Challenges And Opportunities For Paleo-Informed Ecosystem Conservation In Asia

PAGES DiverseK Workshop In Beijing, China.

13-15th May, 2023

Workshop Handbook

CONTENTS

Introduction

The Local Organizing Committee in China and the PAGES DiverseK Working Group are pleased to welcome you to the DiverseK workshop "Challenges and opportunities for Paleo-informed ecosystem conservation in Asia" in Beijing，China on 13-15th May 2023. This workshop involving thematic oral and poster sessions and an intra-meeting field trip, is designed with the following objectives**:** 1) the network development among paleoecologists and stakeholders in Asia with a common goal of effective ecosystem management; 2) the cross-comparison of management solutions under different national schemes within Asia; 3) the identification of best conservation approaches in light of paleo-evidence from the respective regions.

Workshop: 14-15th May 2023

The workshop will hold two overarching sessions as highlighted below:

- **Session I. Environmental policies and ecosystem management in Asia and around the world**

This session will focus on the cross-comparison of management solution under different national schemes within Asia and those said to be successful ecosystem management practices outside of Asia that are based on multi-disciplinary approach merging the social and environmental sciences.

- **Session II. Paleo-informed ecosystem conservation**

This session will focus on sharing experiences from case-studies in Asia where conservation issues are tackled in different ways, drawing recommendations from paleo-data (e.g. conservation of dry steppe environments across Mongolia and China, forest management in different regions of Asia; fire management in human-dominated tropical landscapes; conservation of *Pinus yunnanensis* forest in Southwest China).

Conference Venue

The conference will be held in room A316 (14th May) and A214 (15th May)**, Institute of Geographic Sciences and Natural Resources Research, CAS, Beijing, China.**
Conference Address: 11A, Datun Road, Chaoyang District, Beijing, 100101, China

Workshop Program

13th May
Registration **Open time: 9:00-18:00** **Location: Lobby of China National Convention Center Grand Hotel**

14th May

Meeting location: **Room A316,** Institute of Geographic Sciences and Natural Resources Research

Zoom meeting (9:00-12:00 Beijing Time): ID 811 2465 3874 & Passcode: 007007

https://us06web.zoom.us/j/81124653874?pwd=OTJwMXpjcVFkbGFjcmNrLzhXK241UT09

Time	Speaker	Content
9:00-9:20	CUI Qiaoyu	Welcome to DiverseK workshop
	ZHOU Liping	Welcome from PAGES

Section I

Time	Speaker	Title	Chairperson
9:20–9:40	WANG Guosheng	China's Forestry and Grassland Policies and Actions for Addressing Climate Change	CUI Qiaoyu
9:40–10:00	Charuta KULKARNI	Paleoscience–Policy "Commons": Connecting the Past to a Sustainable Future in a Human Dominated Tropical Biodiversity Hotspot	
10:00–10:20	XIN Xiaoping	Changes and patterns of Eurasia grassland in past two decades	
10:20–10:40	LIU Hongyan	Reconstruction of the LGM refugia and post-glacial distribution development of temperate tree species for nature conservation in China	
Group Photo & Coffee Break			
11:00–11:20	JIN Tong	Embracing nature-based solutions to tackle global environmental challenges: Practices from a global environmental NGO	WU Jing

11:20–11:40	Meghna AGARWALA	Role of fires in ecosystem management in tropical dry forests in Central India: perspectives from across the Holocene	
11:40–12:00	FANG Keyan	Tree life span increases with increasing aridity	
12:00–12:20	WANG Yue	Plants maintain climate fidelity in the face of dynamic climate change	
12:20–14:00	Lunch on Bus		
14:00-17:00	Workshop trip (Visit to Zhoukoudian Site Museum)		
17:00-19:00	Transportation from the museum back to the conference venue		
19:00 -21:00	Invited Dinner		

15th May

Meeting location: **Room A214,** Institute of Geographic Sciences and Natural Resources Research

Zoom meeting (9:00-12:00 Beijing Time): ID 811 2465 3874 & Passcode: 007007

https://us06web.zoom.us/j/81124653874?pwd=OTJwMXpjcVFkbGFjcmNrLzhXK241UT09

Section II

Time	Speaker	Content	Chairperson
9:00–9:20	Laurent MARQUER	Pollen-based land cover modelling for knowledge integration	CUI Qiaoyu
9:20–9:40	Michał SŁOWIŃSKI	History of fire regime shifts during the last 1600 years in North Eastern Mongolia	
9:40–9:55	JIE Dongmei	Phytolith evidence for changes of the vegetation diversity and cover in Songnen grassland since the mid-Holocene	
9:55–10:10	SONG Song	A meta-analyze of biodiversity responds to Paleocene-Eocene Thermal Maximum (PETM)	
10:10–10:25	CHEN Li	The status and working practice of biodiversity conservation in Hulunbuir	
Coffee Break			
10:45-11:00	PENG Yangbo	Yunlong Multi-Value Forest Conservation and Restoration	

11:00-11:15	SI Hongmin	The role of fire in the Central Yunnan Plateau ecosystem: a case study of *Pinus yunnan*ensis forest	JI Ming
11:15–11:30	JI Ming	Using lake sediment-based paleoecology research to inform fire management policy in SW China	
11:30–11:45	CHENG Yuanyu	Assessing lake ecosystem recovery from acidification and responses to emerging environmental stressors: a paleolimnological perspective	
11:45–12:00	Maurice NGABIRE	Significance of ecosystem restoration policy in the Shiyang River Basin	
Lunch Time			
13:30-14:30	**Poster presentations**		WU Jing
	DING Guoqiang	Late Holocene transition from natural to anthropogenic forcing of fire regime in Arid Central Asia	
	CUI Qiaoyu	Holocene fire history: methods, current knowledge, and potentials for the understanding of past vegetation and climate dynamics in China	
	ZHANG Yao	Fire history in the Qinling Mountains of east-central China since the Last Glacial	
	WU Jing	Carbon dynamics in Lake Sifangshan from Northeast China since the Last Deglaciation	
	LIU Xiaolei	Climatic and anthropogenic impacts on Holocene vegetation and biodiversity in southern Sweden	
	Brief introduction of ECRs participants		
14:30-15:30	**Discussions & Common view I**		
Coffee Break			
15:50-16:50	**Discussions & Common view II**		
16:50-17:00	Wrapping up		CUI Qiaoyu
18:00 -21:30	A night tour to the Beijing Downtown (optional)		

Organizing Committee

- Qiaoyu Cui, Institute of Geographic Sciences and Natural Resources Research (CAS), China (qiaoyu.cui@igsnrr.ac.cn); Steering Committee (SC) of DiverseK
- Liping Zhou, Peking University, China (lpzhou@pku.edu.cn); Executive Committee of PAGES
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- Copes-Gerbitz, Faculty of Forestry, University of British Columbia, Canada; SC of DiverseK
- Liping Zhou, Peking University, China; Executive Committee of PAGES
- Yan Zhao, Institute of Geographic Sciences and Natural Resources Research (CAS), China
- Yiyin Li, Peking University, China; SC of IPN
- Jing Wu, Institute of Geology and Geophysics (CAS), China; members of DiverseK
- Ming Ji, Yuxi Normal University, China; members of DiverseK

Sponsors

National Natural Science Foundation of China

PAST GLOBAL CHANGES (PAGES)

Zhoukoudian Site Museum

General Information

Accommodation

The accommodation will be arranged at the **China National Convention Center Grand Hotel** (4-star), located in the central area of the Olympic Park and 0.1 km away from the conference venue. Rooms of different types have been reserved with discount rate for conference participants. The address of the hotel is Building 1, No. 8 Precincts, Beichen West Road, Changyang District, Beijing, China. For more detailed information, please visit the website the hotel webpage: http://en.chinanationalconventioncenter.cn/

Transportation

From airport to conference hotel

Route 1: Beijing Capital International Airport to conference Hotel
Subway:
Take the airport express subway line and get off at Sanyuanqiao Station.
Change to subway Line 10 and get off at Beitucheng Station.
Change to subway Line 8 and get off at Olympic Part Station.
Exit through Exit I and walk about 600 meters to reach the conference Hotel.
Taxi:
The journey is about 28 kilometers and takes approximately 40 minutes depending on traffic conditions.

Route 2: Beijing Daxing International Airport to conference Hotel
Subway:
Take the airport express subway line and get off at Caoqiao Station.
Change to subway Line 19 and get off at Mudanyuan Station.
Change to subway Line 10 and get off at Beitucheng Station.
Change to subway Line 8 and get off at Olympic Part Station.
Exit through Exit I and walk about 600 meters to reach the conference Hotel.
Taxi:
The journey is about 63 kilometers and takes approximately 70 minutes depending on traffic conditions.

Note: The transportation information provided is for reference only. Please plan your trip according to the actual situation.

From train station to conference hotel

Route 1: Beijing South Railway Station to conference Hotel
Subway:
Take the subway Line 14 and get off at Yongdingmenwai Station.
Change to subway Line 8 and get off at Olympic Part Station.
Exit through Exit I and walk about 600 meters to reach the conference Hotel.

Taxi:
The journey is about 20 kilometers and takes approximately 30 minutes depending on traffic conditions.

Route 2: Beijing West Railway Station to conference Hotel
Subway:
Take the subway Line 9 and get off at Baishiqiaonan Station.
Change to subway Line 6 and get off at Nanluoguxiang Station.
Change to subway Line 8 and get off at Olympic Part Station.
Exit through Exit I and walk about 600 meters to reach the conference Hotel.

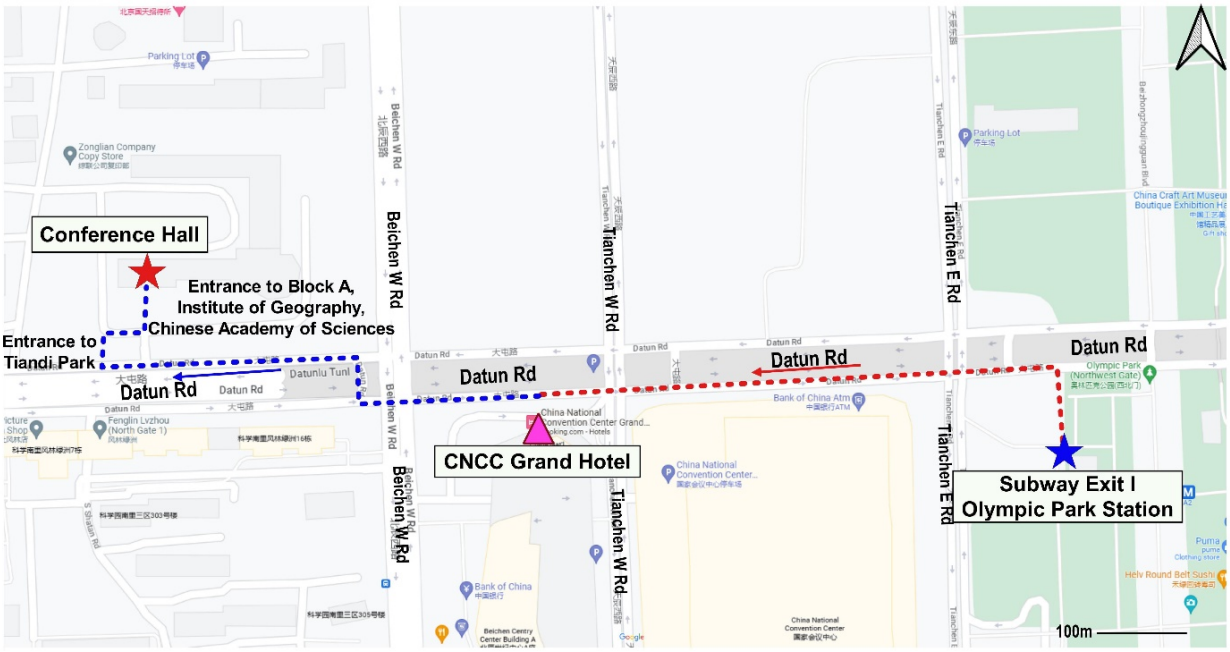
Taxi:
The journey is about 17 kilometers and takes approximately 25 minutes depending on traffic conditions.

Route 3: Beijing Station to conference Hotel
Subway:
Take the subway Line 2 and get off at Gulouwaidajie Station.
Change to subway Line 8 and get off at Olympic Part Station.
Exit through Exit I and walk about 600 meters to reach the conference Hotel.

Taxi:
The journey is about 17 kilometers and takes approximately 25 minutes depending on traffic conditions.

From conference hotel to conference venue

Walking distance about 500 meters.



Conference venue - Hotel – Olympic Park subway station

Information on the workshop trips

Zhoukoudian Site Museum

The ruins of Zhoukoudian are located in Fangshan District, about 50 kilometers southwest of Beijing, backed by the undulating Taihang Mountains, facing the vast North China Plain, is the place where the "Beijing people" lived between 700,000 and 200,000 years ago, the fourth site of early Homo sapiens 200,000 to 100,000 years ago, the pastoral cave people about 4.2-38,500 years ago, and the mountaintop cave people about 30,000 years ago. A total of 27 sites of various fossils and cultural relics of different periods have been found at the Zhoukoudian site, and more than 200 human fossils, more than 100,000 stone tools, a large number of fire relics and hundreds of animal fossils have been unearthed, becoming a world-famous treasure of human fossils and a multidisciplinary comprehensive research base for paleoanthropology, archaeology, paleontology, stratigraphy, chronology, environmental science and karst.

Beijing Downtown in May

A night tour to the Beijing (BJ) downtown will be organized during the workshop. The visit route will offer you to experience the urban glamour of BJ from parts of the new BJ (Olympic part) and old BJ (Yandaixiejie Hutong, one of the most age-old streets in BJ). The guides will be the volunteers from local organization committees. More information about this tour will be released during the workshop.

Fees for workshop trips

There are no fees for workshop trips.

Abstract

Paleoscience–Policy "Commons": Connecting the Past to a Sustainable Future in a Human Dominated Tropical Biodiversity Hotspot

Charuta KULKARNI[1], Dhanya BHASKAR[2]
1. Independent Researcher, Chennai, India.
2. Indian Institute of Forest Management, Bhopal, India.

Achieving food security while maintaining biodiversity is a major challenge for tropical regions that are threatened by global climate change with serious implications for livelihoods of billions. Given the long histories of human occupation and the influence of past climates and land-use practices in shaping tropical landscapes, it is essential to incorporate ecological as well as cultural legacies in their planning and management. Conservation and restoration plants often fail to acknowledge the significance of such legacies, resulting in conflicts between restoration targets and people's needs. We argue that building science–policy interfaces is crucial for envisioning pragmatic environmental solutions–in particular, to encourage paleoscience–policy connections, we introduce the concept of "commons" i.e., mutual areas of interest where specific environmental management issues can benefit from a long-term perspective. Bringing examples from tropical paleoecology and environmental policy, we show how the identification of such mutual areas of interest is pertinent in establishing and expanding paleoscience–policy interfaces. We discuss that identification of paleoscience-policy commons is a requisite for effective tropical landscape management where policy-relevant paleo-studies as well as dialogs between scientific and policy circles are rare. As a case study, we explore agroforestry systems of the Western Ghats of India, one of world's biodiversity hotspots where tropical rainforests support the highest human population density. We identify two commons for the Western Ghats agroforestry systems where past ecological studies with a focus on local policy issues could aid in visualizing appropriate and inclusive management choices. We contemplate that expanding the list of paleoscience–policy commons and complementing it with historical and indigenous knowledge for a region will be key to uncover the complex drivers of tropical ecosystem transformations, thereby supporting natural as well as cultural values in landscapes. Such paleoscience–policy connections have the potential to incorporate long-term perspectives in environmental planning and can promote inclusive approaches within policymaking.

Changes and patterns of Eurasia grassland in past two decades

Xiaoping XIN
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Global grassland covers almost 1/5 of Earth's land surface and is one of the most extensive and important terrestrial vegetation types. With an area of 11.83 million km^2 (based on the 2020 GlobeLand30 dataset), Eurasia grassland accounting for approximately 1/3 of the total global grassland area and 22% of the total Eurasia land area. In this research, we comprehensively evaluated Eurasia grassland ecosystems and their changes using remote sensing technology based on long-term series indicators, including vegetation productivity, fractional vegetation cover, aboveground standing biomass, carrying capacity and utilization intensity, while providing supplemental information in support of field-based surveys, meteorological data and socioeconomic statistics. We also further evaluated the utilization status of the main grazing grasslands, hotspots and typical regions.

Since the 21st century, the overall vegetation status of Eurasia grassland has improved, with over 85% of grassland GPP and over 80% of grassland FVC exhibiting an increasing trend. The average theoretical carrying capacity during 2010~2020 increased by 15.93% compared with that during 2000~2010, equivalent to the forage supply for 230 million sheep units, which approximately equals to the total number of sheep produced each year in China. A total of 71.94% of the main grazing grasslands in Eurasia increased from the perspective of spatial changes. A total of 48.56% of the main grazing grasslands had an increased aboveground standing biomass from the perspective of spatial changes. 69.67% of the main grazing grasslands in Eurasia tended to increase, and a reduction trend was found in 4.80% of the main grazing grasslands.

Reconstruction of the LGM refugia and post-glacial distribution development of temperate tree species for nature conservation in China

Hongyan LIU[1], Qian HAO[2], Ying CHENG[3]

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2. School of Earth System Science, Tianjin University, Tianjin, 300072, China
3. School of Geography and Tourism, Shanxi Normal University, Xi'an, 710119, China

The importance of long-distance migration from low to high latitudes relative to local spread from northern refugia after the Last Glacial Maximum (LGM) remains a focus of debate for many temperate tree species. Three lines of evidence, palaeoecology, phylogeography, and species distribution models, were adopted to detect the LGM refugia and post-glacial distribution development of temperate tree species in China. Our results show that climate was the main influencing factor for oak migration, while human activities did not show much influence on this widespread genus. The topography acted as a buffer and made the mountains to act as refugia under a deteriorated climate. Compared with birch and pine, the refugia locations and migration routes of deciduous oak species were different because of their physiological differences. Birch emerged after the Last Glacial Maximum (LGM), when the climate ameliorated gradually. Birch distribution in mid-latitudinal northern China was mainly driven by the EASM or its variability, especially during the LGM and early Holocene when the climate was unstable, while the replacement by pine and oak occurred during the mid-Holocene when the climate remained stable. The future unstable climate may benefit birch development. The three lines of evidence jointly suggest that Chinese pine, an endemic species, persisted through the last glaciation in the mountains surrounding the Loess Plateau of northern China and that the current distribution of the species originated primarily from the spread of local refugial populations, instead of long-distance migration. These results cast doubt on the notion that Chinese pine migrated from areas south of the Yangtze River and underscore the importance of northern refugia. Our results also confirmed that altitudinal migration of forests might exist in the dry temperate forest-steppe ecotone. This kind of altitudinal migration of forests under different altitudinal ranges could help to explain the inconsistent patterns observed in arboreal pollen across sediment cores as well as the non-linear response of horizontal forest distribution in relation to climate change. Our studies shed light on nature conservation of temperature forests under fast climate warming in northern China.

Embracing nature-based solutions to tackle global environmental challenges: Practices from a global environmental NGO

Tong JIN
The Nature Conservancy, Beijing, 100600, China

The world is facing the interconnected crises of rapid climate change and biodiversity loss. Three quarters of the carbon dioxide emissions driven by humans have occurred since 1950. A nearly 70% average decline of birds, amphibians, mammals, fish and reptiles since just 1970. The Paris Climate Agreement, the Kunming-Montreal Global Biodiversity Framework, and the UN Sustainable Development Goals have set ambitious goals towards 2030. What we do between now and 2030 will determine whether we're able to limit the global warming to 1.5 degrees Celsius-the level scientists agree will avoid the worst impacts of climate change, as well as halting and reversing the trend of biodiversity loss and ultimately safeguard people from catastrophic effects of these crises. The Nature Conservancy (TNC), a global environmental nonprofit working more than 70 years to champion nature-based solutions, has also set its own 2030 goal and shaped its organizational focus to protect healthy land, freshwater and ocean, sustain food and water that people depend on, and tackle climate change by fully unlocking nature's potential. Here we present TNC's conservation plan to 2030 and provide several practical examples across the globe, including China, to illustrate how we adopted a science-based, innovative and collaborative approach to achieve the transformational system change towards 2030 goal.

Role of fires in ecosystem management in tropical dry forests in Central India: perspectives from across the Holocene

Meghna AGARWALA[1], Charuta KULKARNI[2]
1. Ashoka University, India
2. Independent Researcher, Chennai, India

While fire-climate interactions across the Holocene have been examined, fire-climate coupling varies across the world and across ecosystems, necessitating regionally validated studies that establish patterns in different regions. Although there have been several palaeo-ecological studies in India, and in central India, the existing palaeo-ecological studies do not include micro-charcoal data that would help quantify fires across the Holocene. 9641 square kilometres of forests in central India were “highly fire prone” or above in Forest Survey of India’s 2019 report, but the acceptable levels of fires in central Indian forests is unknown. On one hand, scholars suggest that forests of central India are fire-mediated and require fire to maintain open canopy; open canopy is a stable state of the ecosystem. Also, a recent study from Central India finds highest biomass and species diversity at intermediate fire frequencies. On the other hand, fires lead to Lantana infestation, carbon emissions and loss of biodiversity. Given the short time period of ecological studies, this study uses past analogues from across the Holocene to understand fire-climate interaction with species and trait composition of forests in central India, as has been done in other continents. Such a study will help us understand: (a) which traits are associated with and resilient to increasing fire frequency; (b) whether there is a positive feedback between increasing temperatures, reducing precipitation and changing trait composition and identify thresholds for these changes; (c) quantify expected rate of change of forest and trait composition at different rates of climate change; (d) project future scenarios for fire and trait composition in central India based on climate change projects; and (e) understand the factors associated with Teak range expansion into Sal range in the Holocene that would inform management of these economically important species as the climate changes. Researchers have already analysed 19 sediment cores in central India, and used these to map changes in species composition across the Holocene across a temperature and precipitation gradient. However, these studies lack information on micro-charcoal. Our study collects sediment cores from two of these sites, and analyses the core for species composition (palynology), micro-charcoal, stable isotopes (for C3-C4 transition), and uses AMC radio-carbon dating for creating high resolution age-depth models with smaller confidence intervals. The results will be very useful for Forest Departments in central India for forest management and climate adaptation, and contribute to advancement of science.

Tree life span increases with increasing aridity

Keyan FANG
Key Laboratory for Humid Subtropical Eco-Geographical Processes of the Ministry of Education, School of Geographical Sciences, Fujian Normal University, Fuzhou, 350007, China

It is generally accepted that old trees play vital roles in biodiversity conservation and forests' carbon reservoirs. However, the distribution of tree life span and its relationship with environmental conditions has not yet been described under climate changes. Global tree ring datasets were generally collected from the old trees, enabling researchers to extract knowledge on tree longevity. Using dated tree-ring width measurements from living and dead conifers in 4421 sites, we investigate the distribution of the tree life span and its influencing factors. We found that the oldest trees are in Cupressaceae and Pinaceae genera, and the precipitation is the main factor limiting tree life span while the temperature-effect is marginal. Old trees are mainly distributed where the precipitation is lower than 400 mm. Tree life spans are high for trees with slow juvenile growth rates and high resilience under harsh climate conditions. Increasing life span due to drought may length the period of forest carbon sinks.

Plants maintain climate fidelity in the face of dynamic climate change

Yue WANG
School of Ecology, Sun Yat-sen University, Shenzhen, Guangdong, 528406, China

Plants will experience considerable changes in climate within their geographic ranges over the next several decades. They may respond by exhibiting niche flexibility and adapting to changing climates. Alternatively, plant taxa may exhibit climate fidelity, shifting their geographic distributions to track their preferred climates. Here, we examine the responses of plant taxa to changing climates over the past 18,000 y to evaluate the extent to which the 16 dominant plant taxa of North America have exhibited climate fidelity. We find that 75% of plant taxa consistently exhibit climate fidelity over the past 18,000 y, even during the times of most extreme climate change. Of the four taxa that do not consistently exhibit climate fidelity, three—elm (*Ulmus*), beech (*Fagus*), and ash (*Fraxinus*)—experience a long-term shift in their realized climatic niche between the early Holocene and present day. Plant taxa that migrate longer distances better maintain consistent climatic niches across transition periods during times of the most extreme climate change. Today, plant communities with the highest climate fidelity are found in regions with high topographic and microclimate heterogeneity that are expected to exhibit high climate resilience, allowing plants to shift distributions locally and adjust to some amount of climate change. However, once the climate change buffering of the region is exceeded, these plant communities will need to track climates across broader landscapes but be challenged to do so because of the low habitat connectivity of the regions.

Pollen-based land cover modelling for knowledge integration

Laurent MARQUER
Department of Botany, University of Innsbruck, Austria

How to understand the current state of ecosystems and biodiversity? To answer this question, one should explore the legacy of land use and climate changes on present ecosystems. Such legacy should be assessed over a long-time perspective of decades, centuries and millennia to provide reliable information about rates of ecological change, periods of stability, cycles, seral stages and adaptive shifts in ecosystems. To access to this information, and therefore help the societies to plan a resilient future, it is critical to develop modelling schemes for cross-disciplinary research.
Historical baselines can be assessed by using biological proxies such as pollen preserved in sedimentary archives (e.g. lakes and bogs). Pollen records from these archives provide information about past vegetation dynamics at decades, centuries and millennial time scales. However, the non-linear nature of the pollen-vegetation relationship has made it difficult to get quantitative data about past land cover changes using fossil pollen records. Pollen-based land cover modelling (e.g. Landscape Reconstruction Algorithm) has been developed over the last decades to correct biases related to pollen production, dispersion and deposition in order to finally assess quantitatively the past land cover changes at a known spatial resolution. Spatial pollen-based quantitative reconstructions of past plant cover open up the possibility of achieving a considerably more robust assessment of the respective influence of climate and human land-use on land cover changes throughout the Holocene. Knowing the spatial scale of the reconstructions is of a particular interest for combining data from different disciplines such as archaeology/history, dendrochronology and paleoclimatology which aims at increasing our understanding about the degree of the impact of past and ongoing climate changes on societies.
This talk, based on the experience gained in Europe, aims at discussing the current developments in pollen-based land cover modelling to quantify a long-term perspective of landscape change from a local to a regional scale, e.g. spatial plant abundances, rate of plant compositional change and plant diversity indices. In the coming years, these modelling schemes could increase the stakeholder potential to explore long-term monitoring datasets and promote options for paleoecological data integration into biodiversity preservation and land management options.

History of fire regime shifts during the last 1600 years in northeastern Mongolia

Michał Słowiński[1], Milena Obremska[2], Dashtseren Avirmed[3], Michał Woszczyk[4], Saruulzaya Adiya[3], Dominika Łuców[1], Agnieszka Mroczkowska[1], Agnieszka Halaś[1], Witold Szczuciński[5], Andrzej Kruk[6], Mariusz Lamentowicz[7], Joanna Stańczak[8], Natalia Rudaya[9]

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7. Climate Change Ecology Research Unit, Adam Mickiewicz University, Poznań, Poland
8. PaleoData Lab, Institute of Archaeology and Ethnography SB RAS, Novosibirsk, Russia
9. Department of Geology and Geomorphology, Faculty of Geographical Sciences, University of Lodz, Lodz, Poland

In recent years, rapid climatic changes have occurred in Central Asia, particularly in Mongolia. An increase in the thickness of the active layer over permafrost and significant changes in vegetation structure are likely consequences of the long-term temperature increase and precipitation changes. Management of future habitats or biodiversity in northern Mongolia will be significantly complicated by rising temperatures, prolonged and frequent droughts, and gradual degradation of permafrost. Our knowledge of the historical processes of permafrost degradation and the resulting ecological impacts is still largely incomplete. These relationships can be used to explain changes in fire regime, permafrost thaw, and vegetation distribution in the Khentii Mountains region. Based on a multiproxy study of peat archives. We provide the first high-resolution fire history from northeastern Mongolia over the past 1000 years. We studied microscopic and macroscopic charcoal particles as indicators of fire activity. We also tracked changes in regional and local plant composition using pollen data. To investigate how changes in fire regimes and climate affect peatland ecosystem functioning, we also conducted a geochemical analysis. In addition, to better understand changes in past fire regimes and the relationships between fire and vegetation, we used macro charcoal morphotypes to pinpoint vegetation burning. The main objective of this study is to assess the effects of human behavior, vegetation, and prolonged droughts on the frequency of fire regime transitions during the last 1000 years in the Central Asian permafrost margin (Mongolia). The results show that most fires in this area were likely triggered by natural causes, probably related to heat waves that led to prolonged droughts. We have linked the increase in fires to the local weather phenomenon known as "dzud" a catastrophic coincidence of winter snowfall and droughts that affects fire intensity.

Phytolith evidence for changes of the vegetation diversity and cover in Songnen grassland since the mid-Holocene

Dongmei Jie[1,2], Guizai Gao[1,2], Nannan Li[3], Dehui Li[4]
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2. Key Laboratory of Geographical Processes and Ecological Security in Changbai Mountains, Ministry of Education, Changchun, China
3. College of Ocean and Earth Sciences, Xiamen University, Xiamen, China
4. College of Resources and Environment, Hebei Normal University, Shijiazhuang, China

Accurate estimates of grassland ecosystems changes and an understanding of the mechanisms responsible are essential for predicting future changes and for conservation planning. Phytolith is considered to be a reliable indicator for reconstructing the palaeovegetation in grassland ecosystems, however, few phytolith study has attempted to quantitatively reconstruct the corresponding plant community characteristics. In our study, combined with soil phytoliths and plant species inventory data from 77 sites in the Songnen grassland in Northeast China, we established a modern soil phytolith reference for identifying the grassland types and quantitatively indicating plant community cover and species richness. On this basis, the phytolith based paleovegetation in Songnen grassland is Poaceae-dominant communities rather than an Artemisia-Chenopodiaceae ecosystem since the mid-Holocene. And the C4 species' abundance has been increasing in the Songnen grasslands, although C3 vegetation is still dominant. The species richness and plant cover were high and relatively stable for most of the studied interval, but they decreased significantly in the last ~1,000 years. The long-term evolution of this grassland ecosystem was dominated by climate changes, but it was also affected by human activities and local habitat factors. Therefore, phytolith-based reconstruction of Holocene grassland evolution and their driving mechanisms can potentially be used to facilitate conservation planning in this temperate grassland ecosystem.

A meta-analyze of biodiversity responds to Paleocene-Eocene Thermal Maximum (PETM)

Song SONG[1,2], Zihua TANG*[1,3], Shiling YANG[1,3]

1. Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, 100029, China
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The Paleocene-Eocene Thermal Maximum (PETM, ~56 Ma) represents one of the most abrupt global warming events of the past 65 million years that is manifest as a large negative carbon isotope excursion (CIE) and global warming of 4–8°C, which also be considered as the best prehistoric analog for current global warming conditions. Considerable efforts are focused on individual sites and sections in recent decades, but little is known for estimating the biodiversity changes across the PETM event. Here we bring together 19 studies published raw palynological counts and/or relative-abundance data for genus or species-level taxa which correlated to the PETM event, using Meta-analyze based on Hill number for further understanding the diverse change of global vegetation. The results of Meta-analyze indicated that the PETM brought the increasing of global vegetation diversity, and the low and the middle latitude exhibited more evident growth. After the PETM, the diverse continued to increase in the low latitude of the north hemisphere and the middle latitude in the south hemisphere, and decreased in the high and the middle latitude of the north hemisphere.

The status and working practice of biodiversity conservation in Hulunbuir

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Hulunbuir is located at most northern part of China, adjacent to Russia and Mongolia, with a total area of 253,000 square kilometers. Forests, grasslands, rivers, lakes, and wetlands are all over the region. The 13.3 million hectares of forest, and 149 million acres of grassland makes it an important national ecological function and biodiversity conservation priority area, which plays a vital role as an important ecological security barrier and one of richest wildlife resources in northern China.

In recent years, Hulunbuir has continued to promote grassland protection, vigorously implemented the strategy of protecting and repairing grassland ecological barriers, focused on ensuring grassland ecological security, curbed the trend of grassland degradation, and promoted the balance of ' human activity- grazing- grassland protection'. Grassland ecological restoration and management have begun to take shape, and grassland ecological management capabilities have been significantly enhanced. Hulun Lake is the largest lake in Inner Mongolia, which is an important water source for the vast grassland surrounding. It has important ecological functions, such as regulating climate, conserving water, preventing desertification, protecting biodiversity and maintaining ecological balance. Hulunbuir has promoted the comprehensive management of the ecological environment in the Hulun Lake Basin, and executed projects such as desertification land management around the lake, grassland degradation management, and upgrading and reconstruction of sewage treatment plants along the rivers into the lake. From 2016 to 2020, 40 governance projects were completed, with a total investment of 4.998 billion RMB. The biodiversity index and the ecological environment of Hulun Lake has been continuously improved.

After the implementation of the natural forest protection project, the amount of timber harvesting decreased year by year. In 2015, the Greater Khingan Mountains region in Hulunbuir stopped the commercial harvesting of natural forests roundly. By vigorously implementing land greening, promoting key ecological projects such as natural protection projects, 'three north' protection forests, forest tending, and forest pest control, scientifically implementing disaster reduction and natural disaster prevention, steadily expanding forest area, improving forest quality, and enhancing forest ecological functions, the environment on which wildlife depends has changed significantly.

Yunlong Multi-Value Forest Conservation and Restoration

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In 2014, an area next to Yunnan Yunlong Tianchi National Nature Reserve was burnt by a wildfire, and in 2015, an infrared camera captured the Yunnan snub-nosed monkeys adjacent to the site, redefining the southernmost distribution of the species. Therefore, Shan Shui Conservation Center decided to start a restoration project on the burnt site for the habitat conservation of Yunnan snub-nosed monkeys. From 2017 to 2019, 67 hectares of the burnt area were restored with native species, and 173,300 seedlings were planted. From 2020 to 2022, forest tending has been done every year, including but not limited to, pruning Yunnan pine and fertilizing broad-leaved trees.

Beyond its core objective of ecological restoration, the project also pursued goals like scientific research, local community development, nature education, and so on. Therefore, multiple stakeholders have been involved, including non-governmental organizations, nature reserves, scientific research institutions, local communities, enterprises, foundations, and the public.

Specifically, scientific research institutions are invited to do the long-term monitoring of vegetation, mammals, insects, birds, soil, water quality, and meteorology on the burnt site, and the monitoring result of the artificially restored area will be compared with that of the nearby naturally restored area. Local community residents were also invited to help with tree planting and forest tending since they are key participants in the forest recovery process. Eco-fair products and nature education courses have been developed for the local community and the Nature Reserve. Nature watch festivals and volunteer activities were organized for the public to get to know more about forest recovery and the Yunnan snub-nosed monkey conservation.

The role of fire in the Central Yunnan Plateau ecosystem: a case study of *Pinus yunnanensis* forest

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Fire plays a significant role in fire-dependent ecosystems in shaping plant traits, community assemblage, and in maintaining biodiversity and sustaining ecosystems. Excluding fire from fire-dependent ecosystems can substantially alter these ecosystems. The Central Yunnan Plateau is a hot spot of wildfire in China. Some plant species in this region have developed fire-adapted traits. *Pinus yunnanensis* forest is the most widely distributed vegetation in Central Yunnan Plateau. We found that *P.yunnanensis* has multiple fire adaptive traits, including the typical trait of fire embracer—serotiny cones- and some fire tolerator's traits, like thick basal bark, seedling grass stage and self-pruning. The development of those adaptive traits suggests that fire is a recurrent disturbance in *P. yunnanensis* forests. The age composition of *P.yunnanensis* population presents a "discontinuous multi-age cohort" structure. And age cohorts correspond to the burned years of historical fires found from fire sacres, indicating that population recruitments of *P.yunnanensis* depended on fire disturbances. Recurrent fires could also clean up the seedlings and saplings of late-successional species with poor fire resistance, stop the successional process, and form long-standing *P. yunnanensis* forests. These results suggest that the *P.yunnanensis* forest is a fire-dependent system. Recurrent fires are crucial in maintaining the population and in the community assembly. Fires in the Central Yunnan Plateau forests should not be viewed as totally catastrophic events.

Using lake sediment-based paleoecology research to inform fire management policy in SW China

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Important consequences of increasing castrophic wildfires around the world on human welfare, climate change, ecosystem carbon source loss, biodiversity conservation and enormous enonomic costs is calling wildfire management policy shift to adaptive, to mitigate current and future exacerbating fire regime. *Pinus yunnanensis* forest (Yunnan Pine forest) , a fire-adapeted/dependent forest system, the dominated lanscape in Central Yunnan of SW China, has experienced, is experiencing and will experience above fire management challenging under global warming background. For the aim of knowing the role of fire disturbance in *Pinus yunnanensis* forest and filling the gap between ecology and paleoecology, we used lake sediment paleoecology research, including pollen, phytolith, marco-charocoal, archaeological site records etc. to try to reconstruct long-term climate-vegetation-fire-human activity complex interaction. Our study suggest that current fire regime of *Pinus yunnanensis* forest is at the peak value since Holocene with no historical similarity pattern. Ancient Dian people has changed nature fire regime since 3.2 Ka cal yr BP. Drought and wildland-village interface human activity is the most important influence factors of *Pinus yunnanensis* forest fire regime.

Keywords: *Pinus yunnanensis* forest, fire regime, paleoecology, fire management policy shift

Assessing lake ecosystem recovery from acidification and responses to emerging environmental stressors: a paleolimnological perspective

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Mining and smelting activities have heavily affected the Sudbury (Ontario, Canada) region since the late-19th century, leading to acidification and metal contamination in many ecosystems. Regulations on restricting acidic emissions were enacted in the 1970s, after which many Sudbury-region lakes recorded increasing pH and decreasing metal concentrations. Meanwhile, other emerging stressors such as climate warming and lake brownification have likely affected these lakes over the past few decades. Here we revisit Sudbury-region lakes, half a century after the application of remedial efforts, aiming to assess lake ecosystem recovery from acidification and their responses to newly emerging environmental stressors. First, a canonical correspondence analysis is used to assess the relationships between surface-sediment diatom assemblage structure and environmental variables for 80 lakes. Lakewater pH remains the strongest environmental variable shaping diatom species distributions, and so is used to construct a robust inference model (R^2_{boot} = 0.73; RMSEP = 0.32). Additionally, by assessing ecological changes experienced by a subset of these lakes (n = 33) over the past few decades, two major trends are identified: (1) an overall increase in diatom-inferred pH, and (2) a rise in the relative abundance of planktonic taxa. Further, down-core analyses in dated sediment cores are conducted to assess detailed ecological changes for three historically acidified lakes and two reference systems over the past ~200 years. Despite recording marked chemical recovery, the acidified lakes showed minimal or no evidence of biological recovery, with recent diatom assemblages markedly different from pre-disturbance assemblages, likely due to the legacy effects of acidification and climate warming. Our study demonstrates that even half a century after the reduction of acid deposition, biological recovery is still lagging behind chemical recovery in acidified systems. Moreover, due to emerging environmental stressors, particularly accelerated climate warming, a return to pre-disturbance biological assemblages may be unachievable. In light of these findings, it is crucial for managers to understand the marked time difference between chemical and biological recoveries after disturbances, as well as the possibility that a disturbed ecosystem may never fully return to its former state.

Significance of ecosystem restoration policy in the Shiyang River Basin

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Achieving zero Land Degradation Neutrality (LDN) in dryland areas under aeolian desertification and soil salinization is a challenging task that requires continuous scientific understanding and technical efforts to effectively manage natural resources for economic development while meeting environmental needs. For example, in the Shiyang River basin, harsh climatic conditions and overexploitation of water resources orchestrated extreme ecological deterioration that led to land degradation and expansion of desertification at an unprecedented rate, particularly in the downriver of Minqin County. In response, the government, the scientists' community, and stakeholders joined their efforts and expertise to establish a sustainable land rehabilitation and water resources management program. This study used Remote Sensing data to investigate the efficacy of established land management policies to restore degraded land and reverse the aeolian desertification process in the Shiyang river basin between 1990 and 2020. Results show that for the past three decades, land management systems, rational water allocation, and conservation measures have resulted in satisfying results despite the odds of water resources shortage and climate change and provided a promising future for a sustainable ecosystem in the Shiyang River Basin. Till 2020. 2526.9 km^2 of degraded land was reversed, and 1772.6 km^2 of land was rehabilitated entirely; however, 2049.6 km^2 has deteriorated, particularly in the Qilian mountains, a small area of Yongchang and Lianzhong District, the Northwest of the Shiyang River Basin, and the surrounding areas of Minqin oasis and more importantly, since late 2010s water in Qingtu is gradually re-emerging at a satisfying rate. These findings highlight land management contribution, rational water allocation, and conservation measures to reverse desertification and maintain a sustainable ecosystem despite climate change impacts and water resources shortage in the Shiyang river basin. This research will help decision-makers set up novel land management programs for better eco-environment development in the future.

Late Holocene transition from natural to anthropogenic forcing of fire regime in Arid Central Asia: a charcoal record from Lake Sasikul, Pamir Plateau

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The long-term changes of fire regime in Arid Central Asia are poorly known due to the scarcity of sedimentary records. Here, we analyzed charcoal from the sediment of Lake Sasikul to reconstruct the fire regime on the Pamir Plateau over the past 2500 years. The regional fire regime reconstructed by the concentration of fine-grained charcoal (<50 μm) presents a long-term increasing trend. Comparisons with palaeoclimatic and historical data suggest that the regional fire regime before 1 kyr (1 kyr = 1000 cal yr BP) was mainly responded to climate change, while more controlled by human activities after 1 kyr. Intriguingly, the local fire regime reconstructed from coarse-grained charcoal (>100 μm) concentrations is different from the regional one, with a highest level from 1.8 to 0.6 kyr. Due to the lack of local human activities, the local fire history could be attributed to natural climate changes for all of the study period.

Holocene fire history: Methods, current knowledge, and potential for understanding past vegetation and climate dynamics in China

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Understanding the role of fire in the terrestrial biosphere and its consequences for ecosystem-climate dynamics is of key importance for projecting the climate changes in the future. The long-term interactions and feedbacks among fire, climate, and land use have been recorded in various sedimentary archives with which we can measure. Hence, numerous charcoal records have been accumulated produced as the by-products of pollen analysis have accumulated in China; however, several continuous or high-resolution charcoal records are required from different regions and ecosystems to synthesise the long-term trends in fire regimes and to examine the key drivers of fire activity. Herein, this paper reviews the state-of-the-art methodologies commonly used to study fire dynamics and present the examples of fire regimes by regions and biomes based on sedimentary charcoal records. Subsequently, specific concerns about the requirement of further studies on past fires at multi-spatial-temporal scales in China are addressed, which will help improving our understanding of the links among fire, ecosystems, and climate dynamics.

Fire history in the Qinling Mountains of east-central China since the Last Glacial Maximum

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Fire activity has an important influence on climate changes and carbon cycling. Understanding past fire history and its driving mechanisms are essential to mitigate the impact of fires. The study of fire history and driving mechanisms at long time scales can provide a theoretical basis for future fire management and biodiversity conservation in forest areas. In this study, alpine lake sediments from Daye Lake in the Qinling Mountain Range, east-central China, were used to explore the interaction between fire, vegetation and climate change, as well as human activities since the LGM period, based on charcoals and black carbon. The results show that the increase of fire activity in Qinling region during the last glacial period was mainly controlled by regional aridity under weak East Asian summer monsoon. Human activities played an important role on fires activities since the middle Holocene and human-induced fires were commonly dominated in the late Holocene due to land use, e.g., the forest clearing for agriculture and the warfare. Temperature affected fire activity through biomass. The biofuel dominated by conifers induces high intensity fires in the last glacial and herbs contribute more to the high fire frequency over the mid-late Holocene. With future rising temperature, the increased vegetation cover and extreme climate events may increase the fire risk in the Qinling Mountain Range. Our results have implications for understanding fire history and management in other transitional vegetation zones globally.

Carbon dynamics in Lake Sifangshan from Northeast China since the Last Deglaciation

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Research on the global carbon cycle has become a hot issue, as atmospheric carbon dioxide concentrations have continued to rise since the industrial revolution. The terrestrial carbon cycle is an integral part of the global carbon cycle, and the aquatic environment is of great interest because of its ability to sequester large amounts of carbon. Among the aquatic environment, lakes are considered as the potential sequestration of large amounts of organic carbon in their sediments. Northeast China is one of the major lake regions in China, where some of the lakes belong to the volcanic crater lakes. These lakes with relatively small and stable catchments provide more reliable records of regional climate and environment changes, and their long-term lake sediments, covered the rapid warming during the last deglaciation, could be suitable for the study on the relationship between warming, vegetation change and carbon sequestration. Here, we present the pollen and carbon accumulation rate (CAR) records from the Lake Sifangshan in Northeast China to reveal the relationship between climate, vegetation change and carbon sequestration with other records of paleotemperature from study region. The pollen results indicate that the vegetation history has gone through distinct changes from meadow dominated by Cyperaceae and Poaceae to boreal forest dominated by *Betula* in the last deglaciation from 15.2 to 10.8 ka BP, forest steppe dominated by *Artemisia* and *Betula* between 10.8 and 6.9 ka BP, and forest steppe dominated by *Betula*, *Quercus* and *Artemisia* after 6.9 ka BP. According to the results of the pollen analysis, the period with the highest ratio of forest and grassland is between 12.8 and 10.8 ka BP. The values of CAR vary between 0.37 and 3.03 g C m^{-2} yr^{-1}, whose lowest values occur 13.3-11.1, 4.3-3.6, and 2.9-1.4 ka BP. Comparison with quantitative reconstructions of regional paleotemperature records reveal that CAR values from Lake Sifangshan decrease with cooling, which not correlate closely with the regional vegetation changes. The values of CAR are increasing with the warming of the last millennium.

Climatic and anthropogenic impacts on Holocene vegetation and biodiversity in southern Sweden: a multiproxy approach including pollen, plant macrofossil and insects

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Understanding the changes in plant diversity in Holocene and exploring the driving factors may provide references for future landscape management and biodiversity conservation strategies in southern Sweden and even northern Europe. Here, we use pollen records from the Holocene sediments of two bogs, Stavsåkra and Storasjö, in southern Sweden, to study regional vegetation changes based on biomes reconstruction and diversity analysis. We compared changes in plant diversity at two sites in southern Sweden with changes in local fires, as indicated by carbon debris, and changes in annual mean temperature and precipitation in Europe to reveal possible factors of Holocene plant diversity changes in this region. The results indicate that changes in plant diversity recorded by STAV and SSJ profiles in southern Sweden during the Holocene are closely related to fire frequency, which in turn is influenced by both climate change and human activities. There was a positive correlation between plant diversity and fire, and the high value of plant diversity corresponded to the high value of fire, and vice versa. At the beginning of the Holocene (10500–9000 cal yr BP), plant diversity was at a low value, which corresponded to a low fire frequency during this period. In the early and middle Holocene (9000–6100 cal yr BP), plant diversity was at a high value and increased overall, corresponding to a higher fire frequency. In the middle and late Holocene (6100–1000 cal yr BP), plant diversity at Storasjö was still high. However, plant diversity at Stavsåkra decreased rapidly in the middle and late Holocene (6100–3300 cal yr BP), corresponding to a very low fire frequency. During the late Holocene (~1000 cal yr BP), plant diversity decreased, possibly related to human activities. Moderate fire can form diversified habitats such as "forest gaps", thus improving plant diversity. Our results show that the "intermediate disturbance" hypothesis in modern ecology is also applicable to paleoecological changes, providing key evidence for a comprehensive understanding of the driving mechanisms of Holocene biodiversity changes.

Montane Atlantic Rainforest of Southeastern Brazil: altitudinal migration and microrefugia during the Late Pleistocene and Holocene

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The Montane Atlantic Rainforest is a unique and vulnerable ecosystem home to endemic and endangered species. In this study, we tested two hypotheses regarding its history and adaptation to climate change. First, we investigated migration from the mixed ombrophilous forest to the mountainous Serra do Mar region during the Last Glacial Maximum (22,000 yrs cal. BP). Second, we studied altitudinal migration and allocation of flora in microrefugia as a response to rising temperatures during the Middle Holocene (6,000 yrs cal. AP) in Southeast Brazil.

Palynological analysis, organic geochemistry, radiocarbon dating, and modern pollen rain samples were collected from the Curucutu Nucleus of the Serra do Mar State Park and Itatiaia National Park. Results showed the migration of Araucaria Angustifolia between 25,351 and 19,862 yrs cal. BP, indicating mixed ombrophilous forest in a forest/field mosaic landscape. Between 11,473 and 3,987 cal. yrs BP, forest vegetation significantly increased, illustrating the altitudinal migration of montane taxa to areas above 750 meters altitude. Palynological data from Itatiaia National Park showed altitudinal migration to areas above 2,200 meters altitude and the allocation of mountain taxa in microrefugia gradually starting around 6,213 cal. yrs AP and lasting up to 4,255 cal. yrs AP.

During the Middle Holocene, montane taxa possibly formed in both locations, currently occupied by herbaceous vegetation, in favorable microclimatic conditions of temperature and humidity, considered as microrefugia with cool and humid adapted taxa. Organic geochemical analysis supports palynological results and confirms the presence of plants with a C3 photosynthetic cycle between 6,000 and 4,000 cal. yrs BP, suggesting the presence of humid countryside/tree vegetation. Statistical analysis with the data of the modern pollen rain allowed the differentiation of the types of vegetation and the identification of the main components of the pollen spectra in both localities.

In summary, the study found evidence of migration and altitudinal adaptation of the Montane Atlantic Rainforest during the Last Glacial Maximum and Middle Holocene.

The use of multiple analytical methods and modern pollen rain samples allowed for a comprehensive understanding of the ecosystem's history and adaptation to climate change, providing insights for future conservation efforts.

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