An Environmental Research Abstract

Headlines Himalaya

June 15 – June 30 (2021) **No. 655-656** **Editorial Team: Anuj Dangol and Sajan Dulal**

For the 655th – 656th issues of Headlines Himalaya, we reviewed researches from two sources and selected 18 researches from five countries. We selected one research from Nepal and 17 researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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Nepal-Himalaya

MAINSTREAMING CLIMATE CHANGE MITIGATION ACTIONS IN NEPAL: INFLUENCING FACTORS AND PROCESSES

Bishal Baniya, Damien Giurco, Scott Kelly, and Prem Prakash Aryal

Environmental Science and Policy 124: 206-216

This study aims to investigate the influencing factors and the processes for incorporating climate change mitigation actions into policies in the non-environment sector in Nepal. We use semi-structured interviews with policy actors such as national and sub-national policymakers, and respondents from the private sector and international development organizations active in Nepal. We also use thematic, narrative, and focused coding to analyze narrative data obtained from 12 respondents, and qualitative analysis of textual data from six non-environment sector policies to generate insights into the mainstreaming of climate change mitigation actions. A major finding from the study is that global environment-related initiatives like the Paris Agreement and the Sustainable Development Goals, and the green growth concept that aims to mitigate greenhouse gas (GHG) emissions, are influencing the policy discourse in Nepal. Consequently, climate change mitigation actions are integrated either as add-ons or as overriding policy objectives in non-environment sector policies. Our conceptualization of mainstreaming moves beyond the mere integration of policy objectives to focus on the collaborative practices of policy actors, the influencing factors, and the processes for incorporating climate change mitigation actions across non-environment sector policies.

Further reading: https://doi.org/10.1016/j.envsci.2021.06.018

India -Himalaya

LONG-TERM CHANGE IN AEROSOL CHARACTERISTICS OVER INDO-GANGETIC BASIN: HOW SIGNIFICANT IS THE IMPACT OF EMERGING ANTHROPOGENIC ACTIVITIES?

Sunil Kumar, Amarendra Singh, Atul K. Srivastava, Saroj K. Sahu, Rakesh K. Hooda, Umesh C. Dumka, and Virendra Pathak

Urban Climate 38: 100880

Long-term aerosol characteristics were assessed over the Indo-Gangetic Basin (IGB) using satellite-derived aerosol properties from January 2007 to December 2017. The study shows steadily high aerosol optical depth (AOD ~ 0.7) with a decadal increasing trend (~20%) over the IGB. Angstrom exponent (AE) shows a relatively large increasing trend at Lucknow in the central IGB (~25%) as compared to Delhi in the north-west IGB (~18%), which suggests relative increase in fine-mode aerosols at Lucknow (~30%). Though, single scattering albedo (SSA) does not show any considerable decadal trend at both the stations, the ultraviolet-aerosol index (UV-AI) shows an increasing trend, with a pronounced increase at Delhi (~26%) compared to Lucknow (~20%). Result suggests relative dominance of absorbing dust aerosols over Delhi. Further, to understand the impact of emerging activities, analyses were done in two sub-periods: 2007–2012 and 2013–2017. Interestingly, a relative increasing trend in AOD (~31%) is observed at Delhi compared to Lucknow during 2007–2012, which was observed at Lucknow (~22%) during 2013–2017. The emission inventory corroborates with the trend and variability of optical properties for different sub-periods, and results show intense development activities in the region have an influence on vertical as well as horizontal aerosol load.

Further reading: https://doi.org/10.1016/j.uclim.2021.100880

POTENTIAL DISTRIBUTION OF OAK FORESTS IN THE CENTRAL HIMALAYAS AND IMPLICATIONS FOR FUTURE ECOSYSTEM SERVICES SUPPLY TO RURAL COMMUNITIES

Niyati Naudiyal and Joachim Schmerbeck

Ecosystem Services 50: 101310

Oak forests are an ecologically and socio-economically valuable late-successional forest formation of central Himalaya. We used niche modelling to identify the potential distribution of oak forests in Uttarakhand, India and estimated the possible changes in the availability of ecosystem services (ES) from oak forests in a scenario without human disturbance. Quantification of provisioning ES and carbon density was done by field-based household and vegetation assessments respectively. Carbon density was estimated using allometric equations provided by the Forest Survey of India. We found that the region has a much higher potential to support oak than its current distribution. In a no-disturbance scenario, under current climatic conditions, we estimate a 170.6% increase (current area 14741 ha, potential area 39899 ha) in the coverage of dense oak forests which would result in a 60.3% increase in carbon stock, a 90.69% increase in non-wood forest products, a 75.04% increase in fuelwood and fodder, and a 54.83% increase in the supply of small diameter wood. In order to increase the provision of ES in the study area the best-suited course of action would be to support the succession of current pine, pine-oak, and open-oak forests to late-successional dense-oak forest community.

Further reading: https://doi.org/10.1016/j.ecoser.2021.101310

GIS-BASED SPATIAL PREDICTION OF RECREATIONAL TRAIL SUSCEPTIBILITY IN PROTECTED AREA OF SIKKIM HIMALAYA USING LOGISTIC REGRESSION, DECISION TREE AND RANDOM FOREST MODEL

Nemai Sahani and Tirthankar Ghosh

Ecological Informatics 64: 101352

Trails have high conservation value which provides access to the protected area. But expansion of recreational activities along the trail has notably disturbed its environmental quality. The rapid increase of recreational activities along trails of Sikkim Himalayan region has become a major environmental concern. Therefore, modelling and mapping of sensitive trails are essential aspects for decision makers. The present study integrates RS-GIS with different machine learning algorithms to prepare trail susceptibility mapping. Furthermore, the study compares the predictive performance of logistic regression (LR), decision tree (DT) and random forest (RF) model for trail susceptibility mapping. Here we have considered seventeen trail susceptibility conditioning factors as model input. Thereafter, the dataset was randomly divided into two parts: training dataset (70%) and validation dataset (30%). Multicollinearity analysis carried using variance inflation factor (VIF) and tolerance (TOL) to reduce model biasness. Thereafter, trail susceptibility map prepared using LR, DT and RF models. Finally, Receiver operating curve (ROC)-area under curve (AUC) method, statistical overall accuracy (OA) and Kappa index were used to measure the predictive performance of the models. The study concluded that LR (AUC-0.948, OA-94.8% and Kappa Index-0.897) gives better performance in overall accuracy assessment as compared to DT (AUC- 0.931, OA- 93% and Kappa Index- 0.862) and RF (AUC- 0.914, OA- 91.3% and Kappa Index- 0.828) model.

Further reading: https://doi.org/10.1016/j.ecoinf.2021.101352

ASSESSING THE SPATIAL DISTRIBUTION OF AEROSOLS AND AIR QUALITY OVER THE GANGA RIVER BASIN DURING COVID-19 LOCKDOWN PHASE-1

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Remote Sensing Applications: Society and Environment 23: 100546

The present study aims to analyze the variations in aerosol optical depth (AOD), black carbon (BC), organic carbon (OC), sulfate (SO4), dust, sea salt, fine mode dust and sea salt, and air quality over the Ganga River basin (GB), during the nation-wise lockdown phase-1 due to the outbreak of COVID-19. The aerosol data have been obtained from Moderate Resolution Imaging Spectroradiometer (MODIS) and Modern-Era Retrospective analysis for Research and Applications (MERRA-2) for the lockdown phase-1 (March 25 - April 15, 2020) and its corresponding average of the reference period (2001-2019). The total PM2.5 has been modeled over the GB based on the inputs from MERRA-2. The in-situ air quality index (AQI) values from cities across the GB have been obtained during pre-lockdown (February, 29 - March 20, 2020) and lockdown phase-1 period to evaluate changes. Non-parametric pairwise comparison is performed to evaluate the significant change in the pollutants including AOD, and quantile regression is used to explore the effect of meteorology on AOD and other pollutants. The results show a significant reduction ($p \leq 0.05$) in AOD, BC, OC, SO4, dust, dust particulate matter (PM2.5), sea salt, sea salt PM2.5, and estimated total PM2.5 during the lockdown phase-1 with respect to the reference period. The analysis also reveals that meteorological factors do not play a vital role in the reduction of AOD during the lockdown phase-1 period. The estimated reductions for AOD, BC, OC, SO4, dust, dust PM2.5, sea salt, and sea salt PM2.5 are 33%, 21%, 24%, 20%, 18%, 17%, 64%, and 61%, respectively due to imposition of lockdown measures. As many as 28 cities in the GB have shown substantial improvement in the air quality during the lockdown phase-1 period. The reduction in the emission quantity and subsequent improvement in AQI has opened up a new discourse for combatting the persistent air quality issues for million-plus cities in particular and for the north Indian plain in general. The findings of this study thus provide insightful views to the environmentalists and policymakers for framing better emission policy to deal with the air quality issue.

Further reading: https://doi.org/10.1016/j.rsase.2021.100546

China Himalaya

PERFLUOROALKYL SUBSTANCES IN PRECIPITATION FROM THE TIBETAN PLATEAU DURING MONSOON SEASON: CONCENTRATIONS, SOURCE REGIONS AND MASS FLUXES

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Chemosphere 282: 131105

Atmospheric wet deposition is an important process for the occurrence of perfluoroalkyl substances (PFASs) in polar/remote mountain regions; however, there are limited data on PFASs in precipitation from the Tibetan Plateau (TP). Precipitation (rain from May to October 2017) was therefore collected across the TP to investigate the concentrations, composition profiles, sources, and fluxes of perfluoroalkyl acids (PFAAs). The average ∑PFAA concentrations ranged from 212.3 pg L^{-1} to 547.7 pg L^{-1}, and perfluoroalkyl carboxylic acids (PFCAs) accounted for 87% of the measured PFAAs (mean value). Significant positive associations ($p < 0.05$) were found for most PFCAs in the southeast TP, indicating that they may come from similar sources. The monthly PFAA deposition flux ranged from 12.6 to 68.9 ng m^{-2} $month^{-1}$, decreasing from east to west. As climate of the eastern TP is controlled mainly by the Indian monsoon, indicating that the Indian monsoon plays an important role in delivering PFAAs to the TP. PCA (principal component analysis) combined with back-trajectory analysis was used to estimate the atmospheric transport pathways, and the PSCF (potential source contribution function) model was applied to define the potential source regions of individual PFAAs. The results suggested that northeast India, Bangladesh, and southern Nepal are the potential sources of C4–C7 PFCAs; C8–C10 PFCAs are more influenced by emissions from southern Nepal and Bhutan; while the source regions of long-chain PFCAs (C11–C12) can be attributed to northern India and Pakistan. Specifically, PFOS (perfluorooctane sulfonic acid) has a local contribution from the central TP.

Further reading: https://doi.org/10.1016/j.chemosphere.2021.131105

LEGACY EFFECT OF WARMING ON THE HETEROTROPHIC RESPIRATION OF ALPINE GRASSLAND ON THE QINGHAI-TIBET PLATEAU

Fei Peng, Wenjuan Zhang, Chimin Lai, Chengyang Li, Quangang You, Xian Xue, Shaoixu Ma, and Atsushi Tsunekawa

Applied Soil Ecology 166: 104093

The response of soil microbial decomposition of soil organic carbon (C) to temperature variation against an average warming background is of great importance to understand how climate change affects the ecosystem C cycling. In this study, a warming and step-wised stop-warming experiment was conducted to examine whether the response of soil respiration (Rs) and heterotrophic respiration (Rh) persists post-warming and to understand the underlying mechanisms. The treatment plots (10 plots) were warmed (~1.5 °C at 10 cm soil depth) in 2017, then warming was stopped in one group (5 plots) in 2018 (WS18) and stopped in another group (the remaining 5 plots) in 2019 (WS19). Plant biomass, soil microbial biomass, and soil microbial community composition were measured from 2017 to 2019.On average, warming increased Rh by 28% in 2017. The Rh in WS18 was stilled increased by 26% in 2018, which was lower than the warming induced increase in Rh in WS19 at the same period. The Rh in WS18 showed no difference with the control and that in WS19 was higher than the control in only June in 2019. Aboveground biomass of WS18 and WS19 increased by 20% and 29%, respectively in 2017, and they were still

increased by 12% and 17% in 2019 even the warming stopped one two years and one years, respectively. Belowground biomass, microbial biomass, and diversity indices showed no significant differences among treatments in 2018 or 2019. The fungal community was significantly different among WS18, W19, and the control in both 2018 and 2019. The relative abundance of *Ascomycetes*, which made the largest contribution to the differences in the fungal community, was negatively correlated with Rh ($r = -0.4$, $n = 30$, $p < 0.05$). Our results indicate a warming legacy effect on the microbial decomposition of soil organic C, resulting from the increase in plant productivity and fungal community change when warming stopped.

Further reading: https://doi.org/10.1016/j.apsoil.2021.104093

DEVELOPMENT OF AN ECO-FRIENDLY ULTRA-HIGH PERFORMANCE CONCRETE BASED ON WASTE BASALT POWDER FOR SICHUAN-TIBET RAILWAY

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Journal of Cleaner Production 312: 127775

Generally, tunnel waste is stacked in the slag field nearby for landfilling, which is harmful to sustainable development. The broken rocks and rock powder among the tunnel waste can be recycled to produce machine-made sand, producing many by-products calling rock powder. Based on the practical project, three types of waste basalt powder (BP), from tunnel excavation waste and by-products (rock powder) of machine-made sand producing from tunnel excavation waste in Sichuan-Tibet railway construction sites, was used to prepare an eco-friendly UHPC. The BP is used to replace the cement and is included in the design UHPC based on Modified Andreasen & Andersen particle packing model (MAA). Moreover, the chemical and physical behaviors and ecological evaluation of the designed UHPC and UHPC pasted were discussed. The results showed that when BP (Specific surface area 4.6582 m^2/g) replaces up to 15%, the highest compressive strength of designed UHPC (220 MPa) was obtained. Compared with quartz powder, the pozzolanic activity of BP was generally low and increased with the increase of reaction temperature. However, the presence of BP and its fineness in UHPC pastes increased the values of the total autogenous shrinkage and decreased the total heat release at an early age of designed UHPC pastes, this effect is more pronounced with temperature increasing. Based on a quartering method with embodied carbon dioxide emissions and the compressive strength, UHPC with waste BP reduced embodied carbon dioxide and possessed higher compressive strength and lower environmental impact than the control samples of UHPC.

Further reading: https://doi.org/10.1016/j.jclepro.2021.127775

LAKE ECOSYSTEM ON THE QINGHAI–TIBETAN PLATEAU SEVERELY ALTERED BY CLIMATIC WARMING AND HUMAN ACTIVITY

Jie Liang, Rachel L. Lupien, Haichao Xie, Richard S. Vachula, Mark A. Stevenson, Bo-Ping Han, Qiuqi Lin, Yue He, Mingda Wang, Peng Liang, Yongsong Huang, Suzanne McGowan, Juzhi Hou, and James M. Russell

Palaeogeography, Palaeoclimatology, Palaeoecology 576: 110509

Modelling, monitoring, and experimental data have shown that global climate change can impact aquatic phytoplankton communities directly, through the effects of warming on primary producers, as well as indirectly through cascading effects from higher trophic levels. Although both concepts are common in modern limnological studies, it remains unclear whether the ‘top-down’ effects from higher trophic levels on phytoplankton exert strong effects in natural systems over long (centennial) timescales. Here, we use multiproxy data including

pigments, zooplankton remains, nutrient concentrations, and paleoclimate indicators from a sediment core in Dagze Co, Central Tibet (a two-trophic level lake) to reconstruct algal production, zooplankton community, nutrient and salinity changes. Our results show that top-down effects of higher trophic levels offset effects from warming and nutrient addition on algal growth. Warming enhanced glacial meltwater inflow to the lake, and intensive human activities increased nutrient inputs. Changes in lake salinity and N:P ratios coincided with zooplankton community shifts during the past 600 years, and *Daphnia tibetana* replaced the brine shrimp, *Artemia tibetiana*, after the relocation of a town to upstream of the lake in the 1980s led to overharvesting of the brine shrimp. These shifts contributed strongly to changes in algal communities, with changes in zooplankton leading to strong top-down effects that decreased algal production through increasing grazing pressure despite increasing nutrient concentrations. Our results suggest that the typical external drivers (climate and nutrients) of lake ecosystems may be suppressed by internal shifts in plankton communities in lakes.

Further reading: https://doi.org/10.1016/j.palaeo.2021.110509

WATER-USE PATTERNS OF CHINESE WOLFBERRY (*LYCIUM BARBARUM* L.) ON THE TIBETAN PLATEAU

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Agricultural Water Management 255: 107010

Chinese wolfberry (*Lycium barbarum* L.) can efficiently ameliorate land deterioration and increase farmers' incomes on the Tibetan Plateau. Therefore, it has been widely grown in this region in the past decades. The aims of this study were to clarify the patterns of water sources and water use efficiency under 3 management practices to determine the optimal cultivation strategies. A 2-year field experiment was undertaken in a Chinese wolfberry plantation with 3 management practices, including the conventional flat planting plus surface drip irrigation (CK), flat planting with full-film mulching plus surface drip irrigation (MF) and ridge-furrow full-film mulching plus surface drip irrigation (MR). The soil moisture in shallow (0–20 cm), middle (20–60 cm) and deep (60–100 cm) soil layers were regarded as the trees' potential water sources. The IsoSource model and two Bayesian mixing models of MixSIR and MixSIAR were employed to calculate the contribution of different water sources to xylem water. The MixSIR model exhibited relatively better performance in quantifying water source contribution for different layers compared with the IsoSource and MixSIAR models. Management practices significantly altered water use patterns of the wolfberry during the growing periods. Under CK the wolfberry preferentially extracted moisture from the middle and deep layers even during rainfall and irrigation. Under MF and MR they switched more flexibly their water source between the three layers; and they used more water from shallow and middle layers when soil moisture availability increased there, which was especially true under MR. Compared with CK, the average yield of MR and WUE were found to increase by 21.5% and 17%, respectively, over the 2-years period. This indicated that film mulching and ridge-furrow altered the water use strategy of Chinese wolfberry and WUE, which can inform the designing of the best management regimes. The response to tree water use in terms of soil nutrients and subsurface irrigation should be investigated to optimize field management practices, including irrigation schedules and modes.

Further reading: https://doi.org/10.1016/j.agwat.2021.107010

DIVERGENT SHIFTS IN FLOWERING PHENOLOGY OF HERBACEOUS PLANTS ON THE WARMING QINGHAI–TIBETAN PLATEAU

Yuhao Jiang, Baolin Li, Yecheng Yuan, Qingling Sun, Tao Zhang, Yan Liu, Ying Li, and Rui Li

Agricultural and Forest Meteorology 307: 108502

Both advanced and delayed shifts of different magnitude in flowering phenology, based on limited controlled experiments and ground-based observational studies, have been reported on the Qinghai–Tibetan Plateau (QTP). To clarify flowering phenological changes, we collected 1646 ground-observed phenological records of 21 species, from 27 stations, for 78 time series, and daily average air temperature data from 1983 to 2017 on the QTP. Trends in the first flowering date (FFD) and changes with temperature increase were analyzed using regression models. The FFD of early flowering time series showed an overall trend for significant advance (-0.371 ± 0.149 days/year, $p < 0.001$), whereas the mid-to-late-flowering showed a delayed trend (0.158 ± 0.193 days/year, $p = 0.108$). This finding is in contrast with the stable trend for early flowering species and the advanced trend for midsummer and late-flowering species in high latitude and Arctic regions, where the low-temperature environment is similar. The growing degree days from 1 January to the day of the observed occurrence of the FFD for early flowering time series kept stable ($p = 0.531$) and FFD showed a positive regression with chilling days; however, the growing degree days of mid-to-late-flowering time series increased significantly at a rate of 5.375 ± 2.519°C-days/year ($p < 0.001$), indicating the limitation on FFD from other related climatic factors except for forcing temperature may strengthen, and FFD showed no relationship with chilling days. The mid-to-late-flowering time series showed vernalization sensitivity in the spring of the flowering year, whereas the early flowering time series did not. This indicated that retarded vernalization completion may be responsible for the delayed flowering phenology of mid-to-late-flowering species. The FFD of early flowering species, with flower preformation in the preceding autumn, was mainly controlled by forcing temperature in spring; decreased chilling days indicating warmer winter were also beneficial for development and fitness of preformed floral organs, and thus, temperature increase significantly advanced the FFD. These findings suggest that divergent flowering phenology shifts may alter the species composition and ecosystem services of alpine ecosystems, causing challenges in grassland management.

Further reading: https://doi.org/10.1016/j.agrformet.2021.108502

OPTICAL SENSING IN TIBET PLATEAU WILDLIFE OBSERVATION BASED ON TETHERED BALLOON

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Optik 243: 167425

As the third pole of the earth, Qinghai Tibet Plateau breeds many unique species; their population size, living environment and migration process have been observed and studied by many researchers. However, these observations are mainly carried out in summer with UAVs when the temperature is high, while they are hard to work in winter since the harsh environment such as low temperature and strong wind. Here, we used a tethered balloon to observe and monitor Tibetan animals in the winter of Tibet Plateau with a long wave refrigeration infrared camera (resolution is 0.2 m@2 Km). The camera was installed on a two dimensional stable platform and was raised up to 150 m by the tethered balloon. The experiment results show that the camera on the tethered balloon can complete the observation in the harsh environment and obtain better images and videos including the mating process of two Tibetan antelopes. After this experiment, the acquired videos were used for further processing, such as motion detection and animal counting. This method can be used to observe other species occupying similar environment, such as Tibetan yak and Equus kiang.

Further reading: https://doi.org/10.1016/j.ijleo.2021.167425

DRIVING FORCES OF CULTIVATED LAND EVOLUTION IN AGRO-PASTORAL AREAS ON THE QINGHAI-TIBET PLATEAU BASED ON ECOLOGICAL NICHE THEORY

Yixuan Liu, Shiliang Liu, Yongxiu Sun, Fangfang Wang, and Mingqi Li

Journal of Cleaner Production 313: 127899

Scattered cultivated lands in the agro-pastoral areas on the Qinghai-Tibet Plateau (QTP) cause pressure on the structure, function and evolvement of landscape and affect regional ecological sustainability. Based on niche theory, this study is the first to apply the niche breadth, niche entropy and niche overlap model to explore how the cultivated land expansion and development forms affect ecological roles from ecosystem interaction aspects from 1990 to 2015 at regional scales on the QTP. The results showed that: (1) Grassland was overall dominant in most counties, while the interface between the cultivated land and grassland showed great spatial variability and the main land use conversion occurred between them. From 1990 to 2015, the transfer percentage of grassland into cultivated land was 0.27%. (2) Results of cultivated land niche breadth and entropy indicated that at provincial scale, the occupancy rates of cultivated lands in Tibet and Xinjiang were lower than Sichuan, Gansu and Qinghai. (3) Cultivated land niche overlap exhibited by network graph revealed that Gansu, Sichuan and Qinghai had a high niche overlap over 0.994 at provincial scale. At city scale, the maximum overlap was Haibei-Guoluo and Lanzhou-Wuwei (0.999) while the minimum was Bayingol-Kizilsu Kirghiz (0.243), indicating that the development forms and competition of cultivated land between each two regions were quite different. (4) The driving forces derived by niche difference of different ecosystems showed that cultivated land niche was affected the evolution of grassland niche, and the social benefit was the leading benefit of cultivated land change. Overall, this study can assist local government in building the cultivated land management system. Moreover, the results of this study contribute to understand the characteristics and driving forces of the cultivated land evolution on the QTP, thus providing valuable decision reference for ecological protection, land use structure regulation and policy formulation.

Further reading: https://doi.org/10.1016/j.jclepro.2021.127899

COMPARATIVE METABOLOMICS REVEALS THAT *AGARICUS BISPORUS* FAIRY RING MODULATES THE GROWTH OF ALPINE MEADOW PLANT ON THE QINGHAI-TIBET PLATEAU

Fei Liu, Pan Liu, Yonghong Zhang, Liangliang Sun, Ping Zhang, Ming Cao, Huakun Zhou, Wenying Wang, and Jin Xu

Ecological Indicators 129: 107865

The fairy ring is an ecological phenomenon that consists of a visible green ring composed of mushroom fruiting bodies and a green plant stimulating zone. *Agaricus bisporus* fairy ring stimulates the growth of alpine meadow plants on the Qinghai-Tibet Plateau, however, the underlying eco-physiological and molecular mechanisms still unclear. Here, using physiological and metabolomic analyses, we showed that *A. bisporus* fairy ring improves leaf growth of alpine meadow plant by modulating plant metabolism. *A. bisporus* fairy ring induces the accumulation of a set of amino acids in *Kobresia humilis* (one of the main plant species of alpine meadow), such as glutamine, asparagine, tryptophan and proline, etc., and thereby modulating nitrogen metabolism, plant growth and stress responses. *A. bisporus* fairy ring also affects sugar accumulation and carbon metabolism pathways in *K. humilis* plants. Furthermore, *A. bisporus* fairy ring alters the metabolite accumulation in soil. Increased accumulation of several organic acids and lipids in soil is beneficial to promote nutrient element uptake in plants and regulate microorganisms growth and propagation in soil. Taken together, our results indicated *A. bisporus* fairy ring affects alpine meadow plant growth by modulating carbon/nitrogen metabolism, stress responses, nutrient uptake and interaction between soil microorganisms and alpine meadow plants.

Further reading: https://doi.org/10.1016/j.ecolind.2021.107865

TIME-LAG EFFECTS OF CLIMATIC CHANGE AND DROUGHT ON VEGETATION DYNAMICS IN AN ALPINE RIVER BASIN OF THE TIBET PLATEAU, CHINA

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Journal of Hydrology 600: 126532

Vegetation is the most important component of terrestrial ecosystem, reflecting the quality of ecological environment. In this study, non-parametric Mann-Kendall test and Sen's slope were applied to analyze the spatiotemporal variabilities of vegetation coverage, precipitation, temperature and drought during the period 1981–2015 in the Yarlung Zangbo River basin (YZRB), based on GIMMS NDVI3g, CHIRPSv2.0, China Meteorological Forcing Dataset (CMFD) and CRU TS 4.03 (scPDSI) datasets. The Pearson Correlation Analysis and geostatistical methods were adopted to investigate the correlations between climatic variables and vegetation coverage as well as the time-lag effects for different vegetation types. The results showed that the spatial distribution of vegetation coverage is generally characterized as increasing from upper to lower reaches. The northwestern region of lower reaches showed a greening trend in vegetation, while degradation of vegetation was detected in southeastern region. The vegetation in the upper and middle reaches was significantly positively correlated with precipitation and drought, while a significantly negative correlation was detected between vegetation and temperature in the middle reaches and southeast region of the lower reaches, as well as vegetation and precipitation in the lower reaches. One-month lag effect of precipitation and temperature on vegetation appeared in the upper reaches, while no lag for precipitation and one-month lag for temperature were detected in the middle reaches, and both precipitation and temperature showed no lag effect on vegetation in southeast region of the lower reaches. The vegetation types in the YZRB were mainly consisted of meadow, alpine vegetation, shrubs and grassland, in which the growth of shrubs was relatively better than other vegetation types. All the four vegetation types showed a slightly greening trend, which were positively correlated with precipitation and drought, while showed a negative correlation with temperature. The findings help to better understand the mechanism of vegetation dynamics and provide references for ecosystem monitoring and assessment in the YZRB.

Further reading: https: https://doi.org/10.1016/j.jhydrol.2021.126532

Bhutan-Himalaya

THE POTENTIAL IMPACTS OF CLIMATE CHANGE ON THE DISTRIBUTION OF KEY TREE SPECIES AND CORDYCEPS IN BHUTAN: IMPLICATIONS FOR ECOLOGICAL FUNCTIONS AND RURAL LIVELIHOODS

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Ecological Modelling 455: 109650

Rural communities in the Himalayan Kingdom of Bhutan are dependent on natural capital for their livelihoods. Climate change impacts on ecosystem could have serious consequences for these communities but little research has been done to explore these potential impacts. In this study, we used Boosted Regression Tree (BRT) models to model current and potential future distribution of major timber species (*Abies densa, Pinus wallichiana, Tsuga dumosa*), fuelwood species (*Quercus spp, Betula spp, Betula utilis, Rhododendron spp, Rhododendron arboreum*) and an important non-timber resource (*Ophiocordyceps sinensis*) in Bhutan Himalayan region. Models were based on species presence and absence data from 575 plots and a new high-resolution climate dataset developed for

Bhutan. Future projections were based on IPCC's representative concentration pathway (RCP 8.5) for the 2080s in Bhutan. Mean annual temperature and precipitation of driest quarters were found to be the most influential variables in modelling the current distribution of these species, with the distribution of most of the species projected to decrease significantly and shift to higher elevations. The current distribution of *Ophiocordyceps sinensis* was modelled to decrease by 79% at the national level with only 21% range overlap between current and future distributions. Current distribution of timber species like *Abies densa* and *Tsuga dumosa* were modelled to decline by 98% and 99% respectively at national level with very low range overlaps between current and future distribution suggesting high species vulnerability to climate change. In contrast, fuel wood species like *Betula spp, Quercus spp, Rhododendron arboreum* all exhibited less vulnerability to climate change with over 50% of their current range overlapping with future distribution across Bhutan and in the Nikachu watershed. These potential changes in distribution patterns of these species could impact on the functions and ecosystem services provided by these species and socio-economic conditions of rural communities reliant on these species for their livelihoods in Bhutan. Lower rates of global greenhouse gas emissions and adoption of adaptation measures and management interventions can reduce these potential impacts.

Further reading: https://doi.org/10.1016/j.ecolmodel.2021.109650

Pakistan -Himalaya

COMMUNITY-BASED TROPHY HUNTING PROGRAMS SECURE BIODIVERSITY AND LIVELIHOODS: LEARNINGS FROM ASIA'S HIGH MOUNTAIN COMMUNITIES AND LANDSCAPES

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Environmental Challenges 4: 100175

The benefits for biodiversity and human wellbeing are debated for many countries. Some communities in rural mountain areas of the world consider trophy hunting as an integrated conservation and development strategy to protect biodiversity and sustain livelihood. This review will provide the evidence that has been gathered to discuss the benefits of CHTP in the HKPL landscape focusing on Pakistan and Tajikistan". Trophy hunting, which is intensely debated these days, is perhaps confused with the underlying philosophy of community-based trophy hunting programs. This paper seeks to inform these discussions with a fresh perspective on CTHP based on first-hand experience and learning from the high mountain landscapes and communities of Asia - *Pakistan and Tajikistan*. The article essentially reviews the effectiveness of CTHP model for conserving rare and threatened wildlife populations, protected and conserved areas, and community welfare and economic uplift. Results reveal that CTHP has been instrumental in halting illegal hunting and poaching wildlife and eventually increasing their populations in many important yet isolated habitats while improving community livelihood and local economy. The CTHP forms a vital part of the rural socio-ecological resilience for remote and isolated mountain communities. It has offered economic incentives for an integrated conservation and development paradigm to combat wildlife poaching and illegal trade and diversify livelihoods harness vital biodiversity conservation values. The paper also elaborates on the societal impact of financial flows and their use for improved lives and enterprises. There are however, some significant problems related to trophy hunting programmes, including the lack of accurate information to understand the effect of trophy hunting on herd structure and size, weak policy implementation, lack of transparency and corruption. Regular monitoring of wildlife, understanding population dynamics, appropriate

allocation of hunting quotas, hunting revenue, proper evaluation, and careful documentation of CTHP processes and their impacts are urgently required to make CTHP more effective and sustainable.

Further reading: https://doi.org/10.1016/j.envc.2021.100175

TREE-RING-BASED TEMPERATURE RECONSTRUCTION FROM THE WESTERN HIMALAYAN REGION IN NORTHERN PAKISTAN SINCE 1705 C.E.

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Arabian Journal of Geosciences 14: 1122

The western Himalayan region in northern Pakistan is one of the most sensitive hotspots to climate change, due to the rapidly increasing population and delicate mountainous ecosystem. The relatively limited observed instrumental record impedes our understanding of long-term climate variability and their assessment. Using standard dendrochronological techniques, a 395-year (1620 to 2014 C.E.) tree-ring chronology of *Abies pindrow* (Royle) (Himalayan fir) was developed from the western Himalayan region in northern Pakistan. The results of the growth-climate relationship demonstrated that the radial growth of *Abies pindrow* was limited by minimum temperature. Using a robust reconstruction model, a 310-year (1705 to 2014 C.E.) minimum temperature was reconstructed from the western Himalayan region in northern Pakistan. The reconstructed minimum temperature accounts for 38% variance of the actual minimum temperature, and provides the evidences of Dalton minimum and modern maximum periods. The coldest years in the reconstruction were 1726, 1727, 1892, 1921, and 2001, whereas the hottest years were 1789, 1807, 1814, 1846, 2011, and 2013. Multi-taper method (MTM) spectral analysis showed a significant shorter quasi-cycles (2.3 to 3.5 years) and decadal cycles (11.5 to 17.5 years), suggesting a possible teleconnections with El Niño Southern Oscillation (ENSO), and Northern Atlantic Oscillation (NAO) and Atlantic Multidecadal Oscillation (AMO) respectively.

Further reading: https://doi.org/10.1007/s12517-021-07488-3