DO SPECIES MOVE, ADAPT OR DIE? EXPLORING BIODIVERSITY DYNAMICS IN THE FOSSIL RECORD

TRACK: HUMANS AND BIOSPHERE

CHAIRPERSON: DONATELLA MAGRI

13:30 - 19:00 THURSDAY, 25TH JULY, 2019, WICKLOW HALL 2A (LEVEL 2)

INQUA CONGRESS DUBLIN 2019

ELŐADÁSOK – 13.30-TÓL

- The interplay of adaptation, distribution and extinction among Quaternary large mammals

Adrian Lister

- Hungry like a wolf: impacts of carnivore competition on morphology and prey choice

Lucy Flower[1], Danielle Schreve[1], Angela Lamb[2]

- Polar bear's range dynamics in the Late Pleistocene and the Holocene

Heikki Seppä[1], Beth Caissie[2], Marit-Solveig Seidenkrantz[3], Marc Macias Fauria[4]

- Arctic-alpine plants survived past forest expansion: a 24,000-year ancient DNA record from the Polar Urals

Charlotte L. Clarke [1], Mary E. Edwards[1], Ludovic Gielly [2], Paul Hughes[1], Dorothee Ehrich[3], Liudmila M. Morozova[4], Haflidi Haflidason[5,6], Jan Mangerud[5,6], John-Inge Svendsen[5,6], Inger G. Alsos [7]

- A study on the ecology and ethology of Pleistocene fauna (cave bear, red deer) by molecular palaeontology techniques

Aurora Grandal-d'Anglade[1], Alba Rey-Iglesia[2], Ana García-Vázquez[1], Gloria González-Fortes[3]

- American mastodon mitochondrial genomes suggest repeated colonization and extirpation in northern latitudes

Emil Karpinski[1], Dirk Hackenberger [1], Chris Widga [2], Daniel Fisher[3], Grant Zazula[4], Ross MacPhee[5], Hendrik Poinar[1]

- The climate of the Olympic Peninsula, northwestern USA, during the LGM based on fossil beetles, pollen and ice margin deposits
- Allan Ashworth[1], Glenn Thackray[2], Daniel Gavin[3]

Polar bear's range dynamics in the Late Pleistocene and the Holocene

Heikki Seppä1, Beth Caissie2, Marit-Solveig Seidenkrantz3, Marc Macias Fauria4
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ABSTRACT

Reconstructions of species ranges during the past warming periods are important for understanding the impact of climate change on the distribution of arctic mammals. By analyzing the fossil records of key arctic species together with data on past climates and sea ice conditions, it is possible to investigate the species ranges and, eventually, make inferences about the survival strategy of arctic mammals during climatic conditions warmer than at present. Here, we use the dataset of fossil records to investigate changes in the polar bear's distribution during the Late Pleistocene and the Holocene. Over the decades, hundreds of polar bear bones and teeth have been discovered from the high latitude regions, and these findings represent a minimum number of 229 individuals from 45 sites and date from the Late Pleistocene (15 – 11.7 ka) to the Holocene (last 11.7 ka).

During the last deglaciation, the polar bear was present in the south-western and western margin of the Scandinavian Ice Sheet where it survived until the earliest Holocene about 11 ka. In the Early Holocene, fossils have been discovered from Svalbard and the Zhokhov island in the East Siberian Sea. There are no polar bear findings from 8-6 ka, which is generally the warmest period of the Holocene in the Arctic with summer temperature up to 2.5°C higher than at present, but the findings from 8-9 ka and 5-6 ka suggest that the species was able survive this Holocene thermal maximum in the cold refugias in the high arctic of the East Siberian Sea, the northernmost part of Greenland and the Canadian archipelago. Intriguingly, there are polar bear fossils findings from the Aleutian and Pribilof Islands (Unalaska and St. Paul islands) from 5.4-3.4 ka. Unalaska, the southernmost of these islands, is currently located roughly 400 km south of the modern sea-ice limit and 1000 km south **from the nearest polar bear population, and our data suggest that it was outside the area of arctic sea ice in the Mid Holocene. There is firm evidence that the range of polar bear expanded over the late Holocene (last 4000 years) in tandem with the cooling climate and the expanding arctic sea ice.** We conclude that an analysis of the Late Pleistocene and Holocene fossil record of the polar bear highlights the major changes in its range in response to climate changes and thus demonstrates the long-term congruence of its range with sea ice and climate.

Arctic-alpine plants survived past forest expansion: a 24,000-year ancient DNA record from the Polar Urals

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ABSTRACT

The ability of arctic and alpine plants to withstand extinction from future climate change will depend, in part, on their ecological resilience and the availability of suitable habitat in a warmer climate. Knowledge of the role of mountain landscapes as safe-havens promoting the persistence of cold-adapted arctic and alpine plants over long timescales is limited. Here, we present a 24,000-year record of plant community dynamics based on ancient DNA extracted from the sediments (sedaDNA) of Lake Bolshoye Schuchye, the largest and deepest lake in the Polar Ural Mountains of northern Russia. We identified 167 plant taxa based on sedaDNA (45 % identified to genus level, 41 % to species, 14 % to family), which included representatives from all plant functional groups.

We show that cold-adapted plants (e.g. Arabis alpina, Bistorta vivipara, Papaver, Dryas octopetala, Saxifraga oppositifolia) have survived and persisted in the Polar Urals in the face of changing climate and environmental conditions over the past 24,000 years, despite past northward and upward expansion of forest tree taxa (e.g. Larix sibirica, Picea, Betula) between 9000 - 4000 cal. years ago. The large and topographically complex catchment of Lake Bolshoye Schuchye has retained its diverse species pool over time, with a consistent long-term increase in floristic richness over the past 24,000 years.

Using our sedaDNA time-series, we infer that mesoclimatic heterogeneity arising from variable topography in a mountainous landscape facilitates the persistence and co-existence of both cold-adapted and forest plant taxa during warm climate episodes, thereby preserving floristic diversity. Our results highlight the importance and conservation significance of mountainous landscapes as a buffer against the extinction of arctic and alpine plants in a warmer climate.

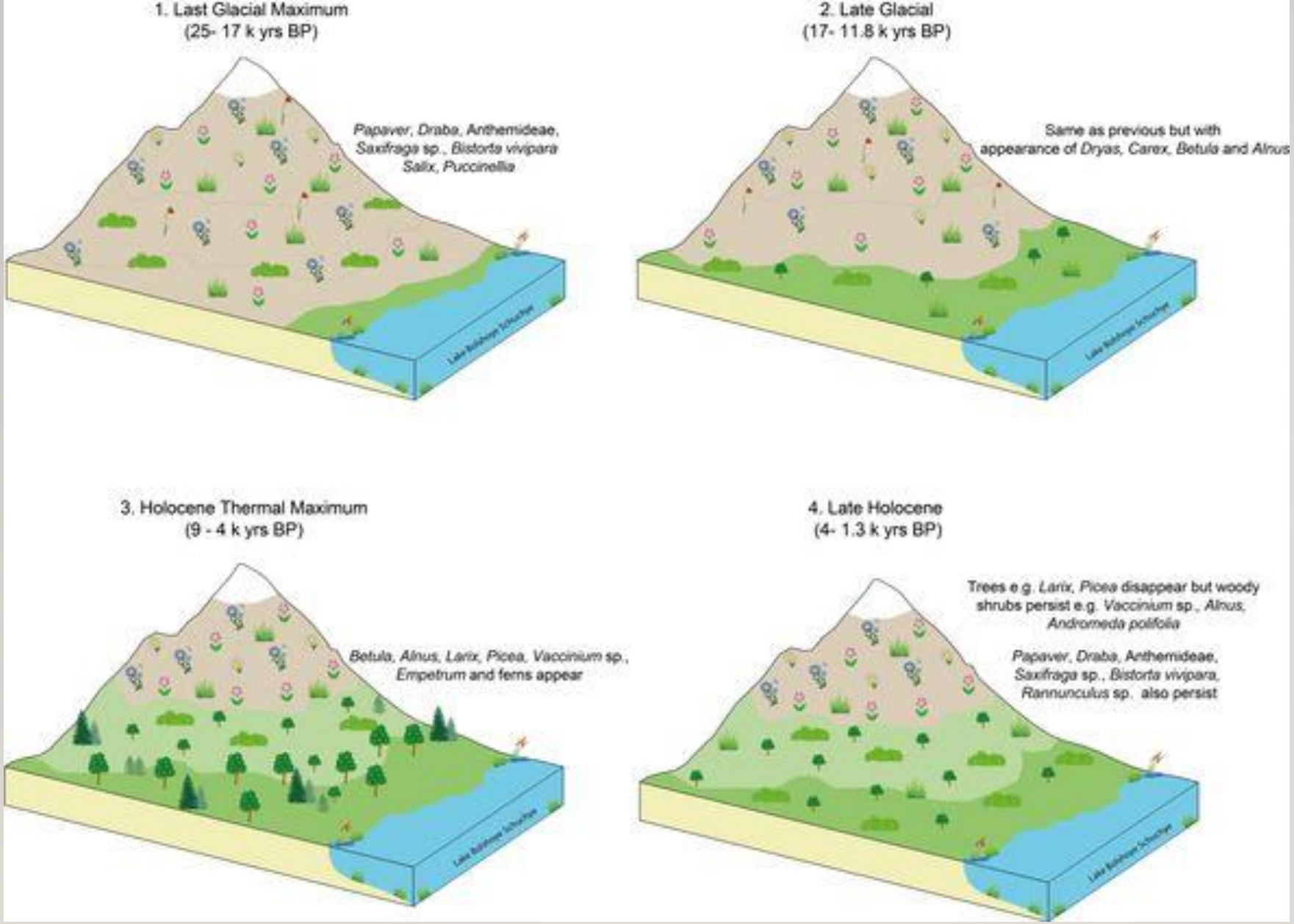

Figure 1 Conceptual model to outline the key changes in plant community composition identified in the *sed*aDNA from Lake Bolshoye Schuchye. Note the continued persistence of arctic and alpine plant taxa through all four time periods of interest.

The interplay of adaptation, distribution and extinction among Quaternary large mammals

Adrian Lister
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ABSTRACT

Mammal species of northern biomes became adapted to Quaternary conditions but were challenged by its constantly fluctuating nature. Morphometric data on the evolution of the mammoth, for example, demonstrates dental adaptation to more open landscapes and grass/herb dominated food through 2.6 myr of the Quaternary, but up to the middle Pleistocene the complex of populations included variation allowing survival in a range of habitats. Morphometric and ancient DNA studies of the woolly mammoth demonstrate a loss of both morphological and genetic variation through the Late Pleistocene, that likely contributed to the species' ultimate demise. Mapping of radiocarbon-dated mammoth remains illustrates complex range shifts in the interval from 50 kyr onwards, with net reduction of range, and this correlates with loss of DNA clades. Extinction is seen not an instantaneous event but a sequence of regional extirpations, so extinction is visualised, with sufficient data, as 'merely' the zero-point of a process of range reduction. Alternating range expansion and contraction is typical of mammalian species in response to fluctuating Quaternary climate, and extinction is most probable in the contracted refugial phase, which often represents the core area of the species. Comparison of mapped radiocarbon dates in species such as woolly mammoth, woolly rhinoceros and giant deer shows that species act individualistically, according to their individual ecology, in the timing and geographical pattern of their distributional response and ultimate extinction. Survivors may be lucky (surviving a severe bottleneck where analogous species went through the zero point of no return, e.g. musk ox vs. mammoth and woolly rhino), or benefit from adaptive flexibility at the individual and population level (e.g. red deer). Adaptability includes behavioural and ecophenotypic flexibility as well as genetically-programmed variation.

ELŐADÁSOK – 17.15-TŐL

- Prevalent known and cryptic extinctions in the Pleistocene have conservation lessons for the next century

Jacquelyn Gill[1], Dov Sax[2]

- Reconstructing two million years of *Gigantopithecus blacki* fossil teeth geochemical record

Renaud Joannes-Boyau[1], Yingqi Zhang[2], Wang Wei[3], Russell Ciochon[4], Ian Moffat[5], Kira Westaway[6]

- Megafauna extinction, faunal turnover, terrestrial vegetation and climate change during the Last Glacial termination in Hungary: leads and lags

Enikő Magyari[1,2,3], Piroska Pazonyi[1], Ilona Pál[3,4], Mihály Gasparik[5], Attila Virág[1], Ildikó Vincze[6], János Korponai[7,8], Zoltán Szabó[2], István Major[3]

- Ecological flexibility of the Pleistocene Sumatran serow and the possible cause of local extinction of the Himalayan goral in Thailand

Kantapon Suraprasit[1,2], Rasmi Shoocongdej[3,4], Yuichi I. Naito[5,2], Jean-Jacques Jaeger[6], Yaowalak Chaimanee[6], Athiwat Wattanapituksakul[4], Hervé Bocherens[2,7]

- Holocene history of 'non-native' tree taxa in Ireland

Susann Stolze[1,2], Thomas Monecke[1]

- Spatiotemporal trends in subfossil chironomid diversity: A robust recorder of climate and environmental change?

Stefan Engels[1], Andrew Medeiros[2], Yarrow Axford[3], Stephen Brooks[4], Oliver Heiri[5], Larissa Nazarova[6], Tomi Luoto[7], Dave Porinchu[8], Roberto Quinlan[9], Angela Self[4]

- Greater tree species richness in eastern North America compared to Europe is does not translate to functional trait space differences

Alejandro Ordonez, Jens-Christian Svanning

Prevalent known and cryptic extinctions in the Pleistocene have conservation lessons for the next century

Jacquelyn Gill1, Dov Sax2 1University of Maine, Orono, USA. 2Brown University, Providence, USA

ABSTRACT

The growing field of conservation paleobiology provides a perspective on the range of species responses to global change beyond the limited scale of human observation. Given the challenges posed by future warming, ecologists are increasingly turning to natural experiments of the recent fossil record to characterize the risks to modern biodiversity. The Quaternary fossil record documents widespread shifts in species' ranges and abundances in response to glacial-interglacial cycles, but aside from the late Quaternary extinctions of large mammals, it is typically thought that climate-driven extinction was rare. This has resulted in the emerging paradigm that species may be more resilient than expected in the face of climate change. In contrast, our re-examination of the Quaternary fossil record indicates that the synergistic effects of climate change (both direct and indirect) and other landscape drivers put many species at greater risk than is currently appreciated. This is true both with respect to known, documented extinctions, but also to unidentified, or 'cryptic,' extinctions. Documented extinctions are more prevalent than commonly thought due to previous temporal, regional and taxonomic biases in the literature. Further, predominate attention paid to the species losses during the last glacial cycle misses pulses of extinction during the Plio-Pleistocene boundary, and during in the mid-Pleistocene, during which glacial cycles lengthened and intensified. Clade-based approaches tend to integrate taxa from different regions or habitat types, down-playing the mechanisms that drive extinction risk. Cases of rapid speciation within habitats that are ephemeral relative to glacial-interglacial cycles provide a model for "cryptic" extinctions, which were likely common during the Pleistocene but also provide context for processes that could also drive extinction risk today. By linking the mechanisms behind both known and cryptic extinctions, we identify processes by which climate change contributes to past and future extinction risk, providing a new framework for identifying climate-driven threats to biodiversity going forward. We argue that the fossil record has yet to be fully marshaled to document extinction risk associated with climate change or to draw lessons from these extinctions for conservation challenges going forward. Our Quaternary casualty list is likely incomplete, representing an opportunity for conservation paleobiology.

A kvarter kihalások globális történetét összegzi, célja, hogy predikálni segítse a napjainkban zajló klímaváltozás biodiverzitásra gyakorlat hatásait.
Főbb megállapításai:

- *Korábbi alacsony kihalási ráta átértékelendő a plio-pleisztocén határ és a közép-plei kihalások tükrében*
- *Gyors fajképződési események során fontos kriptikus kihalások történtek*
- *A kihalási mechanizmusokat összegzi*