Imperial College London

Natural Environment Research Council

## 2023_52_DoLS_Gill: How do trait responses to climate change shape Arctic plant-pollinator networks?

**Supervisors: Dr Richard Gill (mailto:r.gill@imperial.ac.uk);** Phil Stevenson, Kew Gardens; Joe Tobias, Life Sciences, Imperial College London; Keith Larson, Arctic Centre, Umeå University.

**Department:** Department of Life Sciences

Our knowledge of how interaction networks, such as plant-pollinator relationships, are being affected by climate change remains in its infancy. This is primarily due to us having a limited understanding of the underlying mechanisms determining how plant and pollinator populations respond to climatic variation. In particular, we know little as to how functional [morphological & behavioural] traits that mediate plant-pollinator interactions respond to environmental change, particularly about how susceptible certain traits can be. Moreover, we lack studies that have integrated trait response data (for both plants and pollinators) with detailed individual-level interaction observations. Bringing such data together will enable us to better understand how environmentally driven changes to functional trait distributions and levels of functional redundancy, determine plant-pollinator interaction turnover, competition, and co-extinction risk. Ultimately understanding these outcomes can better inform targeted conservation efforts to safeguard 'at risk' interactions, and improve accuracies in predicting pollination provision.

This project will study an Arctic plant-pollinator community located in Lapland (Sweden) by taking advantage of a unique phenology transect spanning an elevational gradient. From the subsequent thermal cline, the student will study plant-pollinator interactions across an environmental and microclimatic gradient using a space-for-time approach. The student will conduct around 3 months of fieldwork each year on how plant and pollinator [bumblebee] traits vary within and between species, primarily analysing how different aspects of temperature determine this. For plants, measures will include floral morphology, nectar and pollen reward composition (e.g. carbohydrates, amino-acids, lipids, sterols) and plant thermal profiles. For pollinators [bumblebees], measures will include body size, proboscis length and body thermal profiles. The project may also include common garden experiments to investigate plant trait plasticity versus local adaptation.

How climatically influenced changes in the distributions or quality of individual-level traits affects pollinator foraging behaviour and health, is still largely unexplored. The student will look to fill this evidence gap by investigating:

i) how temperature variation influences plant and bumblebee trait frequency distributions at different points spanning the elevational range, and how such traits change over the season and between years (building on & using 5 years of past data)

ii) the levels to which both plant and pollinator traits spatiotemporally turn over

iii) how changes to plant traits can predict pollinator visitations, and how this might alter between and within species competition

iv) model how functionally based plant-pollinator networks reshape under future climate scenarios by combing these results with niche modelling