Session h2

PLEISTOCENE POLLEN RECORDS: PATTERNS AND PROCESSES OF ENVIRONMENTAL AND CULTURAL CHANGE

Holocene vegetation & forest fire regimes in subalpine & mixed conifer forests, southern Colorado & northern New Mexico, USA

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We have produced several Holocene-length and longer records of vegetation and fire for high elevation sites in the southern Rocky Mountains and Jemez Mountains of Colorado and New Mexico, USA. Our elevational transect of sites includes locations at the alpine – treeline boundary, within the *Picea engelmannii – Abies lasiocarpa* forest, the mixed conifer forest, and the *Quercus – Pinus* woodland.

Two records – one each from subalpine and mixed conifer forests – illustrate vegetation change over the last ca. 15,000 years. At Hunter's Lake (subalpine site) an open *Picea* forest with *Artemisia* grew around the pond until ca. 12,000 cal BP. *Pinus* pollen increased briefly during the period of the Younger Dryas. Vegetation around the pond during the Holocene was a *Picea engelmannii – Abies lasiocarpa* forest, with little variation in composition. At Chihuahueños Bog (mixed conifer site) an open *Picea* forest grew around a small pond until ca. 11,500 cal BP when *Pinus ponderosa* became established. This shallow pond lasted until ca. 9,000 cal BP. From ca. 8,600 to 6,200 cal BP the pond dessicated in what must have been the driest period of the Holocene there. Wetter conditions returned after 6,200 years ago, with conversion of the site to a sedge bog. Little change in the overstory species occurred throughout the Holocene, with mixed conifer forest dominating throughout.

Our high-resolution fire history records are determined from fine interval sediment sampling and charcoal particle analysis. For most sites, especially those in and near the *Picea – Abies* forest, extreme "peakedness" is apparent in the charcoal records, each peak corresponding to stand-replacing fires within the watershed. Preliminary fire event frequency calculations are on the order of 150 – 200 years. Two upper treeline sites have the lowest deposition rates of charcoal, which may be due to their open nature and significant portions of the drainage basin above treeline that contributes less charcoal to the record when burned. Lower elevation mixed conifer sites show significantly higher charcoal concentrations throughout the Holocene (one to two orders of magnitude) than at the *Picea – Abies* sites. "Peakedness" is less prominent in the charcoal records from the mixed conifer sites, where surface fires may have been more common, although the stand-replacing regime becomes more pronounced in the late Holocene. Periods of highest fire event frequency occur from ca. 1,000 to 2,000 and ca. 9,000 to 12,000 calendar years ago.

The most significant changes in the fire record occur within sediments deposited in the late 19th and early 20th centuries, when charcoal is essentially absent. There is no analog to this phenomenon in the earlier record. This period corresponds to initiation of widespread cattle and sheep grazing in the region, and the initiation of a fire suppression period characteristic of most locations in the western United States. Major shifts in the pollen record occur contemporaneously with these important environmental changes, including an increase in *Quercus* at many sites within the mixed conifer forest and *Quercus – Pinus* woodland.

Vegetation history in west Uganda during the last 1200 years: a sediment- based reconstruction from two crater lakes

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Pollen, plant macrofossils and charcoal records from two neighbouring crater lakes (Lake Wandakara and Lake Kasenda) in lower mountain (altitude ~ 1200 m) west Uganda (0.5° N, 30°E) reveal major changes in local and regional vegetation over the last 1200 years, which can be related to regional variations in climate (especially effective precipitation) and human impact. The biological signals are supplemented by evidence from physical sedimentary analyses (magnetic susceptibility, loss-on-ignition, dry mass accumulation rate) for major catchment changes in a wider regional context. From 1250-1100 years ago, medium altitude moist forest existed around Lake Kasenda, which was largely replaced by grassland by 1000 years ago, coincident with evidence for increased catchment erosion and fire events, linked to both human impact and regional aridity. Grassland, and inferred dry conditions, prevailed around both sites until *c.* 250 years ago, with increased catchment disturbance from 300-400 years ago (coincident with the demise of major regional settlements during a more arid period). Both sites show the return of semi-deciduous and swamp forest from *c.* 200-250 years ago, with tree and shrub pollen remaining high until the most recent times. Pollen assemblages reveal increasingly clear human impact on local and regional vegetation in the 20th century, which obscures any climatic signal. While pollen records may not be sensitive to all climatic fluctuations (e.g. late-18th/early-19th century aridity), they provide compelling evidence for vegetation change from both climatic and human impact. Other proxies should be analysed to further disentangle the relative importance of these two major drivers of environmental change in tropical Africa at different times in the last millennia.

Keywords: East Africa, pollen, macrofossils, charcoal, human impact, climate change, archaeology.

Holocene spread and population expansion of Picea abies (L.) Karst. in Fennoscandia and adjacent areas

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The spread of Picea abies in Fennoscandia provides an excellent opportunity for detailed study of the dynamics of tree spread and population expansion. Early- and mid-Holocene macrofossil evidence for presence of Picea abies in Fennoscandia has questioned traditional interpretations of the timing and direction of its spread. This study aims to determine when, from where and by which pathways Picea abies spread into Fennoscandia and how fast these populations expanded. Insights into the character and dynamics of this spread may contribute to the general understanding of Holocene tree spread.

Holocene pollen diagrams with independent dating control were collected from the northwestern distribution of Picea abies in Europe, including Norway, Sweden, Finland, Estonia, Latvia, Lithuania, northwestern Russia, and parts of Byelorussia and Poland. The timing of the onset of the continuous curve, the first appearance of frequencies of 1%, 3%, 5%, and 10%, as well as timing and the maximum amount of Picea abies pollen, were obtained from these pollen diagrams. Age determinations were displayed and interpolated over the area under investigation using a GIS package.

The spread of Picea abies in Fennoscandia and adjacent areas can be separated into two phases: 1) A rapid early Holocene spread out of Byelorussia and northern Russia at low population density giving rise to small outpost populations, possibly as far east as the Scandes Mountains. 2) A mid- to late-Holocene front-like spread at high population densities moving from east to west into the Baltic Republics and Finland, into northern Scandinavia and then moving south and west towards its present day distributional limits.

The factors that controlled the early Holocene spread of Picea abies are still unclear. Climate and adaptation may have played a role. The later spread of expanding populations may be largely controlled by population density. Disturbance or the availability of new land had a positive influence on the expansion of Picea abies while the Baltic Sea appears to have been a barrier for the expansion.

Fire and human impacts on vegetation changes during the last 10000 years in the Tanba Mountains, Japan

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Japanese forests have been heavily impacted by human activities. Ecologists, cultural anthropologists and historians have been arguing about the origin, development, and cultural significance of "satoyama", a cultural landscape in Japan but have not had comprehensible paleoecological records to show when and how the "satoyama" has come along and been maintained. Using fossil pollen and charcoal in the sediments from two sites (Jaga-ike bog and Hatchodaira bog) we reconstruct the changes in vegetation in the Tanba Mountains near Kyoto, particularly aiming at the impacts of natural and anthropogenic fires on the vegetation in the region.

The Tanba Mountains are located north of Kyoto, an ancient capital of Japan. The regional vegetation is mostly secondary forest, typically consisted of *Castanea crenata* (chestnut), *Quercus* subgenus *Lepidobalanus* spp. (deciduous oaks), *Carpinus* spp. (hornbeams) and *Pinus densiflora* (red pine). This "satoyama" landscape is believed to be the results of the long and continuous human activities, including the collection of fuel wood and litter for fertilization, slash and burn agriculture, partial logging and silviculture. To reconstruct the history of fire and vegetation and estimate when the "satoyama" was established in this region, we obtained peat cores from Jaga-ike and Hatchodaira and analyzed fossil pollen, plant macrofossils and charcoal in the sediments. The cores cover over the last 10000-years at both sites. The size of the sedimentary basin is relatively small (0.2-ha and 5-ha at Jaga-ike and Hatchodaira, respectively), thus the pollen and charcoal records should represent the changes in local vegetation within several hundred meters.

Jaga-ike is located 35-km northwest of Kyoto city. It lies at 600-m elevation on the boundary between the warm-temperate and cool-temperate zones. This site is surrounded by a typical "satoyama" forest, characterized by chestnut, deciduous oaks and red pine. During the late glacial, *Fagus crenata* (beech) and *Quercus* forests developed and no fire events were observed. In the early Holocene, *Castanea* pollen increased dramatically when charcoal is abundant, indicating the positive effects of fire on chestnut abundance. During the mid-Holocene, the cool-temperate forest characterized by beech and temperate conifers, including *Cryptomeria japonica* (Japanese cedar), became developed. Fire was rare in this period. In the late-Holocene, charcoal data suggest that at least two major fire events occurred. The vegetation at *ca.* 2500 yr BP was cool-temperate mixed forest with *Cryptomeria japonica*. After the first fire at *ca.*2500 yr BP, two species of beech (*F. crenata* and *F. japonica*) decreased considerably and *Pinus* increased. The next conspicuous fire took place at *ca.*1000 yr BP, and the vegetation shifted to the *Quercus*, *Castanea* and *Pinus* dominated forests, similar to the modern vegetation around the site.

Hatchodaira is situated 25-km north of Kyoto city. It lies at 810-m elevation in the cool-temperate zone. The present vegetation is also the "satoyama" forest mainly composed of chestnut and deciduous oaks. According to Takahara & Takeoka (1986) and present study, in the early Holocene, the site was surrounded by the cool-temperate forest characterized by *Fagus crenata* and *Quercus*. Poaceae pollen and macroscopic charcoal are abundant throughout this period, suggesting the frequent occurrence of fires. Since *ca.* 4500 yr BP, the vegetation shifted to the forest dominated by *Quercus*, *Betula* (birch) and *Carpinus*. In the late Holocene (*ca.* 1500 yr BP to present), *Castanea* and *Pinus* become dominant along with *Quercus*.

The results from the two sites suggest that the "satoyama" was established at *ca.* 1500-1000 yr BP in the Tanba Mountains. It coincides with the establishment of Kyoto as a Japanese capital 1200-years ago. Charcoal abundance increases conspicuously between 10000 yr BP and 5000 yr BP at both sites. Charcoal records from several sites around Lake Biwa, east of Kyoto, also suggest that forest fires occurred frequently in the early Holocene (Inoue *et al.* 2001). The causes of the frequent fires in the first half of the Holocene are still unclear, but the drier climate must have been partially responsible for the frequent fires either by anthropogenic or natural causes.

INOUE, J., TAKAHARA, H., YOSHIKAWA, S. & INOUCHI, Y. 2001. Reconstruction of fire history during the last 130 ka by analysis of microscopic charcoal in Lake Biwa sediment. **The Quat. Res.** 40: 97-104. (In Japanese with English abstract).

TAKAHARA, H. & TAKEOKA, M. 1986. Vegetation changes since the last glacial maximum around the Hatchodaira moor, Kyoto, Japan. **Jap. J. Ecol.** 36: 105-116. (In Japanese with English abstract).

The late Holocene of Semirechie (Southeast Kazakhstan) according to the geo-archaeological research material

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A palinological model of the modern vegetation cover in arid zones is fundamental for the study of the vegetation of the past and for the reconstruction of climatic changes that have stipulated the change of the vegetation types and the displacement of the borders of the landscape zones.

The Semirechie region of Southeast Kazakhstan, where on a rather small territory are concentrated different landscapes and climatic zones (mountain, transitional rivers, piedmont deserts and semideserts) with large numbers of archaeological sites and sufficiently well studied in geological-paleontological and archaeological relations was used as polygon for the working out of new palinological interpretations and techniques.

The Holocene deposits of Semirechie contain mineral organic residues and archaeological sites: burials and ancient settlements of the Bronze and Early Iron Ages (settlement of Tamgaly, Seryktas - semidesert, desertic zone), at the foot of the Zailiski Alatau (sites of the Bronze, Early Iron and Middle Ages on the deluvial fan of Talgar), in the piedmonts and low-set piedmonts and intermontane valleys (sites of the Talapty plain) and in a high-mountainous zone (settlement of Turgen, Asy, Kalakai).

The geo-archaeological researches on the ancient settlements and natural Holocene deposits helped the compilation of diagrams of the change of temperature and humidity in the different zones of Semirechie. EPR (Electro-paramagnetic resonance) and radiocarbon data gave the main limit events of the late Holocene.

The main results of the palynological researches consist in the establishment in the arid zones of hotter and dryer (than today) unfavorable climates during the second half of the Bronze Age – change in the vegetation from desert with Artemisia - Chenopodiaceae and various herbs (Polygonaceae, Asteraceae, Poaceae, Apiaceae, Brassicaceae) to desert with dominant Chenopodiaceae and few amount of pollens of Artemisia. During the Early Iron Age the climate was more favorable, relatively colder and humid by comparison of the late Bronze Age.

The graphics of the climatic change allow the dating of the sites of different cultural periods (Bronze and Early Iron Age, Middle Ages) and give information for the understanding of the process of population migration and domestic production (pastoral, agrarian).

It was established that the climate of different epochs affected the alive beings.

For the middle Bronze, the subboreal cold was characteristic, for the final and transitional Bronze, it was the warmth of the late subboreal; for the early Iron Age a pluvial climate and the initial phase of a colder and wetter climate. After follows the increase of humidity and the decrease of the temperature.

It was established that the arid phase (interglacial age) promoted the optimization of the climatic conditions in high altitude mountains and the improvement of the ecology for the people. At the contrary in the deserts happened the inverse process – the deterioration of ecological conditions. During the pluvial phase (glacial age) these processes were inverted - in the mountains the situation degraded and the desertic zones became more optimal for life.

The substratum for most of the archaeological sites consist in forests with EPR data related to 10, 15, 13 thousands years ago. The EPR data of 7-5000 ago are characteristics for the neolithic sites. In the Bronze Age sites (like Tamgaly) were collected a series of EPR and radiocarbon data, with intervals from 3,2 thousand years to 2,5 thousand years ago.

The Early Iron Age have EPR and radiocarbon dating from 2,2 to 1,7 thousand years ago, allowing rather correctly to make conclusions about the trend and evolution of the regional climate and to compare it to the phases of the late Holocene on the scale of Blitta- Sernandera- Khotinski.

The palinological data of the Semirechie polygon have allowed the creation of a database of recent and subrecent spore-pollen samples.

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The Last Glacial Maximum in the Winter Rainfall Zone of South Africa: towards a revised regional synthesis

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Quaternary environmental reconstruction in the winter rainfall region of southern Africa has been hampered by the absence of long, continuous terrestrial sedimentary archives, although several shorter, temporally fragmented, records exist. These records are employed in this paper to develop a model of evolving palaeoenvironments for the Last Glacial Maximum (LGM). They reveal that different geographical areas within the winter-rainfall region *sensu lato* may have reacted differently under dynamic environmental circumstances over the period in question. There is an emerging pattern of cooler and wetter LGM conditions across parts of the region, best exemplified by pollen and charcoal remains from Eland's Bay Cave. This contrasts markedly with evidence from sites in the all-year rainfall sector of the region, most notably the Vankervelsvlei wetland in the southern Cape. The contention that the winter rainfall region was cooler and wetter than today and that winter rainfall may have been both more intense and widespread is consistent with other regional palaeoecological studies. The conclusion may have particular significance in light of the implications of substantially reduced partial pressures of atmospheric carbon dioxide at the time.

Some considerations about the existence of refugees in the coastal area from NW Iberia during the last glacial period

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The current models performed to explain the tree-colonization dynamics in wide areas from Central and Northern Europe are commonly based on the acceptance that any refugee areas existed for the mesophilous and thermophilous flora. At first, most of these sheltered areas were tentatively positioned in other southernmost regions, where warm-demanding species might survive during the colder phases of the Glaciar cycles; and subsequently, they might work as source areas when the postglacial forest expansion begun. These hypotheses have been reinforced by evidences supported by several long pollen records available in southern Europe, which probe that some meridian areas, as the Balkans, Greek, the Italian Peninsula or the southern Iberian Peninsula, might constitute in the past important refugee areas for thermo-mesophilous taxa. More problematic results the adscription of the Cantabro-Atlantic territories of NW Iberia. Currently an important richness in flora and fauna exist in this region, resulting its diversity consistently higher than those seen in the more northerly Atlantic Europe; but also any evident glacial morphologies implies that some mountains areas from NW Iberia were strongly affected in the past by glacial climates. Along several decades main fault to resolve the doubts about the persistence of warm demanding taxa in NW Iberia were the lack of long sequences at lowlands. Only indicia from

sequences in caves or some ancient levels placed in mountain glaciated areas existed in the region, but in these sites the chronology, the taphonomy or the origin of the pollen data were usually controversial.

Several organic levels from Cantabro-Atlantic margins, which represent ancient wetlands developed at NW Iberia coastal lowlands, have been well dated during the last decades; and they have resulted as representing several glacial-interglacial periods, from the Pre-Würm to the Late-Glacial. Consequently, high resolution pollen analyses performed for these sites (GÓMEZ-ORELLANA, 2002) constitute a robust source of data to evaluate the situation of the most thermal coastal areas of NW Iberia during the last glacial cycle. These pollen analyses reveal that so coniferous trees: e.g. *Pinus pinaster*-type, *Pinus sylvestris*-type, *Juniperus, Abies, Picea;* as temperate deciduous trees: e.g., *Betula, Quercus robur*-type, *Corylus, Alnus, Fagus, Fraxinus, Ulmus, Acer, Carpinus, Juglans, Frangula, Salix, Tilia;* and broad-leaved evergreen taxa: e.g. *Quercus ilex*-type, *Arbutus, Olea, Ilex, Phillyrea*, were unquestionably present in the coastal areas from NW Iberia at any time enclose between 110,000 - 32,000 BP. This fact implies that the climate in most of the coastal region persists rather mild and humid during long periods. Nevertheless, it seems that the regional distribution of some of these taxa also suffered important changes through this period, because also major environmental changes might exist. The most noticeable case was the modification in *Fagus* forests distribution. Beech forests were considerably developed close to the present Cantabrian Coast along the prewürmian interstadials, also persisting there during the Lower Würm. Nevertheless they are not recorded in the Cantabrian sites during the Würm Interstadial and the Upper Würm, while they appear consistently recorded and dated as <34,250±990/880 B.P. in some meridian records from the Atlantic border of NW Iberia. Seen that most of these meso-thermophilous taxa appear in other mountain sequences of NW Iberia during the Late-Glacial and Early Holocene, it seems likely that NW Iberia Coastal regions were source areas for many of these trees during the post-glacial forest colonization. Other taxa: i.e. *Picea, Abies, Carpinus,* disappeared in the pollen records from coastal sites at different moments along the Würm; and no post-glacial evidence of them exist in other inner mountain sequences. Consequently, it is possible to propose a tentative date for their regional disappearance. Finally, when richness in warm-demanding tree taxa present in this region is compared with the corresponding data seen in other meridian areas from Europe at analogous periods, it seems probed that NW Iberia also worked as a comparable a refugee area during the last glaciation.

GÓMEZ-ORELLANA, L. 2002. **El último ciclo glaciar interglaciar en el Litoral del NW ibérico: Dinámica climática y paisajística**. PhD Thesis. Escola Politécnica Superior. Universidade de Santiago de Compostela.

Chronology, dynamics and impact on vegetation of human activities in French mountains areas: a synthesis for the Alps, Pyrenees, Massif Central and Jura mountains

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From a long time, the middle and high mountain areas attended by the human societies with an aim of exploiting the resources of them. The development growing of the agro-pastoral activities, started since the Neolithic period, contributed to accentuate the anthropogenic pressure on mountain spaces, sometimes involving during the historical period a radical modification in the ecosystems of altitudes. The history of the human impact on middle and high mountains is however not linear. On the contrary, it's rhythmed by key-phases, determining for the history of the environment in these mediums. Within this contribution, we try a first synthesis on the stages and the consequences of the anthropisation in the French mountain mediums starting from the recent pollinic data gathered in the Alps, the Massif Central, the Pyrenees, the Morvan and the Jura mountains. This interregional comparison shows, with some exceptions, the existence of expansion episodes in the determining human activities, commun with the whole of the French mountains. These episodes which are towards *the end of the VIth millenium BP, 4500-4000 BP, 3500 BP, 2800-2600 BP, 2000BP et 1000BP* are identical to those highlighted for the zones of low altitude and they essentially join a chronology shared by the whole of Western Europe. If the question of specific causalities to these rhythms remains still prone to debate, in particular on the possible role of the climatic fluctuations on these phases of expansion, the coherence of these data shows that the mountain mediums were

never marginal but, on the contrary, which they were to all times integrated in processes of the human societies development.

Late-quaternary dynamics of western Tierra del Fuego, southern most Chile

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The southernmost part of South America (south of 48S) today supports vegetation types ranging from Magellanic moorland in the west, to forest, and then to steppe grasslands in the east (Moore 1983). This spatial pattern broadly follows a rainfall gradient, with highest values in the west, and lowest values on the east side of the continent. The composition of the modern forest and grasslands is well-studied, and there is also data on the dynamics of both vegetation types since the last glacial period (Markgraf 1989; Markgraf 1993). However, Magellanic moorland is less well-known, and the dynamics of the ecotone between moorland and forest are unknown. There is even uncertainty about the exact location of the peatland-forest ecotone. Pisano V. (1977) suggests that all the islands, even to the southern and western extremes have coastal forest. But Chilean aeronautical maps and aerial photographs show that the forest is restricted to the inner, sheltered parts of the archipelago, and the outer parts are peatland or even unvegetated (pers. obs.). There has been exceptionally little scientific observation in the region, and the writings of early explorers, especially from Britain (Darwin 1839) and Sweden (Skottsberg 1911) are still valuable.

During several fieldtrips we have collected lake sediment cores across the region, and present 2 radiocarbon dated pollen diagrams with results from LOI and MSCL. According to the first core that have been processed it appears that forest is still expanding into the region, possibly in relation to episodes of volcanic activity (Mt Burney) and tephra deposition. The second core to present will be analysed during the spring and presented at the IPC congress July 2004.

Palynological investigations in Ohalo II – a 23,000 years old prehistoric site on the shore of the sea of Galilee, Israel

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The fisher-hunter-gatherers' prehistoric camp of Ohalo II (dated to ca. 19,500 BP; 23,000 cal. BP) is located on the shore of the Sea of Galilee, Israel, on top of Lisan marls (the precursor of the current lake), 212-213 m below msl. The excavated remains include six brush huts, fireplaces, a human burial and various installations and midden deposits.

The Lisan spectra are rich in arboreal pollen (40%), mainly *Quercus* sp. with some *Pistacia* sp. and *Pinus halepensis*, indicating the spread of a humid Mediterranean maquis on the hills surrounding the lake in the time of deposition. Poaceae and Cheno/Ams (20% each) dominate the NAP. A drying out of the lake, immediately before occupation, is indicated by a marked drop in AP (to 2.5%) and a rise in Cheno/Ams (up to 77%). The latter may also suggest an increased salinity.

Relatively high AP levels (33%) in samples taken outside the huts suggest a relatively humid period during the habitation of the site. High *Quercus* sp. levels and the occurrence of *Pistacia* sp. and *Pinus halepensis* indicate that Mediterranean maquis expanded again on the surrounding hills. The dominance of Cheno/Ams (26.5%) within the NAP may be partly due to the salinity of the underlying sediments. Pollen from within the huts is highly concentrated and the spectra are clearly biased towards Cheno/Ams (over 90%).

While the surface pollen represents the vegetation and climate of the area when the site was inhabited, the huts' pollen is a result of localized, human activities. This pollen accords well with other archaeobotanical data, mainly with the retrieved charred seeds. Many Chenopodiaceae species are edible, suggesting dietary use. It is also possible that they were used as matting or roofing material.

Optimizing the detection of cereal pollen: evidence from Scotland and the Faroe Islands

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In many parts of the North Atlantic region during prehistoric and historical times, cereal cultivation was always of less importance than pastoral activity. Given that cereal pollen may be the best indicator of human presence and agricultural activity, the detection of Cerealia pollen is clearly paramount; finding cereal-type pollen grains is a prerequisite for their assessment as cereal or other large, but wild, grass grains.

The cereals typically responsible for crop representation in the North Atlantic area – species of *Hordeum* (barley), *Triticum* (wheat) and *Avena* (oat) – are self-pollinating and do not liberate much pollen into the atmosphere. Large cereal pollen grains travel short distances and there is a good chance that they will not be encountered with routine counting sums. In an effort to enhance the probability of detecting cereal pollen, site types and coring locations can be carefully chosen, samples may be sieved and microscope slides, especially from contiguous samples, may be scanned at low magnifications.

Such 'optimization' is illustrated by efforts to detect pre-elm decline cereal-type pollen in sites from Scotland as a prelude to presenting new evidence based on rapid scanning of microscope slides. A site in Shetland had initially produced no cereal-type pollen of Bronze or Iron Age provenance, in spite of reasonable pollen counts (500 total land pollen) and archaeological evidence for local crop processing. Rapid scanning of contiguous samples revealed a rather different picture with fairly regular occurrences of cereal-type grains. A site in Suðuroy, Faroe Islands, had produced no cereal-type pollen prior to the inferred Norse *landnám* level. Rapid scanning showed this the presence of cereal-type pollen several centuries before this date, adding to the queries regarding an earlier settlement in the islands.

Session h3

EVOLUTION OF THE LANDSCAPE AND CLIMATE IN THE MEDITERRANEAN ECOSYSTEM

Biotic responses and climatic changes during the Late Glacial and Early Holocene in Northwestern Italy

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Biotic responses during the Late Glacial and at the transition to the Holocene were influenced by a number of factors such as climatic changes, migrational rates, competition, and by the location of refugia. During the Late Glacial, thermophilous species (Quercus, Corylus) were found, amongst other species, on the Italian peninsula. At the onset of the Last Termination, it was suggested that these species expanded northwards with