How evolutionary history combines with local ecology to influence biodiversity and climate adaptation in butterflies. Butterflies are among the most iconic and well-known group of animals occupying the European countryside. They are also rapidly becoming the most advanced model system, outside of humans, mice, fruit flies and a few others, for understanding how evolution at the level of the genome affects adaptation to the environment. Just like many other organisms, butterflies have been affected by the repeated glacial cycles of the last 2 million years, becoming separated during cold periods into geographically separate 'refugia', evolving into distinct species and evolving distinct adaptations, before expanding back across Europe during warm periods, to hybridize, compete, and potentially share adaptations. The primary goal of this project is to understand how the current cycle of postglacial spread and hybridization has affected the ability to respond to natural and anthropogenic environmental change, and how that varies geographically, depending on the origin of the genetic variation present in each location. To achieve this, we will use members of a widespread butterfly species complex, *Pieris napi* and its close relatives, which include species, subspecies and geographic races adapted to warm, cold, forested and open environments that overlap and hybridize to differing degrees in different parts of Europe. Through a combination of whole genome sequencing of wild populations and studies of survival and gene expression in climate-controlled laboratory conditions, we will (1) identify genes and genomic regions that contribute to both environmental adaptation and isolating mechanisms that maintain the distinctness of species, and (2) examine how the local environment and local availability of specific genomic variants alters local biodiversity and the ability to respond to modern environmental change.

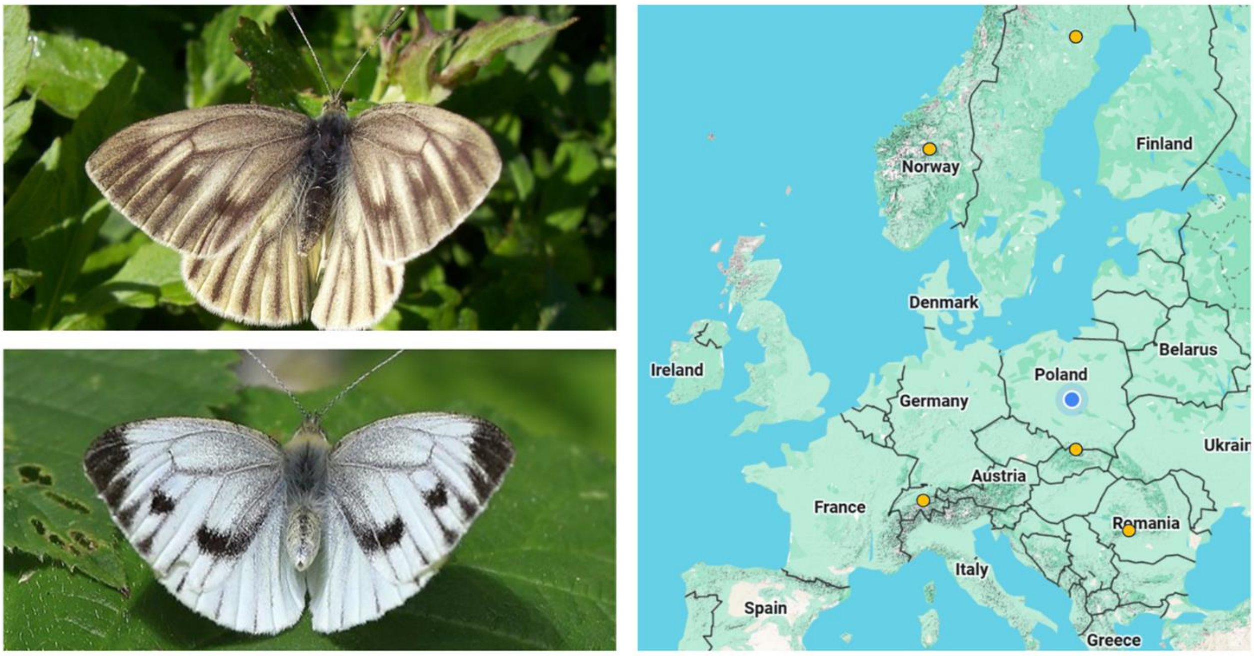

Figure 1. Most members of the *Pieris napi* species complex have females with a white background colour (bottom left panel), including many that live in forests and at high altitude. However, in the Arctic and at high altitudes and heavily forested regions of the Alps and Carpathians, there are populations and species with dark-coloured females (top left panel) that are never found in warmer climates. The two types meet and hybridize in numerous locations (orange points on map mark some example locations), and in some places but not others the light form is replacing the dark form.

Many studies have identified adaptations to climate change and habitat degradation, and identification of genes involved in adaptation is also underway. However, this study's aim is to dramatically increase the level of resolution in determining expected population responses and optimum management strategies by focusing on mechanisms of geographic variation in outcomes. In the *Pieris napi* species complex, there are species and subspecies with dark-coloured females that are always associated with cold environments and are under threat of extinction due to hybridization in some locations (Fig. 1). We aim to identify why populations vary in their ability to respond to environmental change, and why dark-coloured populations seem to be particularly unable to respond to climate warming. We aim to provide a framework for future high-resolution studies in order to improve our fundamental understanding and ability to manage responses to climate change.