Plants play greater role than megaherbivore extinctions in changes to ecosystem structure

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Plants may have exerted greater influence on our terrestrial ecosystems than the megaherbivores that used to roam our landscapes, according to new research.

Previously, scientists believed that the Late Quaternary extinction event, which took place between ~11,000 and 15,000 years ago across much of northern Europe, played a significant role in the subsequent expansion of woody plants and declining nitrogen availability over the last 10,000 years.

But in a new study, published in *Ecology Letters*, researchers suggest the changes had already started to occur in Britain and Ireland at the same time these mammals—such as the woolly mammoth, Giant Irish Deer, reindeer and wild horse—began to die out.

They also believe that natural fires had a greater role to play in these processes than previously thought, and that the natural burning of land should be taken into account when considering rewilding projects in the UK in order to ensure the sustainability of open, fertile habitats for grazing animals.

The research was conducted by academics at the University of Oxford, University of Plymouth, Queen's University Belfast, Swansea University and the Natural History Museum, London.

Dr. Elizabeth Jeffers, from Oxford's Department of Zoology, led the

study. She said: "Our results challenge the ecological argument underpinning trophic rewilding by showing that the fauna living in these regions at the end of the last glacial period were unable to stem the expansion of woody plants across the northern hemisphere."

For the study, scientists produced an unprecedented amount of ecological and climatic information (spanning the transition from the Late Pleistocene to the middle Holocene period, 16,000 to 4,800 years ago) for five study sites in England, Scotland and Ireland. Their dataset included: proxy measurements of plant and large herbivore biomass; nitrogen availability; growing season temperatures; and fire activity.

Two-thirds of the region's megaherbivore species became extinct during this time; using previously available fossil bone data of these species, the authors applied statistical modelling to their dataset in order to investigate the relative impacts of plants, herbivores, fire, and summer temperatures on ecosystem structure and function.

They found that shrubs were consistently one of the strongest predictors of ecosystem change, with increasing shrub biomass reducing ecosystem-scale nitrogen availability and promoting the growth and expansion of trees. Natural fires, not herbivory, were the most significant factor in reversing these effects, however, declining fire activity in the early Holocene enabled shrubs (and ultimately trees) to dominate terrestrial ecosystems.

The findings provide new empirical evidence for the long-term ecosystem engineering effects of woody plants and demonstrate the importance of burning for maintaining the structure and function of open ecosystems in northern biomes.

Dr. Nicki Whitehouse, Associate Professor (Reader) in Physical Geography at the University of Plymouth and one of the senior authors

of the study, added: "This research started when we became interested in the ecological consequences of the megaherbivore extinctions. It led us to look at a range of ecological processes that may have been affected by the loss of these species, including decreasing levels of nitrogen as a nutrient. "What we have found could have significant conservation management consequences; people talk about using large grazing animals to maintain open, fertile habitats, but in fact you need a range of different processes including burning. In the past, fire played an important role in maintaining some of our open ecosystems and grasslands and it should be considered again as an important management tool particularly as part of any rewilding programmes planned across the UK and beyond."

More information: Elizabeth S. Jeffers et al, Plant controls on Late Quaternary whole ecosystem structure and function, *Ecology Letters* (2018). DOI: 10.1111/ele.12944

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