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## Introduction:

### **Biodiversity underpins all ecosystems and their services**

- Biodiversity is the variety of all forms of life and it is essential to the existence and proper functioning of all ecosystems.
- Biodiversity supports habitats for all species by providing many unique environments in which species can exist; these include ecosystems of all types and sizes, rare ecosystems, and corridors between habitats.
- Many scientists believe biodiversity, as it represents all forms of life on earth, provides or supports the core benefits that humans derive from their environment.
- Biodiversity is fundamental for the provision of ecosystem services, which we depend on for food, air, and water security, and multiple other natural benefits.

### **Stressors and drivers of change**

- Many human activities can have a negative effect on biodiversity.



This eco-wheel image shows natural resources provided by biodiversity, the benefits and beneficiaries, and drivers of change.

- The growing human population and the land development that comes with population growth can be especially detrimental because land conversion and subsequent loss of habitats can affect the stability or continued existence of species.
- Habitat loss is a challenge for virtually all species, as humans convert natural habitats to other land uses.
- Overexploitation from extractive uses, such as commercial fishing and game hunting, can greatly reduce species numbers, sometimes to the brink of extinction.
  - An extreme decline was observed in U.S. stocks of Atlantic cod following overexploitation and stock depletion.
  - The Food and Agriculture Organization (FAO) estimates that in 2008, approximately 32% of fish stocks were overexploited, depleted, or recovering from depletion.
  - Upsetting the viability of a single species can have far-reaching impacts for the balance of an entire ecosystem.
- People can also harm biodiversity by putting stress on environments and species through overuse. Outdoor recreation may be a positive, healthful activity for humans, but high numbers of visitors to an area can damage plant life, stress local animal populations, and introduce invasive species.
- Invasive species can outcompete or consume native species to the point of extinction. Some invasive species that are found in the U.S., such as kudzu and the Emerald Ash Borer Beetle, can completely alter ecosystems, affecting overall biodiversity.
- All forms of pollution, from chemicals to nutrient loading, can also pose serious threats to aquatic and terrestrial species.

### **The benefits of conserving biodiversity**

- Biodiversity supports food security and sustained livelihoods through overall genetic diversity.
  - Genes regulate all biological processes on the planet and increase the ability of organisms to cope with environmental stressors.
  - Preserving genetic diversity ensures the continuing existence of a wide-range of crops that may be able to withstand disease, and potentially useful biochemicals such as those used in healthcare. It also means availability of species for pollination and pest control. Losses in genetic diversity will decrease organisms' coping ability and risk losing potentially beneficial biological information.
- Biodiversity has greatly contributed to modern medicine and advancements in human health research and treatment.
  - Many modern pharmaceuticals are derived from plant species, including the anti-tumor agent Taxol from the Pacific yew tree, the anti-malarial artemisinin from sweet wormwood, and the cardiac drug digoxin from the digitalis plant.
  - Pharmaceuticals can also be derived from non-plant species, such as the drug ziconotide, which has been highly effective in relieving nerve pain and severe pain in cancer patients and is derived from the venom of predatory cone snails.
  - Without the species that provide these drugs, it is possible that treatments for ailments like malaria, tuberculosis, cancerous tumors, congestive heart failure and multiple other illnesses may never have been discovered.

- As conversion of habitats and subsequent losses in diversity take place, the potential for losing cures for some of the world's most troubling ailments increases.
- In addition to the many medicinal benefits from biodiversity, human health can be positively affected simply by spending time in outdoor environments, which has been linked to increases in life satisfaction and happiness, and decreases in blood pressure, anxiety, and cardiovascular disease symptoms.
- Conserving biodiversity and protecting a wide range of habitats maintains the many benefits that this diversity provides for all species. Highly diverse environments, such as Yellowstone National Park, are prime ecosystems that support many species in addition to being aesthetically beautiful, educational, and interesting recreation sites.
- Biodiversity conservation efforts are essential in maintaining functioning ecosystems, a steady food supply, and the multiple other benefits including aesthetics, recreation, and spiritual purposes to Native American tribal nations.

This annotated bibliography contains article abstracts from 2021-2022.

This benefits DAE - ELSRC researchers.

E-resources used: Scopus.

**Contact NSTIC to request full-text articles.**

## Articles' Abstracts:

1. Pacioglu, O., Duțu, L., Duțu, F., & Pavel, A. B. (2022). Habitat preferences and trophic interactions of the benthic invertebrate communities inhabiting depositional and erosional banks of a meander from danube delta (romania). *Global Ecology and Conservation*, 38

**Abstract:** River restoration and biodiversity conservation programs require an in-depth knowledge of the influence that sediment composition and hydraulic stress have on invertebrate fauna composition and spatial distribution, as well as on nutrients cycling and food webs' structure and functionality. Compared to low-order streams, the traditional focus of river ecology, the knowledge of these ecosystem properties of the meanders developed along large, lowland watercourses, is currently insufficient. The present study assessed the ecological preferences and the trophic interactions of the benthic invertebrate communities inhabiting erosional and depositional banks developed within a meander of the River Danube flowing through its delta (Danube Delta, Romania). The invertebrates from two mesohabitats, the concave (i.e. erosional) and convex (i.e. depositional) banks developed in the apex region of the meander were sampled quantitatively and qualitatively, along with sediment samples for assessing the grain-size characteristics and hydrodynamic parameters (i.e., critical shear stress, the Reynolds number, the critical velocity and Shields parameter). For assessing their mesohabitat preferences, quantitative samples were taken from both banks, whereas for inferring the trophic interactions, stable isotopes of  $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$  were measured from qualitative samples, comprising both invertebrates and basal resources. The results showed that increased siltation with fine sediments in the depositional bank led to a community dominated by chironomids, oligochaetes and bivalves, whereas the opposite bank comprised crayfish, caddis fly larvae and amphipods with a preference for coarser sediments. The  $\delta^{13}\text{C}$  of most consumers revealed that the dominant forms of carbon entries in the analysed food webs were photosynthetic based, whereas certain snails, chironomids and basal resources from the depositional bank were  $^{13}\text{C}$  depleted ( $\delta^{13}\text{C}$ :  $-35$  to  $-39$  ‰). Such low ratios for  $\delta^{13}\text{C}$  (mean  $< -35$  ‰) reflected the potential of carbon entry through the base of depositional food web as a result of methane oxidation at sediment-water interface (i.e. chemosynthesis), induced by the fine sediments deposition that could have favoured the methane production. Grazing methane-oxidising bacteria in the depositional meander bank could have provided the primary consumers with up to 50 % and the omnivores and predatory invertebrates with up to 30 % of their carbon, which could represent an important subsidy from an additional, chemosynthetic source. The impact of a supplementary carbon input was further reflected in increasing

depositional food web basal niche diversity, which led to distinct trophic niches and lower interspecific competition of consumers compared to the erosional bank of the meander.

2. Paulus, A., Hagemann, N., Baaken, M. C., Roilo, S., Alarcón-Segura, V., Cord, A. F., & Beckmann, M. (2022). Landscape context and farm characteristics are key to farmers' adoption of agri-environmental schemes. *Land use Policy*, 121

**Abstract:** Agri-environmental schemes (AES) belong to the main instruments of the European Union's Common Agricultural Policy (CAP) to foster sustainable farming practices that contribute to the conservation of biodiversity, ecosystem services, climate change mitigation and adaptation. Farmers' attitudes towards these voluntary measures and the socio-economic factors influencing their decisions have been widely studied through interviews or surveys. However, it remains unclear whether the spatial patterns of AES adoption can be predicted based on farm structural and environmental variables.

In this study, we combine biophysical maps with information on farm structure and landscape context to model the influence of these variables on AES implementation at both farm and field level. We fit a set of regression models using farm characteristics (e.g. farm size and specialization, field size) as well as landscape context variables (e.g. elevation, soil fertility, presence of protected areas) as predictors using the Mulde River Basin in Germany as a case study.

Our analysis reveals that the spatial distribution of AES can be explained by these factors:

AES tend to be implemented by larger farms specialized in permanent grassland cultivation and are typically located in protected areas with lower soil fertility. At the field level, AES are preferably allocated on fields close to water bodies and small woody features. The effect of the different environmental and farm-related variables on AES adoption varies across different AES-schemes indicating the complex set of factors farmers take into consideration when allocating a scheme on a field.

As our study shows a quantifiable tendency to place AES in unproductive and/or protected areas, it supports previous evidence criticizing the global tendency to allocate environmental protection measures in regions with low agricultural value, which results in conservation goals

not being met. The models presented here can support the development of future AES, e.g. by developing schemes tailored to fit farms and fields that are currently unlikely to adopt AES, thus improving the effectiveness of environmentally friendly agricultural practices.

3. Pavese, S., Centeno, C., Von Fersen, L., Eguizábal, G. V., Donet, L., Asencio, C. J., Villarreal, D. P., & Busso, J. M. (2022). Video validation of tri-axial accelerometer for monitoring zoo-housed tamandua tetradactyla activity patterns in response to changes in husbandry conditions. *Animals*, 12(19)

**Abstract:** Accelerometers are a technology that is increasingly used in the evaluation of animal behaviour. A tri-axial accelerometer attached to a vest was used on *Tamandua tetradactyla* individuals (n = 10) at Biodiversity Park. First, the influence of using a vest on the animals' behaviour was evaluated (ABA-type: A1 and A2, without a vest; B, with a vest; each stage lasted 24 h), and no changes were detected. Second, their behaviour was monitored using videos and the accelerometer simultaneously (experimental room, 20 min). The observed behaviours were correlated with the accelerometer data, and summary measures (X, Y and Z axes) were obtained. Additionally, the overall dynamic body acceleration was calculated, determining a threshold to discriminate activity/inactivity events (variance = 0.0055). Then, based on a 24 h complementary test (video sampling every 5 min), the sensitivity (85.91%) and precision (100%) of the accelerometer were assessed. Animals were exposed to an ABA-type experimental design: A1 and A2: complex enclosure; B: decreased complexity (each stage lasted 24 h). An increase in total activity (%) was revealed using the accelerometer ( $26.15 \pm 1.50$ ,  $29.29 \pm 2.25$ , and  $35.36 \pm 3.15$ , respectively). Similar activity levels were detected using video analysis. The results demonstrate that the use of the accelerometer is reliable to determine the activity. Considering that the zoo-housed lesser anteaters exhibit a cathemeral activity pattern, this study contributes to easily monitoring their activities and responses to different management procedures supporting welfare programs, as well as ex situ conservation.

4. Precinoto, R. S., Prieto, P. V., Figueiredo, M. D. S. L., & Lorini, M. L. (2022). Edges as hotspots and drivers of forest cover change in a tropical landscape. *Perspectives in Ecology and Conservation*, 20(4), 314-321.



**Abstract:** Forest cover changes are influenced by socioeconomic and biophysical dynamics. However, the relative importance of both social and biophysical factors to forest loss and gain remains in debate. Previous research has focused mainly in identifying determinants of deforestation, while less is known regarding forest regrowth, especially in tropical forests. Here we investigated the spatial pattern and determinants of forest cover changes within a landscape which is representative of the biophysical and socioeconomic conditions found in the Atlantic Forest, and also presents an exceptional conservation value within this global biodiversity hotspot. Events of deforestation and regrowth were identified by comparing land cover maps from aerial images taken in 1975 and 2010. We controlled the spatial autocorrelation among events and used a machine learning algorithm and a selection model approach to build linear models explaining forest loss and gain. Main determinants of both forest loss and gain were biophysical factors, although some of them may also reflect socioeconomic underlying processes. Distance from Strictly Protected Areas (SPAs) was the single socioeconomic determinant important to forest change, in loss events. Both deforestation and forest regrowth were strongly associated with forest edges. Deforestation occurred more intensively on concave or flat areas, low solar radiation conditions, near forests, and far from SPAs. Diversely, forest regrowth occurred mostly in high slopes, low elevation areas, high solar radiation and near to forest edges. Our findings reinforce the important role of topography and protected area on forest change, and highlight edge zones are “hotspots” of forest cover dynamics.

5. Prudic, K. L., Cruz, T. M. P., Winzer, J. I. B., Oliver, J. C., Melkonoff, N. A., Verbais, H., & Hogan, A. (2022). Botanical gardens are local hotspots for urban butterflies in arid environments. *Insects*, 13(10)

**Abstract:** Urban areas are proliferating quickly around the globe often with detrimental impacts on biodiversity. Insects, especially pollinators, have also seen record declines in recent decades, sometimes associated with land use change such as urbanization, but also associated with climate changes such as increased aridity. How these various factors play out in attracting and sustaining species richness in a complex urban matrix is poorly understood. Urban botanical gardens may serve as important refugia for insect pollinators in arid regions due to reliable water availability for both plants and insects. Here, we use community science data on butterfly observations to evaluate if botanical gardens can be hotspots of biodiversity in the arid urban landscapes of the southwest US. We found butterfly richness and diversity were

proportionally overrepresented in botanical gardens compared with the urban landscape they were embedded in. We conclude that biodiversity-friendly botanical gardens in urban arid regions can make a valuable contribution to pollinator conservation, in particular, in face of the continued aridification due to climate change.

6. Rebolledo Monsalve, E., Jiménez Prado, P., Molinero Ortiz, J., & Toulkeridis, T. (2022). Differences in fish abundance in rivers under the influence of open-pit gold mining in the santiago-cayapas watershed, esmeraldas, ecuador. *Water (Switzerland)*, 14(19)

**Abstract:** Illegal gold mining is on the rise in the tropical Andes. The Santiago-Cayapas watershed is located in the north of the Pacific basin of Ecuador, in the Chocó biogeographical region. It is recognized for its high biodiversity, as 62 fish species have been described in the area, and because it contains two of the largest protected areas in the Pacific coast of Ecuador: the mangroves of the Cayapas and Mataje Rivers and the Cotacachi-Cayapas Ecological Reserve. Open-pit gold mining has been described in the area since 2006 and most mining fronts operate illegally and lack any environmental control. Heavy-metal concentrations and fish communities were studied in streams that drain active and abandoned mines, in larger rivers located downstream of the mined areas and in control sites without mining activities. Open-pit mining causes a reduction of dissolved oxygen concentrations and an increase of water temperature, turbidity, and concentrations of Al, Cr, Co, Cu, Fe, Mn, and V. Fish abundance decreased in streams that drain active mines, however, metrics of taxonomic diversity remain unchanged among the study sites. The response of fish communities to open-pit gold mining was complex and driven by the pollution tolerance of each species, the presence of specific adaptations to turbid waters, and changes in the fishing pressure as locals avoid fishing activities in mined areas. Finally, streams that drain abandoned mines showed chemical characteristics, metal concentrations, and fish communities that were similar to control sites, but maintained higher water temperatures than control sites.

7. Reilly, S. B., Karin, B. R., Stubbs, A. L., Arida, E., Arifin, U., Kaiser, H., Bi, K., Hamidy, A., Iskandar, D. T., & McGuire, J. A. (2022). Diverge and conquer: Phylogenomics of southern wallacean forest skinks (genus: *Sphenomorphus*) and their colonization of the lesser sunda archipelago. *Evolution*, 76(10), 2281-2301.

**Abstract:** The archipelagos of Wallacea extend between the Sunda and Sahul Shelves, serving as a semipermeable two-way filter influencing faunal exchange between Asia and Australo-Papua. Forest skinks (Genus *Sphenomorphus*) are widespread throughout southern Wallacea and exhibit complex clinal, ontogenetic, sexual, and seasonal morphological variation, rendering species delimitation difficult. We screened a mitochondrial marker for 245 *Sphenomorphus* specimens from this area to inform the selection of 104 samples from which we used targeted sequence capture to generate a dataset of 1154 nuclear genes (~ 1.8 Mb) plus complete mitochondrial genomes. Phylogenomic analyses recovered many deeply divergent lineages, three pairs of which are now sympatric, that began to diversify in the late Miocene shortly after the oldest islands are thought to have become emergent. We infer a complex and nonstepping-stone pattern of island colonization, with the group having originated in the Sunda Arc islands before using Sumba as a springboard for colonization of the Banda Arcs. Estimates of population structure and gene flow across the region suggest total isolation except between two Pleistocene Aggregate Island Complexes that become episodically land-bridged during glacial maxima. These historical processes have resulted in at least 11 *Sphenomorphus* species in the region, nine of which require formal description. This fine-scale geographic partitioning of undescribed species highlights the importance of utilizing comprehensive genomic studies for defining biodiversity hotspots to be considered for conservation protection.

8. Robles-Tamayo, C. M., García-Morales, R., Romo-León, J. R., Figueroa-Preciado, G., Peñalba-Garmendia, M. C., & Enríquez-Ocaña, L. F. (2022). Variability of chl *a* concentration of priority marine regions of the northwest of Mexico. *Remote Sensing*, 14(19)

**Abstract:** Priority Marine Regions (PMR) are important areas for biodiversity conservation in the Northwest Pacific Ocean in Mexico. The oceanographic dynamics of these regions are very important to understand their variability, generate analyses, and predict climate change trends by generating an adequate management of marine resources and their ecological characterization. Chlorophyll *a* (Chl *a*) is important to quantify phytoplankton biomass, consider the main basis of the trophic web in marine ecosystems, and determine the primary productivity levels and trends of change. The objective of this research is to analyze the oceanographic variability of 24 PMR through monthly 1-km satellite image resolution Chl *a* data from September 1997 to October 2018. A cluster analysis of Chl *a* data yielded 18

regions with clear seasonal variability in the Chl *a* concentration in the South-Californian Pacific (maximum values in spring-summer and minimum ones in autumn-winter) and Gulf of California (maximum values in winter-spring and minimum ones in summer-autumn). Significant differences ( $p < 0.05$ ) were observed in Chl *a* concentration analyses for each one of the regions when climate patterns—El Niño/La Niña Southern Oscillation (ENSO) and normal events—were compared for all the seasons of the year (spring, summer, autumn, and winter).

9. Sáez-Gómez, P., & Prenda, J. (2022). Freshwater fish biodiversity in a large mediterranean basin (guadalquivir river, S spain): Patterns, threats, status and conservation. *Diversity*, 14(10)

**Abstract:** The Guadalquivir River Basin is one of the largest in the Iberian Peninsula and has a remarkable freshwater biodiversity. Although many studies on hydrological regimes or water quality have been conducted in this basin the biodiversity of freshwater fish, as well as their distribution and conservation status, has never been globally addressed as in other Iberian basins. In this context, we synthesized information on freshwater fish using field procedures and a bibliographic search. Fish distribution patterns at different spatial scales and general environmental conditions were analyzed as well as the conservation status of the fish community. We documented the presence of 40 species (20 native and 20 exotic) in the basin during the 20th century until today. However, we only captured 18 species during the field sampling, with a prevalence for any native species of less than 23% (except *Luciobarbus sclateri*). The highest species richness was found in mid reaches, while the lower reaches had very low diversity values. Around 50% of species are threatened; according to the IUCN, several species are declining at an alarming rate and others are probably extinct and/or their current status is unknown. Human disturbances during the last few decades have caused serious changes in fish distribution and consequently to their conservation status. Hydrological alterations, intensive agriculture and introduced species are probably the principal reasons for Guadalquivir's ichthyofauna imperilment. Our study indicates an urgent and real need to identify important areas for fish conservation to guarantee a minimum fish biodiversity conservation over the long term, as well as effective strategies for fish recovery where it still is possible.

10. Santos, M., Moreira, H., Cabral, J. A., Gabriel, R., Teixeira, A., Bastos, R., & Aires, A. (2022). Contribution of home gardens to sustainable development: Perspectives from A supported opinion essay. *International Journal of Environmental Research and Public Health*, 19(20)

**Abstract:** Home gardening has a long history that started when humans became sedentary, being traditionally considered an accessible source of food and medicinal plants to treat common illnesses. With trends towards urbanization and industrialization, particularly in the post-World War II period, the importance of home gardens as important spaces for growing food and medicinal plants reduced and they began to be increasingly seen as decorative and leisure spaces. However, the growing awareness of the negative impacts of agricultural intensification and urbanization for human health, food quality, ecosystem resilience, and biodiversity conservation motivated the emergence of new approaches concerning home gardens. Societies began to question the potential of nearby green infrastructures to human wellbeing, food provisioning, and the conservation of traditional varieties, as well as providers of important services, such as ecological corridors for wild species and carbon sinks. In this context. and to foster adaptive and resilient social–ecological systems, our supported viewpoint intends to be more than an exhaustive set of perceptions, but a reflection of ideas about the important contribution of home gardens to sustainable development. We envision these humble spaces strengthening social and ecological components, by providing a set of diversified and intermingled goods and services for an increasingly urban population.

11. Schlegel, J. (2022). Butterflies benefit from forest edge improvements in western european lowland forests, irrespective of adjacent meadows' use intensity. *Forest Ecology and Management*, 521

**Abstract:** The joint effect of forest edge (FE) heterogeneity and management intensity of the adjacent farmland on FE insect communities is still poorly understood. In this study, a pairwise design was established, consisting of 36 Western European lowland FEs, with each of the 18 FE pairs containing one improved and one nearby non-improved FE. Half of the FE pairs were situated along extensively used and half along intensively used meadows, leading to gradual contrast patterns. Butterflies were selected as the survey group because they contain widely recognized flagship species and are meaningful indicators of landscape quality and resource availability. The main outcomes were as follows: (i) FE improvements led to higher overall FE

heterogeneity scores, calculated on the basis of 16 floristic and structural indicator values. (ii) Overall butterfly species richness and butterfly abundance both benefited from higher FE heterogeneity. (iii) Butterfly species richness was higher on improved FEs, irrespective of adjacent meadows' use intensity. (iv) Butterfly abundance was higher on improved FEs, mainly due to high contrast situations between improved FEs and adjacent intensively used meadows. (v) FE improvements resulted in higher butterfly indicator species richness and abundance. The strategy of the canton of Aargau in Switzerland, where this study was conducted, to ecologically improve around 200 km of additional FEs in the longer term is believed to further promote butterfly diversity in the transition zone between closed forest and open landscape.

12. Tan, K., Li, J. -, Fang, Y. -, Sun, H. -, Niu, X., Yang, S. -, Huang, Z. -, & Xiao, W. (2022). How the color of reflective materials influences the occurrence of mammals and birds. *Global Ecology and Conservation*, 38

**Abstract:** Color reflective materials have been widely employed in agriculture, airports, and road traffic as signals and to prevent the damage caused by mammals and birds. The negative impacts of such applications on wildlife have been acknowledged, but little is known about the particular effects of different colors applied to these materials. We recorded the occurrence of wildlife using 56 camera traps placed in locations affected by different reflective color sheeting (red, yellow, green, blue, white, mirror and control without disturbance) in a subtropical montane forest of southwestern China. We compared richness and abundance of ground bird and mammal species. The results showed that the yellow reflective material has an attractive effect on birds during daytime compared with the control group, while the red and green ones appear to repel them. However, the general tendency was a reduction of bird species occurring at night because of all the different sources of reflective light. For mammals, no significant difference was found among disturbances during either day or night. Species showed different responses to specific colors but further research in this regard is needed. Based on these experimental findings, we recommend that all reflective materials should be avoided or used carefully within protected areas. Moreover, red and green signals are suitable for airports and agriculture fields to effectively prevent damage and safety concerns inflicted by birds.

13. Ulimboka, R., Mbise, F. P., Nyahongo, J., & Røskaft, E. (2022). Awareness of urban communities on biodiversity conservation in Tanzania's protected areas. *Global Ecology and Conservation*, 38

**Abstract:** This study used semi-structured interviews in two cities, Dodoma and Arusha, in Tanzania, to assess the difference in people's conservation awareness between the two cities. Our results revealed that urban people were generally positive towards most statements related to biodiversity conservation in protected areas, and in a few cases, variations between people from different occupations and education levels were significant. For instance, 87% (n = 376) of our respondents agreed with the statement "The knowledge obtained through conservation education is very important in changing our attitude towards protected areas," as well as 71% (n = 376) of our respondents agreed with the statement that "It is important to involve school children in conservation education." We predicted that people in Arusha would be more positive toward all six conservation statements than people in Dodoma (the capital city) because Arusha is close to many protected areas and is a tourist hub. We also predicted that people in Arusha would have more knowledge and awareness of biodiversity conservation than those in Dodoma. However, this prediction was not supported as people from Dodoma were significantly more positive than people from Arusha. This indicates that people in Dodoma are more concerned about biodiversity conservation than people in Arusha. This variation might be influenced by the costs associated with conservation, as people in urban Dodoma live far from conservation challenges such as livestock depredation and/or crop raiding compared to people in urban Arusha.

14. Vanderstock, A., Grandi-Nagashiro, C., Kudo, G., Latty, T., Nakamura, S., White, T. E., & Soga, M. (2022). For the love of insects: Gardening grows positive emotions (biophilia) towards invertebrates. *Journal of Insect Conservation*, 26(5), 751-762.

**Abstract:** As growing urban populations have fewer chances to experience nature, i.e., 'the extinction of experience', the subsequent loss of emotional affinities for biodiversity (biophilia) pose major challenges to environmental conservation. Gardening, as an everyday nature interaction and window into invertebrate ecological functioning may offer opportunities to develop biophilia. However, the associations between gardening and biophilia/biophobia towards invertebrates remains untested. We conducted an online survey (n = 443) with adults

in Japan about their nature and gardening experiences, demographics, and species identification knowledge in relation to their biophilia (like) and biophobia (dislike, fear, and disgust) towards invertebrates. We also asked participants about their perceptions of invertebrates as ‘beneficials’ or ‘pests’. From responses, we ranked invertebrates according to the attitudes held towards them. We found that frequent gardeners were more likely to express biophilia and perceive invertebrates as beneficial, and generally less likely to express biophobia towards invertebrates. Frequency of visits to recreational parks, but not national/state parks was associated with increased biophilia and reduced dislike and fear of invertebrates. Our results suggest that gardening, in addition to localised nature experiences, acts as a possible pathway towards appreciation of invertebrate biodiversity. We recommend that policymakers and conservation organisations view urban gardening as a potential tool to minimise the negative impacts of the extinction of experience.

15. Vignola, R., Esquivel, M. J., Harvey, C., Rapidel, B., Bautista-Solis, P., Alpizar, F., Donatti, C., & Avelino, J. (2022). Ecosystem-based practices for smallholders’ adaptation to climate extremes: Evidence of benefits and knowledge gaps in latin america. *Agronomy*, 12(10)

**Abstract:** Agricultural practices of smallholder farming systems of Latin America can play an important role in reducing their exposure to the risks associated with climate extremes. To date, however, there is no systematic analysis of scientific evidence for the extent to which these practices can provide the multiple benefits needed for smallholders to adapt to climate extremes. In this paper, we searched scientific databases to review scientific evidence of the benefit provided by twenty-six practices in crops commonly farmed by smallholders in the region and highly relevant for their food and nutrition security; namely, coffee, maize and beans. We reviewed scientific documents ( $n = 304$ ) published in the period 1953–2021 to register evidence of the practices’ effects on fifty-five benefits. Our analysis of these documents found measurement records ( $n = 924$ ) largely based on field experiments (85%). Our results show strong evidence of the multiple benefits that some ecosystem-based practices (e.g., tree-based practices for coffee and no tillage for maize) can provide to support the adaptation to climate extremes of smallholder farming systems and enhance a farm’s natural assets (e.g., biodiversity, water, soil). We also found that the majority of research on practices in the region focused more on the socioeconomic dimension (54%) rather than on the capacity



of practices to improve the natural assets of a smallholder farmers or reduce the impact of climate extremes. Given these knowledge gaps, we discuss the importance of a renovated investment in research to address existing knowledge gaps. Our concluding suggestions for future research include the need for systematizing existing knowledge from different sources (e.g., peer-reviewed, gray literature, farmers, extension agencies, etc.), and to assess the extent to which these practices can provide multiple benefits for smallholder farming systems by improving their wellbeing, reducing their vulnerability to different hydroclimatic extremes while also contributing to ecosystem services provision at the landscape level.

16. Yang, C., Li, M., & Wang, Z. (2022). A bibliometric analysis on conservation land trust and implication for china. *International Journal of Environmental Research and Public Health*, 19(19)

**Abstract:** Modern land protection and biodiversity conservation depend greatly on the application of land trust. With the accelerated development of land trust organizations, the land trust has become the most effective land conservation method. Land trusts have been widely used in the ecological protection of nature reserves abroad and have achieved remarkable results. The research on international land trusts has important reference value for the innovation of ecological protection models of China's nature reserves. This study aims to explore the research hotspots of international land trust conservation, clarify the evolution of related knowledge, and provide a reference for domestically related theoretical research and practical work. The research results show the following: (1) From the perspective of the publication trend, the number of international research publications increased exponentially from 1997 to 2021, and the research involves a wide range of disciplines. (2) In terms of research hotspots, land trust and private land protection, the impact of and response to climate change, and the trust mechanism in collaborative governance constitute three hot research topics. (3) From the knowledge base of the research, the international land trust research has formed seven knowledge clusters with clear boundaries, and five key documents with the theme of conservation easements constitute an important knowledge base in this field. (4) Land trust conservation easement as private law can effectively make up for the deficiency of public law. These findings can provide help and reference for domestic land conservation, as well as the reform of China's ecological civilization system.

17. Zanon, T., Gruber, M., & Gauly, M. (2022). Walking distance and maintenance energy requirements of sheep during mountain pasturing (transhumance). *Applied Animal Behaviour Science*, 255

**Abstract:** Sheep pasturing has become an important means for landscape management and conservation in marginal areas of mountain regions by reducing succession with dwarf shrubs and bushes, thus creating space for valuable forage grasses. Furthermore, mountain sheep pasturing for meat production also contributes to local food security. However, little is known about the energetic expenditures of sheep during mountain pasturing, which is important information for optimizing the productivity and economic efficiency, environmental aspects (e.g., biodiversity) as well as animal welfare. Therefore, the aim of the following study was to estimate the maintenance energy requirements of ewes over the whole mountain pasturing period (transhumance) considering movement patterns assessed by using satellite-based Global Positioning System (GPS) tracking devices. Energy requirements for walking increased rapidly at the beginning of transhumance (May - June), which could be explained by the longer walked distance and by overcoming variable altitude during that phase. Walking speed was slower compared to previous findings due to the difficult terrain of mountain pastures on which sheep moved. Energy demand for walking was strongly correlated with walking distance and walking speed. Results out of this study contribute in promoting the efficiency and consequently the rentability of alpine sheep pasturing systems. The latter ensures the production of local food and further preserves the ecosystem services linked to this low-input production system.

18. Zhang, T., Hou, M., Chu, L., & Wang, L. (2022). Can the establishment of national key ecological function areas enhance vegetation carbon sink? A quasi-natural experiment evidence from china. *International Journal of Environmental Research and Public Health*, 19(19)

**Abstract:** The National Key Ecological Functional Areas (NKEFAs) of China rely on the main functional area planning, with the core goal of enhancing the supply of ecological products. Carbon sink is an important ecological product, and it is necessary to understand whether the establishment of NKEFAs has enhanced vegetation carbon sink (CS). Considering the establishment of NKEFAs as a quasi-natural experiment, based on the panel data of prefecture-level cities in China from 2001 to 2019, a time-varying difference-in-differences (DID) model is used to systematically examine the impact of NKEFAs on CS. The study found that the

establishment of NKEFAs has significantly enhanced the CS, and compared to the non-NKEFAs, NKEFAs has increased CS in the covered areas by an average treatment effect (ATE) of 2.1625. The establishment of NKEFAs can enhance CS through the optimization of territory spatial structure, the upgrading of industrial structure and the inter-industrial mobility of labor. The enhancement roles of NKEFAs on CS are heterogeneous across different functional area types, geospatial locations, and quantile levels, with higher enhancement of CS at windbreak–sand fixation type, northwestern region and high quantiles, respectively. In addition, NKEFAs not only have a significant positive ecological spillover effect, but also balanced with local economic growth, they achieve the goals of “lucid waters and lush mountains are invaluable assets”.

19. Zhang, X., Zhang, B., Yao, Y., Liu, J., Wang, J., Yu, F., & Li, J. (2022). Variation model of north-south plant species diversity in the qinling-daba mountains in china. *Global Ecology and Conservation*, 38

**Abstract:** Understanding the variation patterns of mountain plant species diversity is becoming increasingly important in forest ecosystem management and protection. However, the research on plant species diversity has mainly focused on changes in whole plant species. Therefore, an in-depth study of the change mode of plant species via different classification methods and its impact on the overall change in plant diversity is very important for forestland restoration and biodiversity protection. In this study, the Qinling-Daba Mountains, a major feature of China's north–south transitional zone, were selected as the study area. Based on the floristic data of 58 nature reserves in the Qinling-Daba Mountains and its adjacent areas, the north–south change patterns of plant orders, families, genera and species diversity were first analyzed. Second, plant species were divided into different groups according to taxonomic group (orders, families and genera), life form (trees, shrubs and herbs) and endemism (species endemic and nonendemic to China). The change patterns of each group in the north–south direction were analyzed. Finally, the effects of different groups on the north–south change patterns of whole species are discussed. The species diversity of orders, genera and species exhibited a typical latitudinal gradient pattern, specifically, it gradually decreases from south to north, but the species diversity is relatively scattered. According to the north–south variation in species diversity in each order, families and genus, 5% of the orders, 2% of the families and 6% of the genera were positively correlated with latitude, and the rest were negatively correlated or

uncorrelated. According to the north–south variation patterns of different life forms, the diversity of trees and shrubs showed a bimodal Gaussian distribution with latitude. According to the north–south variation patterns of plant endemism, the diversity of endemic species showed a Gaussian distribution with latitude, but the diversity of nonendemic species was negatively correlated with latitude. The dispersion of whole species diversity is caused by species in a few orders, families and genera, trees and shrubs, and endemic species. They may be more strongly affected by the vertical zonality of the mountains, which is inconsistent with the typical latitude gradient model. Our research will provide a basis for forestland management, nature reserve establishment and biodiversity conservation.

20. Zhu, S., Li, L., Wu, G., Liu, J., Slate, T. J., Guo, H., & Li, D. (2022). Assessing the impact of village development on the habitat quality of yunnan snub-nosed monkeys using the INVEST model. *Biology*, 11(10)

**Abstract:** The habitats of the already endangered Yunnan snub-nosed monkey (*Rhinopithecus bieti*) are degrading as village economies develop in and around these habitat areas, increasing the depopulation and biodiversity risk of the monkey. The paper aims to show the areas of these monkeys' high-quality habitats that are at highest risk of degradation by continued village development and hence be the focus of conservation efforts. Our analysis leveraged multiple tools, including primary component analysis, the InVEST Habitat-Quality model, and GIS spatial analysis. We enhanced our analysis by looking at habitat quality as it relates to the habitat suitability for the monkey specifically, instead of general habitat quality. We also focused on the impact of the smallest administrative scale in China—the village. These foci produced a clearer picture of the monkeys' and villages' situations, allowing for more targeted discussions on win–win solutions for both the monkeys and the village inhabitants. The results show that the northern habitat for the monkey is currently higher quality than the southern habitat, and correspondingly, the village development in the north is lower than in the south. Hence, we recommend conservation efforts be focused on the northern areas, though we also encourage the southern habitats to be protected from further degradation lest they degrade beyond the point of supporting any monkeys. We encourage developing a strategy that balances ecological protection and economic development in the northern region, a long-term plan for the southern region to reduce human disturbance, increase effective habitat restoration, and improve corridor design.

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