Valuing neo-native species. Is naturalised Scots pine a threat or benefit for climate resilience?

Global Environmental Change

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Overview

Palaeoecological and ecological evidence indicate that species respond individualistically to climate change, recombining to form new communities. However, many conservation strategies do not allow for such changes in species composition, and this lack of flexibility may restrict species movements that are essential for adaptation to climate change. This project evaluates the role that tree species growing beyond their accepted native limits play in climate change adaptation, using naturalised Scots pine communities in northern England and southern Scotland as a case study. Scots pine colonised most of the British Isles following the last glaciation, but then underwent regional range contraction and is now accepted as native only in the Scottish Highlands. Where pines occur beyond this accepted native range, particularly if they colonise ecosystems with alternative conservation values, self-seeded growth may be regarded as a threat to native biodiversity. However, overly restrictive definitions of native vs. non-native may reduce species resilience to environmental change, particularly in island nations where geneflow is limited by biogeographical barriers.

This project will use ecological and palaeoenvironmental methods to assess how historic, naturalised pine communities on peaty soils developed, how they compare with native and plantation pinewoods in terms of structural and species diversity, and how their growth is impacting surrounding open habitats. Preliminary data indicate that the pines are up to 200 years old and thus pre-date commercial afforestation. Potential reasons for retaining these communities include: (1) contributions to biodiversity and adaptive capacity, and (2) insurance against future climatic fluctuations, given pine's past sensitivity to climate change and contradictory predictions about future climate impacts, as well as emerging disease threats which will be more severe amongst smaller populations. However, there is also concern over the impact of naturalisation on colonised habitats: these are primarily open moors and peatlands which also have conservation value. Past drainage of these habitats for agricultural 'improvement' and afforestation means that many are in suboptimal condition and thus potentially more exposed to climate-induced drying, which will particularly affect eastern Britain, including the project study area. The merits of accepting or removing pine can only be assessed through case studies which allow principles of conservation adaptation to be tested in practice to understand when resisting

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Key Words

- Climate change
- conservation
- adaptation
- ecosystem function
- biodiversity

change is ecologically and economically viable, and when accepting transformation at individual sites becomes essential for regional-scale population and species resilience.

This project will provide a robust evidence-base for evaluating the conservation role of these contentious communities. Conservationists have been relatively slow to consider how to move beyond static native/non-native classifications as part of conservation adaptation to climate change, especially in Europe. By starting with the overlooked middle ground between native and non-native, and initiating cross-border academic-practitioner debate on this topic, the project will allow us to take a lead in rethinking conservation adaptation. The main objectives are to (1) assess the current ecological value of naturalised pine communities growing beyond their accepted native range relative to adjacent open habitats and plantations, and to native pinewoods, and (2) to use the findings to assess the biodiversity and conservation adaptation implications of alternative management strategies for naturalised pine communities. To meet these objectives, we aim to quantify the range of floristic variability in naturalised Scots pine communities and how these develop over time, including how increasing canopy complexity with tree age and density influences the structure and composition of ground cover. This will provide a robust basis for comparative analysis of the floristics of naturalised, semi-native and plantation pinewoods.

Image Captions

Prestwick Carr_DSCF0027,jpg – Mature Scots pine, bracken and birch regeneration on a remnant bog, (c) Althea Davies
2010 236.jpg – Younger Scots pine in a naturalising stand, above a field layer with abundant cotton-sedge (Eriophorum vaginatum), (c) Althea Davies

Methodology

A combination of temporal (palaeoecology and dendroecology) and spatial (GIS-based mapping and ecological survey) methods is required to meet these aims and objectives. Mapping work will identify the distribution of Scots pine populations across the study region, incorporating all known stands and an assessment of their characteristics. These include upland and lowland naturalised peat-grown pine stands. At the site scale, floristic survey of higher plants and mosses or lichens will be used to characterise spatial patterns of structural and species diversity. These plant groups are selected as they have differing dispersal abilities and tolerance to disturbance and are therefore highly sensitive indicators of community condition. These biodiversity data will be combined with dendroecological sampling to characterise tree age-understorey relationships and assess how variable these are. Collection of environmental data will include stand density and environmental factors (soil type and nutrient status, aspect, altitude, biotic impacts including grazing and disease indicators) to ensure that underlying variation is explicitly incorporated into the sampling design. The temporal dimension (stand history, historical contingency) will be established using tree-ring data (an indicator of tree age and demographics) and palaeoecology (pollen, fungal spore, plant macrofossil and charcoal records for the last 500 years) to understand pre-pine communities, how the woodland has developed and how it relates to hydrological and disturbance regimes. This will require a two-tier sampling strategy, with intensive survey and carefully controlled comparisons at a subset of sites and more extensive surveys at a lower level of detail over all known sites, also drawing on existing ecological data. Palaeoecological analyses will be conducted at a subset of sites due to the time-intensive nature of analysis and likelihood that undisturbed peat will not be available at all sites. Dialogue with agencies in both countries (Natural England, Scottish Natural Heritage, Forestry Commission) and potential CASE and industry partners will enable the student to network with relevant stakeholders and develop key skills in evaluating these communities and presenting research findings in a strongly policy and practice-oriented framework.

Project Timeline

Year 1

Mapping of stand locations based on existing data, site visits for final site selection and collation of existing data. 1st field season to include palaeoecological and dendroecological and vegetation sampling of ca 50% of the sites selected for detailed surveys. Engage with stakeholders to understand policy context and current practice.

Year 2

Dendroecological analyses and analysis of 50% of the palaeoecological samples. 2nd field season to include remaining detailed surveys and final collection of environmental data for all sites. Radiocarbon submission to NERC-RCF.

Year 3

Complete palaeoecological and soil analyses. Analyse plant community data. Undertake combined analysis of completed project datasets and begin write-up. Discuss preliminary findings with stakeholders.

Year 3.5

Final data analysis, publication production and project dissemination.

Training & Skills

The student will gain training in palaeoecological and dendroecological methods, plant taxonomy, GIS and advanced statistical techniques. Field survey skills and plant taxonomy are recognised as underrepresented in research and wider environmental industries. Analysis of palaeoecological and contemporary vegetation data and modelling of tree ring data all involve multivariate statistical methods, experience of whichwill ensure that the student becomes a highly numerate graduate. GIS skills are also highly valuable across a wide range of research areas. Overall, the student will benefit from training to develop a diverse range of complementary skills strongly benefiting their career prospects in what is an ever-increasing requirement for interdisciplinary working. The assembled supervisory team complement one other in their ability to deliver project-specific training on (1) high-temporal resolution pollen, fungal spore and charcoal analyses, sample processing for radiometric dating, and multivariate analysis of palaeoecological time-series (Davies), (2) survey skills, plant taxonomy and identification and multivariate vegetation analysis (Jump), (3) dendroecological sampling, preparation and environment-growth and time-series analyses (Wilson). The student will complete a comprehensive Training Needs Analysis as part of the supervision process, in line with the Vitae Researcher Development Framework. They will also join active research groups in peatland ecology, palaeoecology and sustainability (St Andrews) and climate change ecology (Stirling). The student will also be encouraged to attend training and networking events within the DTP and offered via NERC and other relevant organisations (e.g. British Ecological Society).

References & further reading

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