similar trends with the temperature reconstructions from the TP, Asia, and northern hemisphere during the common period (1600-2012), indicating that the thermal variation in southeastern TP was consistent with the continental and hemispheric scale climate system variabilities. Atlantic Multi-Decadal Oscillation (AMO) and solar activity were observed to be key factors influencing annual Tmin variation over the southeastern TP. The results of the moving correlation analyses implied that the radial forest growth at high altitudes on the southeastern TP remained consistent with regional Tmin variation, and the decrease in precipitation has not yet limited forest growth.

For further reading: <https://doi.org/10.1016/j.quascirev.2020.106712>

SYSTEMATICALLY ADDRESSING THE HETEROGENEITY IN THE RESPONSE OF ECOSYSTEM SERVICES TO AGRICULTURAL MODERNIZATION, INDUSTRIALIZATION AND URBANIZATION IN THE QINGHAI-TIBETAN PLATEAU FROM 2000 TO 2018

Yingying Tian, Guanghui Jiang, Dingyang Zhou, and Guangyong Li

Journal of Cleaner Production 285: 125323

Ecosystem services (ESS) change and its response to human activities is critical for enhancing ecosystem management and regional sustainability. This study constructs a theoretical framework of coupled ESS and three modernization (agricultural modernization (AM), industrialization and urbanization) systems, depicts the dynamic changes of ESS and three modernizations in the Qinghai-Tibetan Plateau (QTP) from 2000 to 2018, and further analyses the heterogeneity in the response of multiple ESS to different human activities using the Pearson correlation method and bivariate spatial autocorrelation model. (1) AM showed a significant negative impact on

ESS and other single ESS except for food production and waste treatment services, and there was also an increasingly significant negative correlation between them in space, indicating that AM did not coordinate the local ecological protection and exerted the strongest destruction and an expanding scope of spatially negative effects on ESS. (2) Industrialization was negatively correlated with ESS as well as all of their associated single ESS to a different extent and was only significantly correlated with regulation services, while it interacted spatially with ESS, changing from presenting a weak negative correlation to presenting a weak positive correlation during 2000–2018, which reveals that industrialization had relatively less pressure on ESS and developed in a more eco-friendly mode. (3) Urbanization exerted a weak negative influence on ESS and most single ESS, whereas urbanization was positively correlated with waste treatment, landscape culture provision and biodiversity maintenance services in 2018, and it showed a significant positive impact of a growing tendency to effect ESS in space, which reveals that urbanization was conducive to reducing the overall disturbance of human activities on ESS. (4) The heterogeneity characteristics of the local spatial correlation patterns between the three modernization levels and ESS as well as their changes during 2000–2018 were investigated and presented obvious differences, and the low-high/high-low areas of the levels and changes for these two constructs should be given enough attention and take corresponding adaptive management measures. This study indicates that there are remarkable heterogeneous effects of different intensities and types of human activities on ESS, which should be understood systematically to coordinate the development pathways and patterns of three modernizations and the restoration and sustainable utilization of ecosystems.

For further reading: <https://doi.org/10.1016/j.jclepro.2020.125323>

A COMPREHENSIVE STUDY ON OZONE POLLUTION IN A MEGACITY IN NORTH CHINA PLAIN DURING SUMMERTIME: OBSERVATIONS, SOURCE ATTRIBUTIONS AND OZONE SENSITIVITY

Jian Sun, Zhenxing She, Ruonan Wang, Guohui Li, Yue Zhang, Bin Zhang, Kun He, Zhuoyue Tang, Hongmei Xu, Linli Qu, Steven Sai Hang Ho, Suixin Liu, and Junji Cao

Environment International 146: 106279

Tropospheric ozone (O₃) pollution has been becoming prominent in North China Plain (NCP) in China since last decade. In order to clarify the source contribution and formation mechanism of O₃, the critical precursors of volatile organic compounds (VOCs) were measured with both on-line and off-line methods in Luoyang City in summer of 2019. The concentrations of nitrogen oxides (NO_x, sum of NO and NO₂) and O₃ were simultaneously monitored. Fifty-seven VOCs measured in U.S. Photochemical Assessment Monitoring Station (PAMS) showed daily concentrations in a range of 14.5 ± 5.33 to 29.2 ± 11.2 ppbv in Luoyang, which were comparable with those in other Chinese megacities. The mass compositions of VOCs were determined, with comparatively low proportions of alkanes (<50%) but high fractions of photoreactive alkenes and alkyne. Source apportionment of VOCs was conducted by Hybrid Environmental Receptor Model (HERM). The results indicated that industrial (38.5%) and traffic (32.0%) were the two dominated pollution sources of VOCs in the urban, while the biogenic and residential sources had contributions of 15.8% and 13.8%, respectively. To further measure the O₃ formation sensitivity and its source attribution, the WRF-CHEM model was adopted in this study. The variation of O₃ between the observation and the stimulation using the local emission inventory showed an index of agreement (IOA) of 0.85. The simulation conducted by WRF-CHEM indicated an average of 43.5% of the O₃ was associated with the regional transportation, revealing the importance of inter-regional prevention and control policy. Traffic and biogenic emissions were the two major pollution sources to an O₃ episode occurred from July 21 to July 27, 2019 (when O₃ concentration over 150 μg m⁻³) in Luoyang, with average contributions of 22.9% and 18.3%, respectively. The

O₃ isopleths proved that its formation in the atmosphere of Luoyang was in transitional regime and collectively controlled by both VOCs and NO_x. This was different from the observations in main cities of NCP before implantations of strict emission controls. The isopleths additionally designated that the O₃ formation regime would move forward or shift to NO_x regime after a reduction of over 45% during the episode. Similar patterns were also reported in other Chinese megacities such as Beijing and Shanghai, due to the tightening of the NO_x control policies. Our results do support that the simultaneous controls of NO_x and VOCs were effective in reductions of tropospheric O₃ in Luoyang. Meanwhile, joint regional control policies on the emissions of NO_x and VOCs can potentially overwhelm the current O₃ pollutions in China.

For further reading: <https://doi.org/10.1016/j.envint.2020.106279>

VEGETATION DEGRADATION IMPACTS SOIL NUTRIENTS AND ENZYME ACTIVITIES IN WET MEADOW ON THE QINGHAI-TIBET PLATEAU

Jiangqi Wu, Haiyan Wang, Guang Li, Weiwei Ma, Jianghua Wu, Yu Gong, and Guorong Xu

Scientific Reports 10: 21271

Vegetation degradation, due to climate change and human activities, changes the biomass, vegetation species composition, and soil nutrient input sources and thus affects soil nutrient cycling and enzyme activities. However, few studies have focused on the responses of soil nutrients and enzymes to vegetation degradation in high-altitude wet meadows. In this study, we examined the effects of vegetation degradation on soil nutrients (soil organic carbon, SOC; total nitrogen, TN; total phosphorus, TP) and enzyme activities (i.e., urease, catalase, amylase) in an alpine meadow in the eastern margin of the Qinghai-Tibet Plateau. Four different levels of degradation were defined in terms of vegetation density and composition: primary wet meadow (CK), lightly degraded (LD), moderately degraded (MD), and heavily degraded (HD). Soil samples were collected at depth intervals of 0–10, 10–20, 20–40, 40–60, 60–80, and 80–100 cm to determine soil nutrient levels and enzyme activities. The results showed that SOC, TN, catalase and amylase significantly decreased with degradation level, while TP and urease increased with degradation level ($P < 0.05$). Soil nutrient and enzyme activity significantly decreased with soil depth ($P < 0.05$), and the soil nutrient and enzyme activity exhibited obvious "surface aggregation". The activities of soil urease and catalase were strongest in spring and weakest in winter. The content of TN in spring, summer, and autumn was significantly higher than observed in winter ($P < 0.05$). The soil TP content increased in winter. Soil amylase activity was significantly higher in summer than in spring, autumn, and winter ($P < 0.05$). TP was the main limiting factor for plant growth in the Gahai wet meadow. Values of SOC and TN were positively and significantly correlated with amylase and catalase ($P < 0.05$), but negatively correlated with urease ($P < 0.05$). These results suggest the significant role that vegetation degradation and seasonal freeze–thaw cycle play in regulating enzyme activities and nutrient availability in wet meadow soil.

For further reading: <http://doi.org/10.1038/s41598-020-78182-9>

THE WARMING TIBETAN PLATEAU IMPROVES WINTER AIR QUALITY IN THE SICHUAN BASIN, CHINA

Shuyu Zhao, Tian Feng, Xuexi Tie, and Zebin Wang

Atmospheric Chemistry and Physics 20: 14873–14887

Impacts of global climate change on the occurrence and development of air pollution have attracted more attention. This study investigates impacts of the warming Tibetan Plateau on air quality in the Sichuan Basin. Meteorological observations and ERA-Interim reanalysis data reveal that the plateau has been rapidly warming during the last 40 years (1979–2017), particularly in winter when the warming rate is approximately twice as much as the annual warming rate. Since 2013, the winter temperature over the plateau has even risen by 2 °C. Here we use the WRF-Chem model to lay emphasis on the impact of the 2 °C warming on air quality in the basin. The model results show that the 2 °C warming causes an enhanced easterly wind, an increase in the planetary boundary layer height (PBLH) and a decrease in the relative humidity (RH) in the basin. Enhanced easterly wind increases PM_{2.5} transport from the basin to the plateau. The elevated PBLH strengthens vertical diffusion of PM_{2.5}, while the decreased RH significantly reduces secondary aerosol formation. Overall, PM_{2.5} concentration is reduced by 17.5 % (~ 25.1 µg m⁻³), of which the reduction in primary and secondary aerosols is 5.4 and 19.7 µg m⁻³, respectively. These results reveal that the recent warming plateau has improved air quality in the basin, to a certain extent mitigating the air pollution therein. Nevertheless, the climate system is particularly complicated, and more studies are needed to demonstrate the impact of climate change on air quality in the downstream regions as the plateau is likely to continue warming.

For further reading: <https://doi.org/10.5194/acp-20-14873-2020>

Bhutan-Himalaya

A 2600-YEAR-LONG PALEOSEISMIC RECORD FOR THE HIMALAYAN MAIN FRONTAL THRUST (WESTERN BHUTAN)

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Solid Earth 11: 2359–2375

In spite of an increasing number of paleoseismic studies carried out over the last decade along the Himalayan Arc, the chronology of historical and prehistorical earthquakes is still poorly constrained. In this paper, we present geomorphologic and paleoseismic studies conducted over a large river-cut exposure along the Main Frontal Thrust in southwestern Bhutan. The Piping site reveals a 30 m high fault-propagation fold deforming late Holocene alluvial deposits. There, we carried out detailed paleoseismic investigations and built a chronological framework on the basis of 22 detrital charcoal samples submitted to radiocarbon dating. Our analysis reveals the occurrence of at least five large and great earthquakes between 485±125 BCE and 1714 CE with an average recurrence interval of 550±211 years. Coseismic slip values for most events reach at least 12 m and suggest associated magnitudes are in the range of M_w 8.5–9. The cumulative deformation yields an average slip rate of 24.9±10.4 mm yr⁻¹ along the Main Frontal Thrust over the last 2600 years, in agreement with geodetic and geomorphological results obtained nearby.

For further reading: <https://doi.org/10.5194/se-11-2359-2020>

FULFILLING NATURE NEEDS HALF THROUGH TERRESTRIAL-FOCUSED PROTECTED AREAS AND THEIR ADEQUACY FOR FRESHWATER ECOSYSTEMS AND BIODIVERSITY PROTECTION: A CASE FROM BHUTAN

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The Nature Needs Half (NNH) movement aims to protect 50 % of the earth. That said protected area designation usually neglects freshwater ecosystems and biodiversity. We assessed protection of the surface area of lakes, length of river reaches, habitat area of fish and odonate species within the terrestrial-focused protected areas of Bhutan that meets NNH target. We categorised percentage protection into four progressive levels: (i) Below Aichi ($\leq 16.9\%$), (ii) Aichi and above (17–34.9 %), (iii) Near NNH (35–49.9 %) and (iv) NNH and above ($\geq 50\%$). Overall, we found both freshwater ecosystems and biodiversity were well represented within PAs of Bhutan. 1080 out of 1181 lakes had ‘NNH and above’ percentage surface area protection against only 99 with ‘below Aichi’ protection. Further, 1388 out of 3418 river reaches also had ‘NNH and above’ percentage river length protection, but this number was smaller than the number of reaches with ‘below Aichi’ protection ($n = 1926$). No fish or odonate species had ‘below Aichi’ percentage habitat area protection, but only one fish and no odonate species had ‘NNH and above’ protection. However, lakes and river reaches when considered by agro-ecological zone and river reach types respectively had no equitable and adequate protection. 14 of the 19 lakes within the five lower elevation agro-ecological zones had ‘below Aichi’ protection, while 1075 of the 1162 lakes inside alpine zone had ‘NNH and above’ protection. Similarly, the rarer river reach types had a greater number of the reaches with ‘below Aichi’ protection. More importantly, only 5 lakes within the five lower elevation agro-ecological zones had their whole surface area protected – in contrast to 1068 lakes within the alpine zone. Further, river reaches with shorter reach length and odonate species with smaller habitat area had lower percentage protection. Our findings imply a need for *a priori* consideration of freshwater ecosystems and biodiversity in PA designation even within NNH paradigm.

For further reading: <https://doi.org/10.1016/j.jnc.2020.125894>

MAPPING HUMAN–WILDLIFE CONFLICT HOTSPOTS IN A TRANSBOUNDARY LANDSCAPE, EASTERN HIMALAYA

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The Kangchenjunga Landscape, an important repository of biodiversity, faces several challenges owing to various drivers of change. Human–wildlife conflict (HWC) is one of such issue that transcends social, economic, environmental, as well as national and international borders among the three participating countries – Bhutan, India, and Nepal – making it a complex, transboundary issue. Based on the existing literature, earth observation data, and geographic information system, we used maximum entropy along with relevant environmental predictor variables to model and map HWC hotspots. The results suggested that about 19 per cent of the area within the landscape is at high risk of human–wildlife conflict, with an anthropogenic factor – distance to roads – as the top predictor. Some protected areas are at higher risk than others. The Himalayan subtropical pine forest ecoregion is a high HWC zone (~ 63 per cent), followed by the Terai–Duars savannah and grasslands ecoregion (~ 43 per cent). They also revealed that the low- and mid-elevation zones are prone to conflict due to greater forest fragmentation; patchy protected areas are disconnected from each other, and not big enough for large mammals like elephants and tigers. Human-wildlife conflict is observed to vary across different elevation and climate region of the landscape and highly correlated with forest fragmentation of the midhills. Hence, a holistic approach at the

landscape level is needed for tackling human–wildlife conflict. Connecting good habitats by restoring fragmented inter and intra-country areas would be an effective measure to mitigate human–wildlife conflict.

For further reading: <https://doi.org/10.1016/j.gecco.2020.e01284>

GENDER IN THE MODERNISATION OF WASTE MANAGEMENT: KEY LESSONS FROM FIELDWORK IN BHUTAN, MONGOLIA, AND NEPAL

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Gender & Development 28: 551-569

The waste sector is a significant and growing source of global greenhouse gas (GHG) emissions. Most developing countries are minor contributors to global GHG, and produce limited emissions from municipal solid waste. However, as poor countries become integrated into global circuits of production and consumption, their contributions to global GHG emissions are likely to increase concomitantly. National and local governments and international agencies have identified municipal waste sector reform and modernisation in emerging economies as a global priority for climate change mitigation. International attention and funding is increasingly targeted towards improved and sustainable waste management in developing countries, both as part of climate change mitigation strategies and as a response to the marine litter crises. However, when moving towards more sustainable practices of waste management, it is important to take into account socioeconomic factors and how modern approaches to sustainable waste management will impact the livelihoods of people who currently find their income – often informally – in current waste management activities. Here we look at how gender norms play an important role in current waste management practices and how gender equality is influenced if the modernisation of waste sector is not taking into account gender aspects.

For further reading: <https://doi.org/10.1080/13552074.2020.1840155>

Pakistan- Himalaya

RESISTANCE TO INSECTICIDES AND SYNERGISM BY ENZYME INHIBITORS IN *Aedes albopictus* FROM PUNJAB, PAKISTAN

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The widespread use of insecticides has ecological consequences such as emergence of insecticide resistance and environmental pollution. *Aedes albopictus* is a major vector of dengue virus in the Punjab province, Pakistan. Control of *Ae. albopictus* with insecticides along with source eradication is critical in the prevention and control of dengue fever but is threatened by the development of insecticide resistance. Here, field strains of *Ae. albopictus* from eight cities of Punjab were evaluated for resistance against temephos, deltamethrin and permethrin. For temephos, high resistance ($RR_{LC50} > \text{tenfold}$) was found in larvae of the Rawalpindi strain, moderate resistance ($RR_{LC50} = \text{five- to tenfold}$) in Multan, Faisalabad, Sialkot, Lahore and Sheikhpura strains, and low resistance ($RR_{LC50} < \text{fivefold}$) in Kasur and Sahiwal strains. In the case of deltamethrin, high resistance was seen in adults of the strain from Faisalabad, moderate resistance in the strains from Sialkot, Sheikhpura, Lahore and

Kasur, and low resistance in Sahiwal, Multan and Rawalpindi strains. For permethrin, adults of all the field strains exhibited high levels of resistance. In synergism bioassays, toxicity of all the insecticides in the field strains significantly enhanced when tested in combination with piperonyl butoxide or *S,S,S*-tributylphosphorotrithioate, suggesting the probability of metabolic-based mechanisms of resistance. In conclusion, field strains of *Ae. albopictus* from Punjab exhibit resistance to temephos, deltamethrin and permethrin, which might be associated with metabolic mechanisms of resistance.

For further reading: <https://doi.org/10.1038/s41598-020-78226-0>