

Institute: W. Szafer Institute of Botany, Polish Academy of Sciences

Title: Palaeogenomics of Central European refugia: spatio-temporal dynamics of arctic-alpine flora at the interplay of northern and temperate latitudes.

Name of potential supervisor: dr hab. Michał Ronikier

Background information:

The project aims to investigate role of the Central European mountains in historical biogeography and diversity of the arctic-alpine flora since the Last Glacial until present, based on genomic approaches. Recurrent climate fluctuations in the Quaternary, which included cool and warm episodes (glacials and interglacials, respectively), had a major role in shaping the extant European biota, its distribution patterns and diversity. Comprehending the impact of these past climate changes on organism distributions is one of keys to understand current biological diversity and forecast its future. The arctic-alpine flora includes species widely distributed in the (sub)polar regions of the North but often also present in cool, island-like alpine ecosystems of the temperate mountains – now mainly the Alps, but also other ranges. In contrast to the Alps, mountain ranges of Central Europe (especially the Carpathians) were not strongly glaciated and could potentially have provided suitable environment for arctic-alpine flora during both glaciation of Northern Europe and during warming periods. Hence, they could also serve as an important source of recolonization of the North. With this research we plan to provide a complex, novel insight into the role of Central Europe in the resilience, dynamics, and maintaining the species and genetic diversity of the European arctic-alpine flora.

The PhD will be conducted within an OPUS research project of the Polish National Science Centre (no. 2020/37/B/NZ8/03307).

The main question to be addressed in the project:

What was the role of Central European populations of the arctic-alpine species in postglacial recolonisation processes of Northern Europe? What was the historical range dynamics of intraspecific genetic lineages observed today? How had inter- and intraspecific diversity of arctic-alpine communities in the Central European mountains changed through time since the Last Glacial?

Information on the methods/description of work:

We will perform genetic studies both of contemporary populations and their past traces conserved as environmental DNA within ancient sediments deposited at the bottom of mountain lakes. In the first step, biogeographical reconstructions will be based on “environmental metabarcoding”, i.e. sequencing DNA fragments which allow for species identification, from mixed environmental samples. By DNA barcoding of chronologically deposited lake sediments, reaching the Last Glacial, we will gain insights into how the species composition of the investigated areas changed from then until present. In the following step, by sequencing ancient DNA, and applying highly innovative phylogeographic methods, we further plan to track individual genetic lineages of selected species in particular sediment layers (by capturing vestigial DNA isolated from sediments on molecular probes), and thus through time, from the Last Glacial onwards and link them to the genetic structure of current populations.

Additional information (e.g., special requirements from the candidate):

The candidate will have an MSc or equivalent in Biology, Biotechnology or Bioinformatics, previous laboratory experience in DNA analyses (experience in Next Generation Sequencing techniques and related data analyses is considered a strength), basic knowledge of UNIX type systems (experience in handling computer programs used in genetic data analyses is welcome), good English skills (spoken and written). Motivation for field works in the mountains, lab-based work, and bioinformatics data handling is expected, as well as personal suitability for traveling (at least one research stay abroad is planned).

Earlier experience in conducting research, handling and publishing data, documented by publications, is a plus.

Place/name of potential collaborators:

Dr. Tomasz Suchan (W. Szafer Institute of Botany),

Prof. Inger Greve Alsos (The Arctic University of Norway, Tromsø, Norwegia)

References:

Alsos I.G., Edwards M.E., Clarke C.L. 2020. Survival and spread of arctic plants in response to climate change: DNA-based evidence. *Past Global Changes Magazine* **28**(1): 12–13. <https://doi.org/10.22498/pages.28.1.12>

Ronikier M, Schneeweiss GM, Schönswetter P, 2012. The extreme disjunction between Beringia and Europe in *Ranunculus glacialis* s.l. (Ranunculaceae) does not coincide with the deepest genetic split – a story of the importance of temperate mountain ranges in arctic-alpine phylogeography. *Molecular Ecology* **21**: 5561–5578. <https://doi.org/10.1111/mec.12030>

Suchan T, Pitteloud C, Gerasimova NS, Kostikova A, Schmid S, Arrigo N, Pajkovic M, Ronikier M, Alvarez N, 2016. Hybridization capture using RAD probes (hyRAD), a new tool for performing genomic analyses on museum collection specimens. *PLoS ONE* **11**(3): e0151651. <https://doi.org/10.1371/journal.pone.0151651>