

Headlines Himalaya

October 15 – 30 (2021)

No. 671-672

Editorial Team: Puspa Aryal and Uma Dhungel

For the 671th - 672th issues of Headlines Himalaya, we reviewed researches from six sources and selected 23 researches from four countries. We selected two researches from Nepal and 21 researches from other Himalayan countries (India, China, and Pakistan).

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Nepal-Himalaya

POPULATION LEVELS AND PRODUCTIVITY OF THE HIMALAYAN GRIFFON (*GYPS HIMALAYENSIS*) IN BAITADI DISTRICT, NEPAL

Krishna Prasad Bhusal, Hiru Lal Dangaura, and Christopher J.W. McClure

Environmental Challenges 5: 100318

The Himalayan Griffon (*Gyps himalayensis*), is a globally near threatened vulture species that nests in the cliffs of mid hills and Himalayas of Nepal. We studied the Himalayan Griffon breeding population and productivity on its prominent nesting sites at Khodpe in Baitatdi district, Nepal from 2010 to 2020. In 2012, this district was declared free of veterinary diclofenac—a drug that caused precipitous population declines in *Gyps* vultures across south Asia during the late 1990s and early 2000s. We therefore expected an increase in the number of occupied nests during our study. However, the growth rates for the number of occupied nests, fledglings, and young fledged per nest during our study were negative with confidence limits overlapping zero. It is possible the population is limited by the availability of nest sites, although we also cannot discount carcass poisoning, electrocution, persecution, and forest fire as limiting factors. This colony is one of the few remaining known breeding sites within the Kailash

Sacred Landscape, Nepal. We therefore recommend continued and enhanced monitoring of this species as well as continuation of conservation efforts.

For further readings: <https://doi.org/10.1016/j.envc.2021.100318>

RESPONSE OF THE LAPRAK, NEPAL, LANDSLIDE TO THE 2015 M_w 7.8 GORKHA EARTHQUAKE

William C. Haneberg, Sarah E. Johnson, and Narayan Gurung

Natural Hazards 109 (2021): 1-8

Coseismic displacements estimated from comparison before-and-after satellite images suggest that the large and intermittently active landslide upon which the village of Laprak, Nepal, was built moved a geometric mean of 80 cm (95% mean confidence interval of 74–86 cm) or less during the 2015 M_w 7.8 Gorkha earthquake. The village was located about 6 km from the earthquake epicenter. We used published geotechnical and topographic data collected as part of a previous study of the landslide, publicly available earthquake information, and a physically plausible range of pre-monsoon dry season pore-pressure coefficients to constrain Monte Carlo simulations based on six published simplified Newmark models of coseismic displacement in natural slopes. Kolmogorov–Smirnov statistics show that five of the models produced coseismic displacement distributions in good to marginal agreement with our satellite image measurements. A seventh result obtained by combining results from the six individual models to balance the strengths and weaknesses of each also produced good agreement. The agreement between our observed and simulated results suggests that simplified Newmark models may be reliable tools for reconnaissance level earthquake hazard assessment in mountainous areas if probabilistic approaches are used to account for input parameter uncertainty.

For further reading: <https://doi.org/10.1007/s11069-021-05067-z>

India-Himalaya

ANALYSING CHALLENGES AND STRATEGIES IN LAND PRODUCTIVITY IN SIKKIM HIMALAYA, INDIA

Prabuddh Kumar Mishra, Aman Rai, Kamal Abdelrahman, Suresh Chand Rai, and Anuj Tiwari

Sustainability 13: 11112

Agriculture is the major source of livelihood in rural areas and is considered the backbone of the Indian economy. In Sikkim, agriculture is being practiced by 80% of the rural population, and having no other major livelihood options has created immense pressure on the farmers and agricultural land. Agriculture sector is under great stress as the farmers are being confronted by various challenges in Sikkim Himalaya in recent years, such as land degradation, climate change and socio-economic problems. Despite the number of indigenous agriculture management methods being practised in Sikkim Himalaya, the agricultural production system is weakening. In this context, this paper presents an analysis of challenges faced by indigenous communities, local farmers and potential sustainable strategies for their management in Rani Khola watershed of Sikkim Himalaya. Data and information were collected by field observation, questionnaire surveys of 300 households, key informant interviews and focus group discussions conducted during 2017-18. Data processing and analysis were carried out with a combination of techniques, such as the application of remote sensing (RS), geographic information system

(GIS)-based data processing and descriptive statistics. Major challenges identified in the watershed are water scarcity (80%), climate change (88%), soil erosion and runoff (72%), higher investment cost (100%), lack of irrigation facilities (77%), fragmentation and size of landholdings (100), human–wildlife conflict (59%) and pests and disease (60%). Some possibilities and innovations that could address these problems are the use and retaining of various indigenous soil and water conservation (SWC) measures, diversified farming systems, community involvement in the government development process, better irrigation facilities, strengthening the local economy, coordinated planning between stakeholders and development of market feedback mechanism within the system.

For further readings: <https://doi.org/10.3390/su131911112>

POSITIVE EFFECTS OF COVID-19 LOCKDOWN ON RIVER WATER QUALITY: EVIDENCE FROM RIVER DAMODAR, INDIA

Baisakhi Chakraborty, Biswajit Bera, Partha Pratim Adhikary, Sumana Bhattacharjee, Sambhunath Roy, Soumik Saha, Anitabha Ghosh, Debashish Sengupta, and Pravat Kumar Shit

Scientific Reports 11: 20140

The global economic activities were completely stopped during COVID-19 lockdown and continuous lockdown partially brought some positive effects for the health of the total environment. The multiple industries, cities, towns and rural people are completely depending on large tropical river Damodar (India) but in the last few decades the quality of the river water is being significantly deteriorated. The present study attempts to investigate the river water quality (RWQ) particularly for pre- lockdown, lockdown and unlock period. We considered 20 variables per sample of RWQ data and it was analyzed using novel Modified Water Quality Index (MWQI), Trophic State Index (TSI), Heavy Metal Index (HMI) and Potential Ecological Risk Index (RI). Principal component analysis (PCA) and Pearson's correlation (r) analysis are applied to determine the influencing variables and relationship among the river pollutants. The results show that during lockdown 54.54% samples were brought significantly positive changes applying MWQI. During lockdown, HMI ranged from 33.96 to 117.33 with 27.27% good water quality which shows the low ecological risk of aquatic ecosystem due to low mixing of toxic metals in the river water. Lockdown effects brought river water to oligotrophic/meso-eutrophic condition from eutrophic/hyper-eutrophic stage. Rejuvenation of river health during lockdown offers ample scope to policymakers, administrators and environmentalists for restoration of river health from huge anthropogenic stress.

For further reading: <https://doi.org/10.1038/s41598-021-99689-9>

DEFICIENCY OF PHYTO-AVAILABLE SULPHUR, ZINC, BORON, IRON, COPPER AND MANGANESE IN SOILS OF INDIA

Arvind Kumar Shukla, Sanjib Kumar Behera, Chandra Prakash, Ajay Tripathi, Ashok Kumar Patra, Brahma Swaroop Dwivedi, Vivek Trivedi, Ch. Srinivasa Rao, Suresh Kumar Chaudhari, Soumitra Das, and Anil Kumar Singh

Scientific Reports 11: 19760

Nutrient deficiencies in soil–crop contexts and inappropriate managements are the important reasons for low crop productivity, reduced nutritional quality of agricultural produce and animal/human malnutrition, across the world. The present investigation was carried out to evaluate nutrient deficiencies of sulphur (S) and micronutrients [zinc (Zn), boron (B), iron (Fe), copper (Cu) and manganese (Mn)] in agricultural soils of India for devising effective management strategies to achieve sustainable crop production, improved nutritional quality in crops and better animal/human health. A total of 2,42,827 surface (0–15 cm depth) soil samples were collected from agriculture

fields of 615 districts lying in 28 states of India and were analysed for available S and micronutrients concentration. The study was carried out under the aegis of All India Coordinated Research Project on Micro- and Secondary-Nutrients and Pollutant Elements in Soils and Plants. The mean concentrations were $27.0 \pm 29.9 \text{ mg kg}^{-1}$ for available S, $1.40 \pm 1.60 \text{ mg kg}^{-1}$ for available Zn and $1.40 \pm 4.70 \text{ mg kg}^{-1}$ for available B, $31.0 \pm 52.2 \text{ mg kg}^{-1}$ for available Fe, $2.30 \pm 3.50 \text{ mg kg}^{-1}$ for available Cu and $17.5 \pm 21.4 \text{ mg kg}^{-1}$ for available Mn. There were variable and widespread deficiencies of S and micronutrients in different states. The deficiencies (acute deficient + deficient + latent deficiency) of S (58.6% of soils), Zn (51.2% of soils) and B (44.7% of soils) were higher compared to the deficiencies of Fe (19.2% of soils), Cu (11.4% of soils) and Mn (17.4% of soils). Out of 615 districts, > 50% of soils in 101, 131 and 86 districts were deficient in available S, available Zn and available B, respectively. Whereas, > 25% of soils in 83, 5 and 41 districts had deficiencies of available Fe, available Cu and available Mn, respectively. There were occurrences of 2-nutrients deficiencies such S + Zn (9.30% of soils), Zn + B (8.70% of soils), S + B (7.00% of soils) and Zn + Fe (5.80% of soils) to a greater extent compared to the deficiencies of Zn + Mn (3.40% of soils), S + Fe (3.30% of soils), Zn + Cu (2.80% of soils) and Fe + B (2.70% of soils). Relatively lower % of soils were deficient in 3-nutrients (namely S + Zn + B, S + Zn + B and Zn + Fe + B), 4-nutrients (namely Zn + Fe + Cu + Mn) and 5-nutrients (namely Zn + Fe + Cu + Mn + B) simultaneously. The information regarding the distribution of deficiencies of S and micronutrients (both single and multi-nutrients) could be used by various stakeholders for production, supply and application of right kind of fertilizers in different districts, states and agro-ecological regions of India for better crop production, crop nutritional quality, nutrient use efficiency, soil health and for tackling human and animal malnutrition.

For further reading: <https://doi.org/10.1038/s41598-021-99040-2>

China Himalaya

CALCULATION OF COMPENSATION FOR FOREST ECOSYSTEM DAMAGE BY ENGINEERING PROJECTS IN GUANGDONG PROVINCE, CHINA

Xitao Yang, Yunxian Yan, Shuangshuang Li, and Huijian Hu

Environmental Challenges 5: 100316

In China, ecological damage compensation refers to the punitive ecological compensation for ecosystem damage by human activities, and it internalizes negative externalities by adjusting the interest relationship between ecological protectors and destroyers. Making reasonable and scientific payment standard of ecological damage compensation is an important factor to implement ecological damage compensation mechanism. Here, we take the forest ecosystem damage due to engineering projects in Guangdong Province, China as an example to discuss a calculation method for this compensation. Based on the forest ecosystem service (ES) value, this method comprehensively measures the degree, area, and duration of forest ecosystem damage due to various engineering projects. The contribution of construction projects to socioeconomic development and the importance of ecologically sensitive areas is also considered. Finally, a rapid, quantified, and differentiated compensation standard for ecological damage is obtained. This standard provides a scientific basis for balancing the interests between ecological protection and economic development. Thus, our results have certain guiding significance for the protection and sustainable development of the various types of ecosystems.

For further readings: <https://doi.org/10.1016/j.envc.2021.100316>

RISK ASSESSMENT OF *ANOPHELES PHILIPPINENSIS* AND *ANOPHELES NIVIPES* (DIPTERA: CULICIDAE) INVADING CHINA UNDER CLIMATE CHANGE

Chao Li, Yuan Gao, Nan Chang, Delong Ma, Ruobing Zhou, Zhe Zhao, Jun Wang, Qinfeng Zhang, and Qiyong Liu

Biology 10: 998

Anopheles philippinensis and *Anopheles nivipes* are morphologically similar and are considered to be effective vectors of malaria transmission in northeastern India. Environmental factors such as temperature and rainfall have a significant impact on the temporal and spatial distribution of disease vectors driven by future climate change. In this study, we used the maximum entropy model to predict the potential global distribution of the two mosquito species in the near future and the trend of future distribution in China. Based on the contribution rate of environmental factors, we analyzed the main environmental factors affecting the distribution of the two mosquito species. We also constructed a disease vector risk assessment index system to calculate the comprehensive risk value of the invasive species. Precipitation has a significant effect on the distribution of potentially suitable areas for *Anopheles philippinensis* and *Anopheles nivipes*. The two mosquito species may spread in the suitable areas of China in the future. The results of the risk assessment index system showed that the two mosquito species belong to the moderate invasion risk level for China. China should improve the mosquito vector monitoring system, formulate scientific prevention and control strategies and strictly prevent foreign imports.

For further readings: <https://doi.org/10.3390/biology10100998>

PREDICTING THE POTENTIAL DISTRIBUTION OF *HYLOMECON JAPONICA* IN CHINA UNDER CURRENT AND FUTURE CLIMATE CHANGE BASED ON MAXENT MODEL

Zhen Cao, Lei Zhang, Xinxin Zhang, and Zengjun Guo

Sustainability 13: 11253

Hylomecon japonica is considered a natural medicinal plant with anti-inflammatory, anticancer and antibacterial activity. The assessment of climate change impact on its habitat suitability is important for the wild cultivation and standardized planting of *H. japonica*. In this study, the maximum entropy model (Maxent) and geographic information system (ArcGIS) were applied to predict the current and future distribution of *H. japonica* species, and the contributions of variables were evaluated by using the jackknife test. The area under the receiver operating characteristic curve (AUC) value confirmed the accuracy of the model prediction based on 102 occurrence records. The predicted potential distributions of *H. japonica* were mainly concentrated in Jilin, Liaoning, Shaanxi, Chongqing, Henan, Heilongjiang and other provinces (adaptability index > 0.6). The jackknife experiment showed that the precipitation of driest month (40.5%), mean annual temperature (12.4%), the precipitation of wettest quarter (11.6%) and the subclass of soil (9.7%) were the most important factors affecting the potential distribution of *H. japonica*. In the future, only under the shared socioeconomic Pathway 245 (SSP 245) scenario model in 2061–2080, the suitable habitat area for *H. japonica* is expected to show a significant upward trend. The area under other scenarios may not increase or decrease significantly

For further readings: <https://doi.org/10.3390/su132011253>

THE IMPACT OF AIR QUALITY ON INBOUND TOURIST ARRIVALS OVER CHINA BASED ON GREY RELATIONAL ANALYSIS

Wei Zhang, Ziqiang Li, Yujie Zhang, Elly Yaluk, and Li Li

Air pollution has a significant impact on tourism; however, research in this area is still limited. In this study, we applied grey relational analysis to panel data from 31 provinces in China and evaluated the relationship between air quality and inbound tourist arrivals. The study focused on provincial-level disparities for the different key air quality evaluation standards during 2009–2012 and 2013–2019. For instance, we considered PM₁₀, SO₂, NO₂ and the excellent and good ratings of Air Pollution Index (API) during 2009–2012 and the additional PM_{2.5}, CO, O₃ and the excellent and good ratings of Air Quality Index (AQI) from 2013 to 2019. Results indicate that: (1) Inbound tourist arrivals are significantly and positively affected by ambient air quality, and the impact from 2013 to 2019 was greater than that from 2009 to 2012; (2) there is regional diversity in inbound tourist arrivals, and the impact of the different air quality indicators varies; (3) inbound tourists showed greater sensitivity to air pollution under the AQI standard; (4) the impact of air quality indicators on the inbound tourist arrivals shows grey relational order, and the concentration of PM_{2.5}, PM₁₀ and SO₂ have less impact than NO₂, CO and O₃ on changes in tourism numbers; (5) consistency in the air quality impact on foreign tourists and compatriot tourists from HK, MO and TW varies by air quality indicators. This study highlights the need for appropriate measures to improve air quality for high-quality and sustainable development of inbound tourism.

For further readings: <https://doi.org/10.3390/su131910972>

RESEARCH ON THE CONCENTRATION, POTENTIAL AND MISSION OF SCIENCE AND TECHNOLOGY INNOVATION IN CHINA

Ziyang Li, Hongwei Shi, and Hongda Liu

PLoS ONE 16: e0257636

Building an innovative country is a clear strategy for my country to promote economic, industrial, and social development. Mastering the status quo and late-comer advantages of technological innovation in my country's provinces is an important prerequisite for accurately positioning the innovation mission of each province. This article innovatively uses innovation concentration and innovation potential to measure and analyze the provincial scientific and technological innovation level at the inventory and incremental level. Taking the cross-sectional data of 31 provinces in my country in 2019 as a sample, construct the provincial "innovation potential-innovation concentration" evaluation The index system, through the entropy weight method, determines the weight of each evaluation index, and uses the TOPSIS method to conduct multi-objective evaluation of each province. According to the calculation results of provincial scientific and technological innovation concentration and innovation potential, an in-depth interpretation of the spatial distribution of my country's provincial scientific and technological innovation echelon is carried out. The study found that: the innovation concentration and innovation potential matrix echelon division of my country's provinces is divided into four echelons, namely high innovation. The echelon of drivers with high concentration and high innovation potential, the echelon of followers with high innovation concentration and low innovation potential, the echelon of dark horses with low innovation concentration and high innovation potential, and the echelon of latecomers with low innovation concentration and low innovation potential. Finally, the positioning strategy of the innovation mission of each echelon province is put forward to provide reference and enlightenment for the construction of innovative provinces and the promotion of a scientific and technological power.

For further reading: <https://doi.org/10.1371/journal.pone.0257636>

GENETIC DIVERSITY ANALYSIS OF THE INVASIVE GALL PEST *LEPTOCYBE INVASA* (HYMENOPTERA: APODEMIDAE) FROM CHINA

Xin Peng, Hantang Wang, Chunhui Guo, Ping Hu, Lei Xu, Jing Zhou, Zhirou Ding, and Zhende Yang

PLoS ONE 16: e0258610

Leptocybe invasa Fisher et LaSalle is a global invasive pest that seriously damages *Eucalyptus* plants. Studying the genetic diversity, genetic structure and introgression hybridization of *L. invasa* in China is of great significance for clarifying the breeding strategy, future invasion and diffusion trends of *L. invasa* in China and developing scientific prevention and control measures. Genetic diversity and phylogenetic analyses of 320 *L. invasa* female adults from 14 geographic populations in China were conducted using 10 polymorphic microsatellite loci (SSRs) and mitochondrial DNA cytochrome oxidase I gene sequences (COIs). (1) The Bayesian phylogenetic tree and haplotype network diagram showed that only haplotype Hap3 existed in *L. invasa* lineage B in China, while haplotypes Hap1 and Hap2 existed in lineage A, among which haplotype Hap2 was found for the first time. The nucleotide and haplotype diversities of lineage A were higher than those of lineage B. (2) The SSR genetic diversity of the Wuzhou Guangxi, Ganzhou Jiangxi and Panzihua Sichuan populations was higher than that of the other 11 populations, and the SSR genetic diversity of lineage A was higher than that of lineage B. (3) The AMOVA analysis of mitochondrial COI data showed that 75.55% of the variation was among populations, and 99.86% of the variation was between lineages, while the AMOVA analysis of nuclear SSR data showed that 35.26% of the variation was among populations, and 47.04% of the variation was between lineages. There were obvious differences in the sources of variation between the COI and SSR data. (4) The optimal K value of COI and SSR data in structure analysis was 2, and PCoA analysis also divided the dataset into two obvious categories. The UPMGA phylogenetic tree based on SSR data clustered 14 geographic species into two groups. The results of genetic structure analysis supported the existence of two lineages, A and B, in China. (5) Structural analysis showed that there was obvious introgressive hybridization in Wuzhou Guangxi, Ganzhou Jiangxi, Panzihua Sichuan and other populations. These results suggest that lineage introgressive hybridization has occurred in the *L. invasa* population in China. The introgressive hybridization degree and genetic diversity of lineage A are obviously higher than those of lineage B. Lineage introgressive hybridization may be the driving force for further *L. invasa* invasion and diffusion in China in the future.

For further reading: <https://doi.org/10.1371/journal.pone.0258610>

URBAN DEVELOPMENT TREND ANALYSIS AND SPATIAL SIMULATION BASED ON TIME SERIES REMOTE SENSING DATA: A CASE STUDY OF JINAN, CHINA

Yanghua Zhang, Liang Zhao, Hu Zhao, and Xiaofeng Gao

PLoS ONE 16: e0257776

Uncontrolled urban growth detracts from healthy urban development. Understanding urban development trends and predicting future urban spatial states is of great practical significance. In order to comprehensively analyze urbanization and its effect on vegetation cover, we extracted urban development trends from time series DMSP/OLS NTL and NDVI data from 2000 to 2015, using a linear model fitting method. Six urban development trend types were identified by clustering the linear model parameters. The identified trend types were found to accurately reflect the on-ground conditions and changes in the Jinan area. For example, a high-density, stable urban type was found in the city center while a stable dense vegetation type was found in the mountains to the south. The SLEUTH model was used for urban growth simulation under three scenarios built on the urban

development analysis results. The simulation results project a gentle urban growth trend from 2015 to 2030, demonstrating the prospects for urban growth from the perspective of environmental protection and conservative urban development.

For further reading: <https://doi.org/10.1371/journal.pone.0257776>

GEOGRAPHICAL SPATIAL DISTRIBUTION AND PRODUCTIVITY DYNAMIC CHANGE OF EUCALYPTUS PLANTATIONS IN CHINA

YuXing Zhang and XueJun Wang

Scientific Reports 11: 19764

The *Eucalyptus* spp. is fast-growing and is usually harvested at a young age, which enables efficient and sufficient timber supply. However, its negative impact on soil fertility incurs wide debates. Therefore it is necessary to study on the growing traits of eucalyptus to provide scientific guidance on its plantation management and associated policy-making. In this study, we collected the sample plot data from 9 National Forest Inventories (NFIs) during 1973–2018, China Forest-Land Database Map in 2003 and 2016, as well as climate and elevation data and analyzed how the spatial distribution of eucalyptus plantations in China changes with time. We quantitatively characterized and evaluated the productivity, carbon accumulation capacity, and abandonment rate of eucalyptus plantations. Statistical models on how eucalyptus productivity and abandonment rate change with time are established to evaluate the soil fertility and feasibility for growing eucalyptus plantations and predict the temporal productivity variation. The results show that regions with annual mean temperature of 19–21 °C, annual precipitation of 1400–1600 mm, and elevation of 0–300 m above sea level is most suitable for the growth of eucalyptus. The annual mean productivity of eucalyptus plantations ranges from 4.14–8.57 m³ hm⁻² a⁻¹. Higher productivity (9.32–10.88 m³ hm⁻² a⁻¹) could be reached in newly cultivated lands. Based on data from the 9th inventory (2014–2018), the mean carbon fixation of eucalyptus is 5.29 t hm⁻² a⁻¹, which is 2.95 and 2.18 times greater than *Pinus massoniana* Lamb. And *Cunninghamia lanceolata* Lamb. Its plantations area accounts for 6.85% of total plantations in China, but it contributes to more than 17.96% of total annual cut from plantations. In Guangdong and Guangxi provinces, areas of eucalyptus plantations are 30.32% and 34.91% of the total plantation area in each province respectively, but eucalyptus plantations contribute to 66.29% and 49.97% of harvested timber stock volume. Eucalyptus plantation consumes soil fertility significantly. The cumulative abandonment rate (based on area) is about 25%, 50%, and 75% after 5, 10, and 20 years of growing eucalyptus, respectively. The soil fertility decreases significantly after 50 years of growing eucalyptus continuously. In such case, it is difficult to restore the soil fertility. It is suggested that with improved management measures such as proper crop rotation rotating crops properly, it is possible for the abandoned plantations to be reused for growing eucalyptus. Currently the rates of replanting eucalyptus are still below 20% and 30% after 20 and 50 years of without growing eucalyptus, respectively. Although the proportion of eucalyptus area replanted to its abandoned area is now less than 20% in 20 years and less than 30% in 50 years, there is potential to keep increasing the replanting rate. We argue that developing eucalyptus plantations could contribute to global timber supply, help to protect natural forests, increase global carbon storage and fixation, and help to slow down global warming. In conclusion, we should not stop growing eucalyptus despite its high consumption of soil fertility.

For further reading: <https://doi.org/10.1038/s41598-021-97089-7>

DYNAMICS IN C, N, AND P STOICHIOMETRY AND MICROBIAL BIOMASS FOLLOWING SOIL DEPTH AND VEGETATION TYPES IN LOW MOUNTAIN AND HILL REGION OF CHINA

Wenting Jiang, Lei Gong, Lihui Yang, Shuping He, and Xiaohu Liu

Scientific Reports 11: 19631

Changes in soil carbon (C): nitrogen (N): phosphorus (P) stoichiometry have great significance on understand regulatory mechanism and restoration of ecosystem functions. However, the responses of C, N and P stoichiometry to soil depth and different vegetation types remains elusive. To address this problem, the study aims to explore the effects of soil depth and vegetation types on soil C, N, and P stoichiometry, and their relationships with microbial biomass in low mountain and hill region of China. The results indicated that soil SOC and TN concentrations in oak forest were markedly higher than those in grassland, and the vertical distribution of SOC and TN concentration showed an inverted triangle trend as the soil deepens. However, there was no significant change in soil TP concentration among 0–20 cm, 20–40 cm, and 40–60 cm. Soil C/N among different layers (0–20, 20–40, and 40–60 cm) is narrower fluctuation margin, and its value is basically stable within a certain range (11–14.5). Both soil C/P and N/P showed significant variability in different vegetation types, and soil N/P decreased with soil layers deepen. Both the microbial biomass C (MBC) and N (MBN) showed a decreasing trend with the increase of soil depth, and three soil layers from high to low was: oak forest > pine forest > grassland. Our results will potentially provide useful information for the vegetation restoration and forest management and great significance to enrich the scientific theory of ecological stoichiometry.

For further reading: <https://doi.org/10.1038/s41598-021-99075-5>

RISK ASSESSMENT AND SOURCE APPORTIONMENT OF TRACE ELEMENTS IN MULTIPLE COMPARTMENTS IN THE LOWER REACH OF THE JINSHA RIVER, CHINA

Wenyan He, Fei Li, Jiang Yu, Min Chen, Yun Deng, Jia Li, Xiliang Tang, Zhuoyu Chen, and Zhongluan Yan

Scientific Reports 11: 20041

Studies on trace element (TE) pollution in abiotic matrices have typically focused on water, sediment, and soil, either separately or in pairs. The importance of multi-media connectivity has been ignored. This study analyzed the concentrations of 6 TEs in three connected environmental compartments of a 28-km section of the lower reach of the Jinsha River. The ecological risk posed by TEs was higher in soil than in sediment. The contribution of exposure pathways to human health risk were ranked as ingestion > dermal contact > inhalation. An improved regional environmental risk index (*RERI*) method was then developed to evaluate the comprehensive risk on both ecology and human health caused by TEs. The average *RERI* value was generally higher in the wet season (0.42) than in the dry (0.41) and dry-to-wet transition seasons (0.08) because of the combined effects of the high TE concentrations in riparian soil and the long exposure time. Source apportionment indicated that industrial activities, weathering of parent rock, and agricultural activities were possible sources of TEs in this region. The methods and results of this study could inform local environmental management and provide references for similar cases wherein multiple compartments of river systems should be considered.

For further reading: <https://doi.org/10.1038/s41598-021-99626-w>

EFFECTS OF SULFURIC, NITRIC, AND MIXED ACID RAIN ON THE DECOMPOSITION OF FINE ROOT LITTER IN SOUTHERN CHINA

Xin Liu, Miaoqing Meng, Yong Zhang, Chong Li, Shilin Ma, Qinyu Li, Qiong Ren, Yinlong Zhang, and Jinchi Zhang

China has been increasingly subject to significant acid rain, which has negative impacts on forest ecosystems. Recently, the concentrations of NO_3^- in acid rain have increased in conjunction with the rapid rise of nitrogen deposition, which makes it difficult to precisely quantify the impacts of acid rain on forest ecosystems. For this study, mesocosm experiments employed a random block design, comprised of ten treatments involving 120 discrete plots ($0.6 \text{ m} \times 2.0 \text{ m}$). The decomposition of fine roots and dynamics of nutrient loss were evaluated under the stress of three acid rain analogues (e.g., sulfuric ($\text{SO}_4^{2-}/\text{NO}_3^-$ 5:1), nitric (1:5), and mixed (1:1)). Furthermore, the influences of soil properties (e.g., soil pH, soil total carbon, nitrogen, C/N ratio, available phosphorus, available potassium, and enzyme activity) on the decomposition of fine roots were analyzed. The soil pH and decomposition rate of fine root litter decreased when exposed to simulated acid rain with lower pH levels and higher NO_3^- concentrations. The activities of soil enzymes were significantly reduced when subjected to acid rain with higher acidity. The activities of soil urease were more sensitive to the effects of the $\text{SO}_4^{2-}/\text{NO}_3^-$ (S/N) ratio of acid rain than other soil enzyme activities over four decomposition time periods. Furthermore, the acid rain pH significantly influenced the total carbon (TC) of fine roots during decomposition. However, the S/N ratio of acid rain had significant impacts on the total nitrogen (TN). In addition, the pH and S/N ratio of the acid rain had greater impacts on the metal elements (K, Ca, and Al) of fine roots than did TC, TN, and total phosphorus. Structural equation modeling results revealed that the acid rain pH had a stronger indirect impact (0.757) on the decomposition rate of fine roots (via altered soil pH and enzyme activities) than direct effects. However, the indirect effects of the acid rain S/N ratio (0.265) on the fine root decomposition rate through changes in soil urease activities and the content of litter elements were lower than the pH of acid rain. Our results suggested that the acid rain S/N ratio exacerbates the inhibitory effects of acid rain pH on the decomposition of fine root litter.

For further reading: <https://doi.org/10.1186/s13717-021-00334-0>

SOLAR RADIATION EFFECTS ON LEAF NITROGEN AND PHOSPHORUS STOICHIOMETRY OF CHINESE FIR ACROSS SUBTROPICAL CHINA

Ran Tong, Yini Cao, Zhihong Zhu, Chenyang Lou, Benzhi Zhou, and Tonggui Wu

Solar radiation (SR) plays critical roles in plant physiological processes and ecosystems functions. However, the exploration of SR influences on the biogeochemical cycles of forest ecosystems is still in a slow progress, and has important implications for the understanding of plant adaption strategy under future environmental changes. Herein, this research was aimed to explore the influences of SR on plant nutrient characteristics, and provided theoretical basis for introducing SR into the establishment of biochemical models of forest ecosystems in the future researches. We measured leaf nitrogen (N) and phosphorus (P) stoichiometry in 19 Chinese fir plantations across subtropical China by a field investigation. The direct and indirect effects of SR, including global radiation (Global R), direct radiation (Direct R) and diffuse radiation (Diffuse R) on the leaf N and P stoichiometry were investigated. The linear regression analysis showed that leaf N concentration had no association with SR, while leaf P concentration and N:P ratio were negatively and positively related to SR, respectively. Partial least squares path model (PLS-PM) demonstrated that SR (e.g. Direct R and Diffuse R), as a latent variable, exhibited direct correlations with leaf N and P stoichiometry as well as the indirect correlation mediated by soil P content. The direct associations (path coefficient = -0.518) were markedly greater than indirect associations (path coefficient = -0.087). The covariance-based structural equation modeling (CB-SEM) indicated that SR had direct effects on leaf P concentration (path coefficient = -0.481), and weak effects on leaf N concentration. The high SR

level elevated two temperature indexes (mean annual temperature, MAT; $\geq 10^{\circ}\text{C}$ annual accumulated temperature, $\geq 10^{\circ}\text{C}$ AAT) and one hydrological index (mean annual evapotranspiration, MAE), but lowered the soil P content. MAT, MAE and soil P content could affect the leaf P concentration, which cause the indirect effect of SR on leaf P concentration (path coefficient = 0.004). Soil N content had positive effect on the leaf N concentration, which was positively and negatively regulated by MAP and $\geq 10^{\circ}\text{C}$ AAT, respectively. These results confirmed that SR had negatively direct and indirect impacts on plant nutrient status of Chinese fir based on a regional investigation, and the direct associations were greater than the indirect associations. Such findings shed light on the guideline of taking SR into account for the establishment of global biogeochemical models of forest ecosystems in the future studies.

For further reading: <https://doi.org/10.1186/s40663-021-00344-6>

ESTIMATION OF THE GROUNDWATER BALANCE OF A MOUNTAINOUS BASIN BASED ON LONG-TERM STREAMFLOW DATA: A CASE STUDY OF THE TAO'ER RIVER BASIN, CHINA

Weifei Yang, Changlai Xiao, Zhihao Zhang, Xiujuan Liang, and Zhang Fang

Environmental Earth Sciences 80: 689

Groundwater resources of mountainous basins are particularly important for maintaining the ecological environment and downstream domestic water demands. Quantitative analysis of the groundwater balance in a mountainous area is very important for monitoring and management of groundwater resources. Conventional analysis methods usually require extensive field investigation for estimation of hydrogeological parameters, which can be challenging in a mountainous basin. This study applied a series of methods based on daily streamflow data to estimate the groundwater balance of the Tao'er River Basin in Northeast China and also analyzed the response characteristics of effective groundwater recharge to rainfall. The results showed that groundwater recharge in the Tao'er River Basin occurs mainly through rainfall percolation in summer, and that groundwater is rapidly discharged in the form of baseflow and evapotranspiration. Baseflow discharge accounted for $\sim 93\%$ of recharge, whereas evapotranspiration accounted for the remaining $\sim 7\%$. The multi-year average effective groundwater recharge values of the Chaersen, Suolun, Dashizhai and Zhenxi sub-basins were 59.7 mm, 62.4 mm, 19.6 mm and 34.6 mm, respectively. Groundwater recharge showed a slow and weak response to rainfall before the rainiest month (January–July). In general, the recharge peak appeared ~ 4 days after a rainfall event, and the recharge process continued for 13–16 days. However, the response was relatively rapid and obvious after the rainiest month (August to December). The recharge peak appeared ~ 3 days after a rainfall event, and the recharge process continued for 7–9 days.

For further reading: <https://doi.org/10.1007/s12665-021-09974-z>

MITIGATING SPATIAL CONFLICT OF LAND USE FOR SUSTAINABLE WETLANDS LANDSCAPE IN LI-XIA-RIVER REGION OF CENTRAL JIANGSU, CHINA

Yan Sun, Xiaoping Ge, Junna Liu, Yuanyuan Chang, Gang-Jun Liu, and Fu Chen

Sustainability 13: 11189

Li-Xia-river Wetlands make up the biggest freshwater marsh in East China. Over the last decades, social and economic developments have dramatically altered the natural wetlands landscape. Mitigating land use conflict is beneficial to protect wetlands, maintain ecosystem services, and coordinate local socioeconomic development.

This study employed multi-source data and GIS-based approaches to construct a composite index model with the purpose of quantitatively evaluating the intensity of land use conflict in Li-Xia-river Wetlands from 1978 to 2018. The results showed that the percentage of the wetlands' area declined from 20.3% to 15.6%, with an overall reduction rate of 23.2%. The mean index of land use conflict increased from 0.15 to 0.35, which suggests that the conflict intensity changed from "no conflict" to "mild conflict." The number of severe conflict units increased by about 25 times. A conspicuous spatial variation of land use conflict was observed across different periods, although taking land for agricultural activities was the overriding reason for wetlands reduction. However, in recent years, urban sprawl has posed the greatest threat to Li-Xia-river Wetlands. Coordinating land use conflict and formulating a practical strategy are the initial imperative steps to mitigate the threat to wetlands.

For further reading: <https://doi.org/10.3390/su132011189>

RELATING LAND USE/COVER AND LANDSCAPE PATTERN TO THE WATER QUALITY UNDER THE SIMULATION OF SWAT IN A RESERVOIR BASIN, SOUTHEAST CHINA

Kaige Lei, Yifan Wu, Feng Li, Jiayu Yang, Mingtao Xiang, Yi Li, and Yan Li

Sustainability 13: 11067

Understanding the relationship between land use/cover pattern and water quality could provide guidelines for non-point source pollution and facilitate sustainable development. The previous studies mainly relate the land use/cover of the entire region to the water quality at the monitoring sites, but the water quality at monitoring sites did not totally reflect the water environment of the entire basin. In this study, the land use/cover was monitored on Google Earth Engine in Tang-Pu Reservoir basin, China. In order to reflect the water quality of the whole study area, the spatial distribution of the determinants for water quality there, i.e., the total nitrogen and total phosphorus (TN&TP), were simulated by the Soil and Water Assessment Tool (SWAT). The redundancy analysis explored the correlations between land use/cover pattern and simulated TN&TP. The results showed that: (1) From 2009 to 2019, forest was the dominant land cover, and there was little land use/cover change. The landscape fragmentation increased, and the connectivity decreased. (2) About 25% TP concentrations and nearly all the TN concentrations at the monitoring points did not reach drinking water standard, which means nitrogen and phosphorus pollution were the most serious problems. The highest output per unit TN&TP simulated by SWAT were 44.50 kg/hm² and 9.51 kg/hm² and occurred in areas with highly fragile landscape patterns. (3) TN&TP correlated positively with cultivated and construction land but negatively with forest. The correlation between forest and TN&TP summited at 500–700-m buffer and construction land at 100-m buffer. As the buffer size increased, the correlation between the cultivated land, and the TN weakened, while the correlation with the TP increased. TN&TP correlated positively with the Shannon's Diversity Index and negatively with the Contagion Index. This study provides a new perspective for exporting the impact of land use/cover pattern on water quality.

For further reading: <https://doi.org/10.3390/su131911067>

Pakistan- Himalaya

A SUSTAINABLE IRRIGATION SYSTEM FOR SMALL LANDHOLDINGS OF RAINFED PUNJAB, PAKISTAN

Marjan Aziz, Sultan Ahmad Rizvi, Muhammad Azhar Iqbal, Sairah Syed, Muhammad Ashraf, Saira Anwer, Muhammad Usman, Nazia Tahir, Azra Khan, Sana Asghar, and Jamil Akhtar

Drip irrigation has long been proven beneficial for fruit and vegetable crops in Pakistan, but the only barrier in its adoption is the high cost of installation for small landholders, which is due to overdesigning of the system. In the present study, the cost of a conventional drip irrigation system was reduced by redesigning and eliminating the heavy filtration system (i.e., hydrocyclon, sand media, disc filters (groundwater source), pressure gauges, water meters, and double laterals). Purchasing the drip system from local vendors also reduced the cost. Field trials were conducted during 2015 and 2016 to observe the productive and economic effects of low-cost drip irrigation on vegetables (potato, onion, and chilies) and fruits (olive, peach, and citrus). The low-cost drip irrigation system saved 50% cost of irrigation and increased 27–54% net revenue in comparison with the furrow irrigation system. Further, water use efficiency (WUE) was found from 3.91–13.30 kg/m³ and 1.28–4.89 kg/m³ for drip irrigation and furrow irrigation systems, respectively. The physical and chemical attributes of vegetables and fruits were also improved to a reasonably good extent. The present study concluded that low-cost drip irrigation increased the yield by more than 20%, as compared with traditional furrow irrigation, and thus, it is beneficial for the small landholders (i.e., less than 2 hectares).

For further readings: <https://doi.org/10.3390/su132011178>

PHYTO-ECOLOGICAL STUDIES AND DISTRIBUTION PATTERN OF PLANT SPECIES AND COMMUNITIES OF DHIRKOT, AZAD JAMMU AND KASHMIR, PAKISTAN

Mevish Mumshad, Israr Ahmad, Shujaul Mulk Khan, Abdullah, Khadija Rehman, Mohammad Islam, Shazia Sakhi, Sami Ullah Khan, Sahib Gul Afridi, Sulaiman Shams, Samana Azam, Ishtiaq Ahmad, Rabia Afza, and Zeeshan Ahmad

PLoS ONE 16: e0257493

Plant species represent the hierarchical expression of vegetation as it is affected by various environmental gradients. We explored the plant species composition, distribution pattern, communities formation and their respective indicators under the influence of various environmental factors in the Dhirkot region, Azad Jammu and Kashmir. It was hypothesized that different environmental factors were responsible for the formation of various plant communities each with a distinct indicator. Quantitative ecological techniques were used for the sampling of vegetation. A total of 114 quadrats were established in 13 selected sampling sites. Phytosociological attributes were calculated for each plant species at each quadrat. Soil samples were collected and analyzed using different standard protocols. All the collected data were analyzed using Cluster Analysis, Indicator Species Analysis and Canonical Correspondence Analysis of PCORD and CANOCO software, respectively. A total of 145 plant species were recorded belong to 62 different families. Asteraceae and Lamiaceae were the dominant families, represented by 12 species each (8.27%). Cluster Analysis classify all the stations and plants into four major plant communities as 1) *Olea-Desmodium-Prunilla* community. 2) *Abies-Zanthoxylum-Pteracanthus* community 3) *Cedrus-Elaeagnus-Hypericum* community 4) *Alnus-Myrsine-Ranunculus* community. Soil pH, electrical conductivity, soil saturation, organic matter and altitude were the significant environmental factors that play its essential role in the plant species distribution, composition, formation of major plant communities and their respective indicators in the region. It is recommended that the identified indicator and rare plant species of the investigated area can further be grown for conservation and management purposes in *in-situ* environment.

For further reading: <https://doi.org/10.1371/journal.pone.0257493>

AN ETHNOBOTANICAL STUDY OF WETLAND FLORA OF HEAD MARALLA PUNJAB PAKISTAN

Muhammad Sajjad Iqbal, Khawaja Shafique Ahmad, Muhammad Azhar Ali, Muhammad Akbar, Ansar Mehmood, Fahim Nawaz, Syed Atiq Hussain, Noshia Arshad, Saba Munir, Hamna Arshad, Khizra Shahbaz, and Rainer W. Bussmann

PLoS ONE 16: e0258167

Wetlands are biologically diverse and highly productive ecosystems that support one-third of all threatened and endangered plants of the world. Wetland plants have been studied ethnobotanically much less than terrestrial plants, including in Pakistan, thus information about the uses of local wetland plants in traditional healthcare system is scarce. Head Maralla is a non-recognized wetland with diversified flora that has been focused of the current study. The ethnobotanical data were collected from four sites viz., River Tavi, Upstream Chenab, River Manawarwala Tavi, and Bhalolpur through questionnaire and interviews during field trips. Quantitative indices including informant consensus factor (ICF), cultural significant index (CSI), relative frequency of citation (RFC), and use value (UV) were used to analyze the data. On the whole, 119 plant species were identified belonging to 54 families, of which 87 species were dicot, 12 monocots, 11 aquatic, 5 ferns, and 4 species were bryophytes. Of these, 50% of the plant species were utilized for therapeutic purposes, followed by leaves which had more than 20% usage of total consumption. Herbs were the primary source of medicine (73 spp) followed by trees (22 spp), weeds (11 spp), shrubs (9 spp), foliose (2 spp) and thaloids (2 spp) in the area. F_{ic} ranged from 0.66 to 0.93 for constipation and respiratory disorders with an average F_{ic} of 0.87 reflecting a high consensus among the informants about the use of plants to treat particular ailment. Major ailments viz., urination (14%), cough (8.40%), cold (6.70%), stomach (5.90%), asthma (5.90%), skin infection (5%), constipation (5%), and diarrhea (4%) etc., were treated with local plant recipes. The highest CSI value was found for *A. vesica* (7.55) widely used in respiratory disorders and in digestive problems. RFC ranged from 0.92 to 0.15 with the maximum value obtained for *R. communis* (0.95). The use values ranged from 0.03 to 0.90 with the maximum use value for *R. communis* (0.90). A positive correlation was found between CSI and RFC ($r = 0.29$), and CSI and UV ($r = 0.29$). The JI values ranged from 7.14 to 0.14 indicating strong affinity with Samahani valley, Azad Kashmir, Pakistan. Unique species *Osmunda regalis* was first time reported from Pakistan with novel uses for renal and blood purifier. Fifteen percent (15%) plants contribute as fodder species consumed by local community for livestock while almost 6.7% species were utilized for timber and fuel purposes. The ecosystem of Head Maralla provides a complex habitat for aquatic, terrestrial, and agriculture wetland vegetation. It is suggested that conservation efforts should be made to conserve the ethnoecological knowledge of these areas and pharmacological studies should be conducted for novel drug synthesis in future.

For further reading: <https://doi.org/10.1371/journal.pone.0258167>