The decline in pollination emerges as one of the most critical challenges in recent decades, highlighted by substantial insect losses (e.g., a 40% decline in butterfly numbers across Europe and a 75% reduction in insect biomass in selected protected areas of Germany over the last 25 years). This trend signals that it will become increasingly difficult for both cultivated and wild flowering plants to reproduce. Global climate warming plays a significant role in the decline of biodiversity and changes in species distribution, impacting animals and plants that struggle to adapt to a rapidly transforming world. Severe droughts, increasing wildfires, heavy rains and flash floods are just several effects that we will all have to face in the near future. Researchers race against time to study the effects of climate change on particular species and traits. It has become fundamental to understand unavoidable changes in the distribution of pollinator species and to integrate them into realistic and continent-wide conservation plans.

The charismatic hummingbird hawkmoth is a day-flying moth that pollinates many flowers using its long proboscis to reach nectar in plants that bees or flies cannot access. Some flowers depend on this moth, which truly resembles a hummingbird in flight, to reproduce. This hawkmoth migrates throughout Europe, North Africa and Asia, but the exact route it covers is unknown. To study the potential impact of climate warming on this species' distribution, first we have to find out where to and from it flies. Using state-of-the-art geolocation methodology, we will discover the hawkmoth's migrating pathways. The analysis of stable isotopes obtained from insect wings will allow us to pinpoint where a given individual hatched. So, if we collect an insect that came to Sweden in spring, we will be able to determine in which southern country it began its journey. We will also study the DNA of pollen stuck to the moth's body to see what flowers it visited on its way. Correlating that with known plants distribution will give us even more precise information on which geographical areas the insect crossed. To complement the results of laboratory analyses, we will set up a citizen science project and encourage people to upload their observations of the easily recognised hummingbird hawkmoth to the iNaturalist platform. These data altogether will allow us to figure out the moth's migratory route in Europe and North Africa. Interestingly, in the South of Europe, some individuals stay for the winter. Why do some moths migrate, and others, belonging to the same species, do not? To answer this question, we will compare many characteristics of the moths: their flight performance, metabolism, size, weight and even the buzzes they produce in flight. We will also sequence their entire DNA to see if migrants and residents differ genetically. Ultimately, we will create a model, based on forecasts of how climate may change in the next decades, that predicts the future distribution of the hummingbird hawkmoth. Will migrants become residents increasingly further north? If residents shift northward, can they keep up with climate change? Or will temperatures change faster than insects can move, leaving them with a climatic debt? By studying the hummingbird hawkmoth, a widespread insect crucial for pollination, we aim to understand how global warming affects migratory species distribution. Our findings will help us grasp the broader implications of climate change and can serve for the development of new conservation policies.