Fraser Island is part of a large sand mass that extends along the subtropical coastline of south-eastern Queensland. The island is a World Heritage site, listed for its unique natural environment that includes numerous perched oligotrophic dune lakes and a diverse suite of coastal and subtropical vegetation communities. Here we present geochemical and microfossil information for a sediment core collected from Lake McKenzie, in the island’s centre. AMS $^{14}$C and $^{210}$Pb dating has been conducted and indicates a basal age of ca. 37,000 cal. BP. A hiatus in the sedimentary record is apparent at around 25 cm depth and spans the time period from ca. 18,280 to 13,990 cal yr BP. Elemental and stable isotope measurements of carbon and nitrogen in bulk organic matter, along with biomarker and compound specific carbon isotope analyses, show a clear shift in lake conditions appearing with the re-commencement of sediment accumulation following this hiatus. A marked decline in the abundance of microfossils of the green colonial algae *Botryococcus*, coincides with a distinct change in composition of *Botryococcus* derived lipids and a shift to more negative $\delta^{13}$C values of long chain odd $n$-alkane compounds. An increase in lake size around 13,990 cal yr BP is suggested by the recommencement of sediment accumulation at the site, and is presumably in response to increased effective precipitation. The lake McKenzie record provides a long-term perspective on changing environmental conditions in central Fraser Island.
Diatoms as Environmental Indicators to Infer Past Conditions in Relation to Acidity (Humedal de Batuco, Region Metropolitana, Chile Central)

Maria Laura Carrevedo\textsuperscript{1,2}, Claudio Latorre\textsuperscript{1,2,3}, Blas Valero Garcés\textsuperscript{3,4}, Ana Moreno\textsuperscript{3,4}

\textsuperscript{1}Department of Ecology, Pontificia Universidad Católica de Chile, \textsuperscript{2}Institute of Ecology and Biodiversity (IEB), \textsuperscript{3}Laboratorio Internacional de Cambio Global (LINCGLOBAL), \textsuperscript{4}Instituto Pirenaico de Ecología

Diatoms are the most common and diverse group of algae in wetlands, however the strong influence of acidity on distribution of diatom taxa has rarely been studied in Central Chile. Humedal de Batuco (33°12,152’ S, 70°49,490’ W) is a coastal wetland and has great relevance due to the landscape gradients that occur associated to disturbances of the coupled ocean-atmosphere system of the tropical Pacific. We use diatoms as bioproxies to infer past environmental conditions. In 2008 (under the multiproxy approach of LINCGLOBAL) a shortcore was obtained with a gravity corer: BAT1 (length 35 cm, 0.3 m depth). BAT1 (AMS date of 200±5014C yrs BP) was opened, photographed, described sedimentologically and volumetrically subsampled every 5 cm. Aliquots were taken for diatomic analysis, processed according to standard methods for diatoms, permanent slides mounted and the first 5 cm were observed under an optical microscope, understanding that the surface sediments represent an integrated sample of the diatoms of the wetland, both spatially and temporally. We identified 29 species belonging to Bacillariophyceae and calculated the generic relative abundance: Actinocyclus (1; 7,8%), Anomoeoneis (2; 3,9%), Aulacoseira (1; 2%), Cocconeis (1; 2%), Craticula (1; 3,9%), Cyclotella (2; 9,8%), Cymatopleura (1; 2%), Encyonema (1; 2%), Epithemia (1; 2%), Eunotia (4; 17,6%), Gomphonema (3; 5,9%), Navicula (4; 15,7%), Nitzschia (4; 11,8%), Pinnularia (1; 2%), Tabellaria (1; 2%) and Tryblionella (1; 7,8%). These results, based on presence-absence of species and generic relative abundance variations would indicate conditions of oscillating pH between alkaline and acidic in recent times.

OSM14 Effects on ecosystem dynamics
The primary aim of the study is generation of a biome map of India using the Holdridge life zone (HLZ) model. According to the HLZ model, natural vegetation of an area could be objectively determined by the local climate. Using this conceptual framework of HLZ model, minimum distance classifier and climatic datasets, the distribution of potential biomes was assessed. The study identifies nineteen (19) potential Holdridge life zones; seven (7) biomes and nineteen (19) sub-biomes in the Indian sub-continent. In order to verify the biome mapping precision, actual vegetation cover type map derived from IRS Wide Field Sensor (WiFS) data has been used to calculate the accuracy. The overall accuracy and kappa coefficient come out to be 82.7% and 0.75, respectively.

Climate change has become a familiar concept as some of its intense impacts are being increasingly recognized. Since the HLZ model uses climate parameters only; it can help predict potential biome redistribution. In this study, modeling was carried out on entire region of India using various combinations. First, the current (present) climate data was used to generate a primary biome map of India. Second, predictive modeling was carried out using different assumptions of changes in temperature and precipitation; and third, the IPCC predicted climate simulations was also used to test the similarity between the results. When the geographic shifts in ranges are considered, the results suggest Tropical Desert (Plains), Tropical Desert Scrub (Lower Montane), Tropical Very Dry Forest (Plains), Tropical Dry Forest (Plains), Tropical Dry Forest (Lower Montane), Tropical Moist Forest (Lower Montane), and Tropical Wet Forest (Lower Montane) being most susceptible to changes in the percentage of area cover under climate change for different years for emission scenarios and the various modeled climate change regimes. Such estimates are very important for the detection and assessment of regional impacts of climate change so that better management and conservation strategies can be adopted for the biodiversity and forest dependent community.
Poster
Foliar and total soil $\delta^{15}$N as a proxy for precipitation in the Atacama Desert

Francisca P. Díaz$^{1,2}$, Claudio Latorre$^{1,2}$

$^1$Departamento de Ecología, Pontificia Universidad Católica de Chile, Alameda 340, Santiago, Chile.; $^2$Institute of Ecology and Biodiversity (IEB), Las Palmeras 3425, Ñuñoa, Santiago, Chile.

Precipitation is an important control of the nitrogen cycle and known to affect the isotopic nitrogen signal ($\delta^{15}$N) of total soil N and leaves. In general, soil and foliar $\delta^{15}$N decreases with increasing mean annual rainfall across diverse ecosystems. Such changes in the N cycle would be important to detect in paleoecological records, especially in arid regions where rainfall is a limiting factor for biological activity. Here, we present a modern analog study of the $\delta^{15}$N signal along an environmental gradient in the Atacama Desert of northern Chile.

We performed vegetation and soils surveys along a 2000 m altitudinal gradient in the western Andean slope adjacent to the Atacama Desert. Rainfall increases by an order of magnitude along this gradient. We sampled 22 sites, starting at 4500 m (mean annual precipitation (MAP) = 160 mm/yr) and ending at 2500 m (MAP < 10 mm/yr). We analyzed the N content and $\delta^{15}$N of 28 soil samples and foliar $\delta^{15}$N of 50 specimens from widespread Andean-Atacama species (Baccharis tola, Jarava frigida, Opuntia camachoi, Parastrephia quadrangularis and Atriplex imbricata). We also compared the signal of two different seasons (after and before the rainfall season in summer).

Our results show no relation between total soil N (mg/kg) and MAP ($R^2 = 0.03$, $p>0.05$). In contrast, there is a significant negative correlation between mean soil $\delta^{15}$N and MAP ($R^2 = 0.77$, $p < 0.01$). This soil $\delta^{15}$N signal is persistent across the wet and dry seasons. Although foliar $\delta^{15}$N for individual species shows no correlation with MAP, mean foliar $\delta^{15}$N per site shows a significant positive correlation ($R^2 = 0.52$, $p < 0.01$). Thus despite the elevated intra-site variation observed for the foliar $\delta^{15}$N values, a large part of this variation can be explained by which species and season were analyzed.

Before we consider the paleoclimatic potential of foliar $\delta^{15}$N as a precipitation proxy in the Atacama, two aspects need to be addressed. First, mean soil $\delta^{15}$N is correlated with MAP as expected, but other processes could change the isotopic soil signal (e.g. age and depth) and should be considered before using it as a precipitation proxy. Second, mean foliar $\delta^{15}$N per site shows an important correlation with precipitation but individual species tend to be much more variable.

Finally, the challenge remains of finding suitable integrators of foliar $\delta^{15}$N in the paleoecological record. Fossil herbivore dung and urine $\delta^{15}$N preserved in caves and in rodent middens hold much promise in this regard.

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Treeline shifting in tandem with climate change is widely observed phenomenon in various parts of the world. With an array of different habitats and graded climatic zones, Nepal’s high mountains provide a great potential in multidimensional tree ring research. This dendroecological study was carried out at the treeline ecotone (3,750m - 4,003m asl) in Kalchuman Lake (Kal Tal) area of Manaslu Conservation Area in Central Nepal Himalaya with an aim to assess the impact of climate (environmental) change at treeline and its dynamics. Two rectangular vertical belt transect plots (20m x 250m) were marked out covering treeline as well as species limit. With ecological mapping of all individuals, tree-cores were collected from two dominant tree species of the area: Abies spectabilis (D. Don) Mirb and Betula utilis D. Don. Stand character and age distribution testified B. utilis more matured with maximum age of 300yrs compared to A. spectabilis (max. 160yrs). With younger plants (<50yrs) accounting for an overwhelming 89% of population, A. spectabilis has a substantially high recruitment rate. Population age structure along an elevational gradient revealed that the species has been shifting upward in recent decades at a rate of 2.61m per year. However, the upper distribution limit of B. utilis was stagnant in the past few decades having only13% of its population <50yrs old, and small number of seedlings and saplings in both transects. Temporal pattern of growth in A. spectabilis significantly negatively correlated with mean monthly temperature of July-August of current year and September of previous year although we also noticed that there was a tendency for positive relationship of growth with previous November through current March temperature. However, regeneration of A. spectabilis was positively related with May-Aug precipitation and Jan-Apr temperature of current year. Population demography indicates that the two most dominant tree species of treeline ecotone community have species specific response to climate change with much wider differences anticipated in the population status of the species as climate continues to change throughout the century. Further detail study is required to quantify the role of climate change and land use on the treeline dynamics of the Nepal Himalaya.
Climatic variables are known to affect the growth in trees. Tree rings produced as a result of annual growth is a best proxy to measure the influence of climate on growth. Several studies have established relationship between annual rainfall and growth by examining tree rings. We are presenting dynamics in carbon stock and rate of assimilation of carbon in peninsular India by examining the growth rings of Teak (Tectona grandis, L.f.). Teak is one of the dominant trees in the dry and moist deciduous forests of peninsular India. The dendro-climatic potential of teak is well established. The anthropogenic activities have led to increase in the concentration of CO2 in the atmosphere. Various biomes across the globe have responded to the elevated levels of CO2 differently. Trees have responded to the inter-annual variability in monsoon through changes in mortality, recruitment or growth. We have exploited the growth response of trees to the inter-annual variability in monsoon to understand the carbon sequestration. We have used the tree rings of teak from peninsular India to understand carbon dynamics over several years. We ask specifically how the monsoon variability affects the carbon stocks. We have employed allometric equations to estimate the biomass and carbon stocks. We analyzed the changes in the carbon stock and related that changes to amount of rainfall received. We further discuss the impact and significance of monsoon variability in Carbon dynamics. We also discuss the larger implications of climate change on forest systems of peninsular India and importance of dendrochronology in understanding dynamics of Carbon sequestration.
Permafrost melting and ecotoxicological consequences in a periglacial lake in the Eastern Alps: Answers from the past and present

Boris Ilyashuk\textsuperscript{1}, Karin Koinig\textsuperscript{1}, Elena Ilyashuk\textsuperscript{1}, Richard Tessadri\textsuperscript{2}, Roland Psenner\textsuperscript{1}

\textsuperscript{1}Institute of Ecology, University of Innsbruck, Austria, \textsuperscript{2}Institute of Mineralogy and Petrography, University of Innsbruck, Austria

Understanding how climate change influences mountain lakes both directly and indirectly by modifying catchment processes is central to ongoing and future research. Special emphasis is now placed on problems associated with the interactions between climate change, the melting mountain permafrost, enhanced pollutant release, and ecosystem health. Our study aims to contribute to the current understanding of the linkages between warming-related processes of excessive metal release from melting rock glaciers and potential ecotoxicological risks in high-alpine lakes. Here, we report the initial results from our ongoing research on lakes situated in a periglacial environment in the Ötztal Alps, Central Eastern Alps, Italy. The focus of the research is the assessment of ecotoxicological effects of trace metal inputs from an active rock glacier on the present-day ecosystem of Rasass See, a remote high-alpine lake (2680 m a.s.l.), and the reconstruction of changes in the ecotoxicological state of the lake during the Holocene caused by warming-related increases in discharge of metals from the rock glacier. In order to assess the current ecological status of this lake, where levels of nickel in water exceed its limit for drinking water by one order of magnitude, concentrations of trace elements were measured in the surface sediments and tissues of aquatic macrophytes and invertebrates. The measured values were used to assess the biomagnification factor of trace metals through the benthic food chain in the lake and to compare it with values measured in reference lakes without rock glaciers in their catchment. Frequency and severity of morphological deformities in chironomid larvae (Diptera: Chironomidae) from the lake were comparable with those recorded in lakes polluted by agricultural and industrial chemicals. The incidence of morphological deformities in living chironomid larvae is reflected well in their subfossil assemblages that yield a robust basis to reconstruct changes in the frequency of deformities and periods of critical ecotoxicological situations in the past.
Studies on ecosystem dynamics deal with the contemporary environmental processes operating in a given geographical region representing complex systemic interactions amongst landscape, topography, flora, fauna, climate, human interference, soil-cover, geological formations, etc. Palaeoecology, on the other hand, deals with the historical processes through multi-disciplinary studies involving palaeobiological, archaeological, physic-chemical an absolute dating of sediments. Later phases of late Holocene deposits provide a meeting hub for palaeoecological and neo-ecological studies as both the disciplines can potentially facilitate insights for “cause and effect” relationship, useful for seeking sustainable environmental applications for societal utility.

The paper deals with a multi-proxy palaeoecological study on a late Holocene biological assemblages from Lake Mansar (21 20E:79 20N) situated in Nagpur district of Maharashtra State, India. This shallow freshwater lake site is formed by impounding the rivulet during early Historical period. It falls under hot tropical, sub-humid eco-climatic zone of erstwhile central province of India receiving annual average rainfall varying from c. 1000 to 1250 mm. The major amount of precipitation results from southwest monsoon, from mid-June to mid-September and minor amount during winter season from the retreating monsoon. The lake lies at the base of a well excavated. Historical hilltop settlement of Mansar exhibiting three cultural phases of occupation and construction activities from c. 200 B.C. to 700 A.D.; namely Period I (c. 200 B.C.-200 A.D.), Period II (c. 250 -500 A.D.) and Period III (c. 500-700 A.D.). There is also an epigraphical and architectural evidence for bunding of rivulet (nullah) during Early Historic period (Personal communication: Joshi and Sharma). The archaeological excavations were carried out by J.P. Joshi and A.K. Sharma at the hilltop settlement (about 10 to 20 m above lake level) while the palaeoecological excavations (trenching) were carried out by our team (under the Research Project to 1st author by Deccan College) in the foot-hill lake of Mansar to understand mutual interactions and climatic fluctuations, if any, during the immediate past. Bio-geological variations of the lake during last circa two thousand years indicate hydrological change which could have been partly due to man-made activities as also natural environmental changes and discerning the two types of changes is difficult at this stage.

Thus, our multidisciplinary studies involving litho-stratigraphical, pollen analytical, radiocarbon, palaeontological, phytogeographical, neo-ecological approaches are being integrated for holistic unraveling of palaeoenvironmental changes of sub-recent biological diversity prevailing in the region. The vegetation and agricultural-botanical study of the hill-slopes and adjacent low-lying valley strips (mainly carried out by the first author during his initial research career around sub-humid hilly terrains around Pune and during later years, the second author participated in field visit) with respect to hill slope soils under semi-humid to sub-humid climatic regime with basaltic terrain of western India could possibly suggest comparable ecosystemic parallel for understanding relevance of the ‘palaeo’ processes during sub-modern period contemporary society.
Regional-scale dynamics in humid, late Holocene broadleaf forests

Neil Pederson, James Dyer, Ryan McEwan, Amy Hessl, Cary Mock, David Orwig, Harald Reider, Ben Cook

1Tree Ring Laboratory of Lamont-Doherty Earth Observatory and Columbia University, 2Ohio University, 3University of Dayton, 4West Virginia University, 5University of South Carolina, 6Harvard Forest, 7Lamont-Doherty Earth Observatory and Columbia University, 8NASA GISS

In humid, broadleaf-dominated forests where the prevailing disturbance regime is perceived as gap dynamics, paleoecological evidence shows regional-scale changes in disturbance regimes and forested ecosystems in association with climatic variation. Yet, there is little evidence of regional-scale disturbance linked with specific climatic triggers in extant forests. We use 76 tree-ring collections covering 840,000 km2 and 5.3k tree recruitment dates spanning 1.4 million km2 of the eastern United States to investigate the potential for regional-scale dynamics in late-Holocene forests through time. Specifically, we test a null hypothesis of gap dynamics in which disturbance and tree recruitment would resemble a white-noise process: forest dynamics would not be regionally synchronous and time-series of disturbance and recruitment would not deviate significantly above the long-term background rate. Importantly, we find that both time-series of forest dynamics reflect the annual, stochastic patterns of gap-dynamic processes expected in closed-canopy forests. However, both series also reveal the occurrence of regional-scale dynamics that are outside the envelope of gap-dynamic processes. Growth-release analysis of the 76 populations indicates severe canopy disturbance over 42,800 km2 from 1775-1780 peaking in 1776. The 1776 event is nearly seven sigmas above the 1685-1880 mean rate of disturbance. We also find that during years and periods of elevated disturbance, canopy disturbance is often more severe and occurs at broader spatial scales than the long-term mean. Climate plays a critical role in these dynamics as years of elevated disturbance are significantly associated with prior drought. Particularly, the 1775-1780 event was preceded by repeated drought as well as an extensive, severe frost event in 1774. A pulse of tree recruitment, composed of 34 different species, occurs over much of the eastern US during the late-1600s. According to multiple geologic and tree-ring based estimates of hydroclimate, a dry and highly variable climate precedes and occurs during this recruitment event. These two large, biodiverse, and geographically widespread data sets indicate that “white-noise” processes are not the sole drivers of forest dynamics in a humid, broadleaf-dominated region. Rare and intense events occurring 230-360 years ago are still influencing today’s old-growth forests across much of temperate eastern North America. In fact, the time-series of canopy disturbance is so poorly described by a Gaussian distribution that it can be considered ‘heavy tailed’ or a ‘Black Swan’ event, an event that can alter ecosystem trajectory. Similarly, the late-1600s recruitment event is of a scale and intensity that has not been previously described in extant forests of the eastern US. While it is well known that historical events resonate through the structure and dynamics of forested ecosystems for centuries, events from centuries ago have been uncovered for the first time at annual resolution that are still reverberating in today’s broadleaf forest. Given evidence of two Black Swan events and drought-driven disturbance, our results provide mechanisms of how climatic events can shape broadleaf forests for centuries. These insights are critical given the potential for more frequent extreme climatic events and rapid, regional-scale forest turnover with future climate change.
Sediment constitutes an essential compartment of an ecosystem where products from natural processes and anthropogenic influence accumulate with time. These sediment act as an archive for different environmental conditions, which leave geochemical signals in sediment that can be used to interpret both contemporary and paleoenvironmental histories. Organic matter (OM) preserved in sediment represent a unique reservoir of information about the biogeochemical processes in the geological past, and how these processes responded to environmental changes. The objective of the study was 1) to assess the geochemical signals through characteristics of organic matter from the Pichavaram mangrove-estuarine complex and 2) examine polycyclic aromatic hydrocarbons (PAHs) as biomarker for degree of hydrocarbon contamination. Five sediment cores were collected from different locations of the Pichavaram mangrove-estuarine complex. Each of these locations exhibited distinct characteristics with respect to vegetation cover, land-use pattern, and anthropogenic influence. Sediment cores were dated using lead-210 chronology and subsequently analysed for grain-size composition, pore water salinity, dissolved organic C (DOC), loss-on-ignition (LOI), elemental ratios (C/N and H/C), pigments (Chl a, Chl b, and total carotenoids) and polycyclic aromatic hydrocarbons (PAHs). Our results showed relatively high concentrations of pore-water DOC (32 ± 14 mg/L) and low salinity levels (50 ± 5.5‰) in locations from mangrove areas than estuarine areas. Likewise, LOI, organic C and N, and pigment concentrations were also higher in mangroves than estuarine areas. Source apportionment studies revealed that OM was mainly derived from upstream terrestrial matter and/or mangrove litter, and marine OM. The bulk parameters of organic matter indicated that the Vellar and Coleroon Estuaries are more affected by anthropogenic processes than mangrove forests. The source and vertical distribution showed an increased up-core in PAH flux in sediments which coincide with rapid urbanization since the 1970s. The flux showed a decrease in recent years (since 1990), which coincide with less riverine discharge to mangrove-estuarine complex. The low concentration of high molecular weight (HMW) PAHs in older sediments specified the direct impact of increasing anthropogenic activities in the area. Diagnostic PAH ratios showed that most PAHs in the sediments are derived from petrogenic sources, with a limited input from pyrogenic processes involved with combustion of firewood and lignite. In both estuarine and mangrove sediments, the sediment toxicity values remained far below the effect range low (ERL) and effect range medium (ERM) limits for LMW and HMW PAHs. Thus, despite the fact that PAH concentration increased, these compounds do not represent an immediate ecological hazard.
Poster

Holocene environmental variability – a high-resolution study from northeast Finland

Shyhrete Shala¹, Minna Väliranta², Karin F. Helmens¹, Tomi P. Luoto³

¹Department of Physical Geography and Quaternary Geology, Stockholm University, Stockholm, Sweden, ²Department of Environmental Sciences, University of Helsinki, Helsinki, Finland, ³Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland.

Environmental variability during the Holocene is, though not as pronounced as during glacial periods, commonly acknowledged to have been of considerable significance both to the flora/fauna and to human civilization. An exceptionally long lake sediment core retrieved from Lake Loitsana, northeastern Finland, allows for environmental reconstructions to be conducted with a decadal resolution. Our study covers the entire Holocene but with emphasis on mid to early Holocene; the aim is to quantify July temperatures and reconstruct environmental conditions such as catchment erosion, trophic status and vegetation development directly after the deglaciation and throughout the Holocene. Furthermore, the timing and magnitude of the Holocene thermal maximum (HTM); a warming which is mostly pronounced in the Northern Hemisphere and with summer temperatures 1-2°C higher than today, has been assessed. The methods used in this study include biogeochemical data (loss on ignition and C/N measurements), macrofossil analysis, diatom analysis, chironomid analysis, lithological characteristics and AMS ¹⁴C dating. A radiocarbon date on tree Betula seeds indicates that the area was deglaciated prior to 10 700 cal. yrs. BP and preliminary plant macrofossil and chironomid results suggest that a peak in temperature occurred already during early Holocene; a time when summer insolation was at its highest. Aquatic macrofossil taxa, i.e. Glyceria lithuanica, indicate mean July temperature of minimum 15°C at 10 700 cal. yrs. BP which is 2°C higher than present day climate. Diatom assemblages indicate changes in water depth as well as trophic state. The vegetation immediately after deglaciation in the Early Holocene appears to have responded rapidly to the summer insolation peak after the influence of the ice-sheet was diminished. The reconstructed timing of the HTM is inconsistent with quantitative pollen-based temperature reconstructions.
The arid landscapes of Trans-Himalayas covers the high altitude region of the Tibetan Plateau and its marginal mountains spread over 2.6 million sq km in the rain shadow of the greater Himalayas. These arid landscapes cover vast stretches of rangeland ecosystems, dominated by graminoid biomass. Being least productive ecosystems on earth, they have a unique assemblage of wild life populations. The region is one among the few places on earth that continues to support Pleistocene period large wild herbivores. The Pastoral activity in the rangelands dates back to several millennia with domestic ungulates sharing forage resources with wild herbivores. Competitive effects of resource overlap between livestock grazing on wild ungulates and hunting have resulted in local extinctions and overall decline in the population of wild herbivores from several regions. We have set out to understand the history of climatic and anthropogenic impacts on rangeland vegetation in order facilitate restoration and re-wilding. Given the importance of the rangelands in the Trans-Himalayas, our understanding of past vegetation composition which presumably supported a greater diversity of wild herbivores is limited.

Against this background, to understand past vegetation and species extinctions brought about by climatic changes in the region, we have collected 2 sediment cores from swamps in Kibber Plateau, Spiti Valley. We are using multi proxies such as, pollen, fungal spores, charcoal and geochemical evidence (C/N, %C, %N and $\delta^{13}$C) to reconstruct the historical events. Our initial results from geochemical proxies are presented here. The $^{14}$C age of the two cores cover a period of 6.3 kyr BP(core-1) and 5.9 kyr BP (core-2). $\delta^{13}$C from Core-1 has values ranging between -29.09‰ to -16.62‰ and core-2 between -22.38‰ to -10.79‰. Total organic carbon from the two cores vary between a high of 14.7% and 7.67% and a low of 1.04% and 2.85% along with nitrogen values between 0.85% to 0.13% and 0.38% to 0.11% respectively. Variations in C/N ratio from core-1 is between 17.86 to 6.38 and Core-2 is 32.48 and 15.38. C/N ratios and low values of $\delta^{13}$C from core-1 when compared to Core-2 suggests that the proportion of organic carbon is more from planktonic source than from the terrestrial plants. The variation in $\delta^{13}$C of core-1 with corresponding C/N ratio reflects predominance of C_3 type when compared to core-2 having C_4 type of vegetation. Around 6 kyr to 5 kyr BP, Core-1 shows no significant correlation with %C and C/N, suggesting the organic carbon source from the swamp itself and shows low value of $\delta^{13}$C (-24.60‰). However, Core-2 showed significant correlation with high value of $\delta^{13}$C(-19.16‰) during this period. Between 4kyr to 2kyr BP a positive trend is seen in core-1 with C/N and %C, and $\delta^{13}$C varies between -4% to -2% with a mean of -20%. Core-2 had no correlation between C/N and %C and $\delta^{13}$C fluctuating between -4% to -2% with a mean of -17‰ is observed. This reflects predominance of C_4 type with drier conditions during this period. Climatic signals inferred from two cores through $\delta^{13}$C is associated with C_3-C_4 transition in vegetation alternating with wet and dry phases since 6 kyr BP.
Talk
Long-term perspectives on landscape structure, ecological change and biodiversity during the Quaternary; comparisons between NW European Pleistocene fossil beetle assemblages

Nicki Whitehouse¹, David Smith², Danielle Schreve³

¹School of Geography, Archaeology & Palaeoecology, Queen’s University Belfast, UK, ²Institute of Archaeology and Antiquity, University of Birmingham, UK, ³Centre for Quaternary Research, Department of Geography, Royal Holloway, University of London, UK

Climate has been in continual flux over the Quaternary, and is directly or indirectly the primary determinant of the distribution of most insect species. The story of European Pleistocene beetles has been one of local extinction and invasion in response to climate and latterly, human impact. While many species have clearly changed their ranges compared to their modern distributions, none seem to have become globally extinct – at least in temperate latitudes – something that at first seems counter-intuitive in view of the perturbations of Pleistocene climatic events. Perhaps one of the striking aspects of these patterns concerns the similarity of the NW European fauna in the different warm and cool periods. The re-expansion of thermophilous species seen at the end of the last glaciation and in the early Holocene is no more than a coming together of a species configuration that have occurred many times previously, although each interglacial appears to have had its own novelties. How similar or dissimilar were assemblages between different warm stages? Why are some periods very similar, others far less so? One might expect ecological configurations to have become increasingly dissimilar, the further back one goes in time. However, this is far from the case. What drives these communities?

There are in excess of 100 published interglacial and interstadial sub-fossil beetle assemblages (excluding the late glacial interstadial) from the British Isles alone. These assemblages contain detailed species-level data, thereby offering the opportunity to examine long-term species and ecological trends against a changing climate story. We have examined these assemblages to investigate what drives faunal configurations; in particular, we assess the varying role of magafaunal herbivory and disturbance in creating novel communities and associated landscape spatial heterogeneity. Herbivory in particular appears to have had important, differing ecological repercussions during warm stages within invertebrate and plant groups, with associated implications for ecosystem processes and function. Here, we focus on changing ecological groupings of dung beetles, sand & gravel indicators, wood/tree and open/meadow species and present analyses from a range of sites dated to MIS stages 5e, 7, 9, 11 and several early Middle Pleistocene sites and compare results with the Holocene record. We examine three interlinked questions:

(1) Did landscape spatial heterogeneity change over the different stages studied and did this affect biodiversity in different ecological groups?
(2) What was the role of disturbance and herbivory in these periods and how do these compare with the present interglacial? Did they play an important role in biodiversity?
(3) How did biodiversity in the ecological groups examined change over the periods represented by the study sites?

Methodologically, this work also prompts difficult questions such as appropriate measures of past biodiversity and whether modern rarity categories are appropriate for the study of past species.
In a world where biomass burning is steadily increasing, understanding fire’s linkages to climate and human activity becomes increasingly important. Reconstructions of past fire provide a critical source of information to assess the role of climate and land-use change in altering fire regimes. A variety of paleofire proxy data (e.g., satellite, historical, tree rings, lake sediments, ice cores) is now available, and scientists within these communities have been actively engaged in data synthesis and database development. The Global Palaeofire Working Group, for example, has published important papers describing past trends in biomass burning at regional to global scales. These syntheses generally point to temperature as the primary driver of biomass burning, outweighing the influence of humans until (possibly) recently. In contrast, studies at finer scales highlight the importance of prehistoric humans in altering natural fire regimes by changing the frequency and timing of ignitions and modifying fuels. In between global and local-scale reconstructions lies the scale where human and climate probably interacted to shape fire regimes. Three examples from temperate forest ecosystems illustrate fire’s long-term role in shaping ecosystem dynamics and the opportunities for paleodata to inform fire management: (1) In the western US, charcoal data disclose the time since last fire and the long-term trajectories in fire area and frequency that relate to changes in climate and vegetation. Fire histories show considerable spatial variation as a result of sharply defined climate and fuel boundaries in a heterogeneous region, and the signature of anthropogenic burning is less clear. Understanding climate-fire-ecosystem links in the western US helps determine which ecosystem types and fire regimes are most altered by 20th century fire suppression and land-use change and which are most likely to burn in the future. (2) In northwestern Patagonia, the position of the forest-steppe ecotone is governed by climate change along a steep environmental gradient. Holocene charcoal records suggest that nonclimatic (human) drivers altered fire activity at a subregional scale and the resulting fire-fuel feedbacks shifted vegetation between forest and grassland stable states. Understanding the sensitivity of this ecotone to fire helps target areas of highest priority for fire management. (3) In New Zealand, prehistoric fires were rare prior to the arrival of Maori, ~700 years ago, and widespread use of fire during an initial burning period permanently transformed the natural vegetation. Return to pre-Maori forests would require almost full-fire suppression to convert the vegetation to less flammable, late-successional types. In summary, paleofire data provide unique insights about the dynamics that link fire, climate, fuel, and people across temporal and spatial scales and our best source of information for assessing the resilience of forest ecosystems to climate change, the rate and trajectory of recovery following disturbance, and the role of human activity in modifying fire regimes. The challenge for paleofire researchers is to make such data relevant and meaningful to land managers addressing the consequences of altered fire regimes in the face of current climate and land-use change.