Biodiversity colonisation of the Arctic under climate change: impacts on land, sea & people

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Background: Climate is changing rapidly across the Arctic region, as well as across lower northern latitudes. As a consequence, there are widespread expectations that many species from temperate regions will move into Arctic ecosystems in the near future, and such changes are already being observed. The impact of such changes on the terrestrial ecology of the Arctic, in terms of incoming species and the consequences of these potential novel colonists to the way of life of people in the Arctic, remains relatively little studied. Moreover, with changes in Artic sea-ice there is an increased threat of marine species traversing previously impenetrable ice-locked areas of ocean to reach novel Arctic regions, either under their own locomotion or as passive passengers on e.g. ships.

Aims: We aim to assess the potential for the Artic to be invaded by novel species, and the potential for novel assemblages to form. As Arctic systems are relatively species poor, this provides an excellent opportunity to explore in some detail the likelihood of species interactions across trophic webs to facilitate or limiting the likelihood of range shifts being realised. We will explore the impacts of projected changes on Artic ecosystems, focussing on key species and habitats and will evaluate the consequent human impacts of such changes.

Methodology: **Simulating novel colonists and changes** The Conservation Ecology Group in Biosciences has wide experience of projecting species range shifts under climate change (e.g. Stephens et al. 2016). We will utilise this expertise to project novel colonists to the entire Artic region, focussing on all birds and mammals as well as simulating changes for key potential colonist plant and insect species. Moreover, we will extend our modelling to marine systems, using projections of change to marine environmental variables under future climate scenarios. Current aspirations from the IPCC Paris meeting is to limit future global temperature rise to <2°C, yet we are currently tracking a much higher emission trajectory. Hence, it will be necessary to simulate changes under an extensive range of future climates. In addition to climatic variables, out models will incorporate species traits and projected vegetation and productivity changes, to produce more nuanced projections of future range changes than current simulations. Models will be validated using changing range data from a series of sources. For example, a new distribution Atlas for birds (to be published in mid-2020, Fig 1), which can be contrasted with a similar Atlas from 30-years ago, will facilitate validation of such models for this group.

Species Interactions For a subset of key ecosystems (e.g. tundra, birch and coniferous habitats) with relatively simple food webs we will go beyond modelling individual species responses, to predict impacts on species incorporating the potential co-occurring responses of other species upon which they depend.

Timetable of Activity: In the first year, the student will collate range data on Arctic and potential colonist species, and will undertake distribution modelling to simulate changes to these species. In year two, they will extend simulations to marine species and will assemble dominant food-web pathways for key terrestrial and aquatic ecosystems, whilst also spending time at a placement institute in the Arctic. Year three will synthesise the modelling from the previous two years to produce summary impact assessments, which will be used to infer impacts on the people of the Artic and to develop future-proof conservation management strategies. The student will attend national conferences in years 1-2 and an international meeting in year 3.

Maintenance Payment are £14,700 (approx.) p.a. plus tuition fee for 3 years (see https://www.dur.ac.uk/arctic/process/).

Application Process: This project is in competition with others for funding, and is **aimed at UK and EU students**. Success will depend on the quality of applications received, relative to those for competing projects. If you are interested in applying, in the first instance contact Professor Willis (s.g.willis@durham.ac.uk) asap (by 15th December at the very latest), with a CV and a covering letter, detailing your reasons for applying for the project. Applicants encouraged to formally apply should do so online via www.durham.ac.uk/postgraduate/apply attaching their CV, covering letter, 2 academic references, and evidence of previous academic qualifications.

CLOSING DATE FOR APPLICANTS : 15th December 2019 latest date to contact Prof Willis**.**   The post is also advertised on findaphd.com.