Summary and resolution of the 'Cooperating on Arctic Biodiversity Challenges' meeting

Geneva, Switzerland, 2-3 December 2025

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This document reflects the group's perspective and is the outcome of the High North Talks (HNT) meeting held in December 2025. It summarizes the collective discussions and conclusions of biodiversity and vegetation experts from that meeting. The views, information, and opinions expressed in this publication are those of the group and do not necessarily reflect the views of the GCSP or the members of its Foundation Council. The GCSP is not responsible for the accuracy of the information contained herein.

Preparation for the Fifth International Polar Year 2032-2033 (IPY5) requires intensified coordination between polar scientists in all Arctic countries and beyond. As Arctic ecosystems are experiencing ongoing transformation with far-reaching consequences for the global climate system and local livelihoods, the establishment and maintenance of pan-Arctic environmental and biodiversity monitoring have become even more of a vital necessity.

Russia accounts for half of the terrestrial Arctic, and the contribution of researchers working there to IPY5 is therefore essential. However, since February 2022, Russian research has been largely excluded from the international polar scientific agenda, leaving no clear framework for the involvement of Russian scientists in IPY5. As co-design is central to the International Polar Year, the absence of Russian scientists and their knowledge not only limits access to invaluable data on the state of Russian Arctic ecosystems, but also results in the loss of crucial expertise needed to formulate a common response to Arctic change, and conduct truly panArctic research.

To develop a collaborative framework for pan-Arctic biodiversity research toward IPY5, we gathered in Geneva, Switzerland for a two-day meeting involving 15 scientists from Switzerland, Norway, Iceland, the European Union, the United States of America, and Russia. During the meeting, facilitated by the Geneva Centre for Security Policy (GCSP), we discussed the progress and challenges of international Arctic biodiversity research and identified prospective pan-Arctic projects and means necessary to ensure inclusive participation of biodiversity scientists from all Arctic States in IPY5.

At the meeting, all participants presented their research to identify common links and potential collaboration. In the past four years, several advances were achieved by Russian scientists: the number of Russian plant occurrences on iNaturalist more than doubled since 2021; a checklist of vascular plants of Asian Russia, along with several regional checklists, was published; inventories of bryophyte flora and mycobiota progressed; several new syntaxa were classified; research on soil fauna-vegetation interactions advanced, and the Russian section of the Arctic Vegetation Archive was published, supporting modeling and mapping efforts. Participants from other Arctic countries highlighted progress in Arctic vegetation research including developments of international collaborative networks such as Herbivory, Nordic Borealisation, harmonizing digitized herbarium data, developing DNA barcode libraries, trait databases, and studying permafrost-vegetation interactions and plant diversity dynamics over space and time. Progress has also been made toward developing an international Arctic Early Career Vegetation Scientist network (AVECS).

There is continuous interest in collaboration with Russian environmental scientists from the international research community despite geopolitical barriers. Recent reductions in funding and support for climate change and biodiversity research in some Western countries has increased concerns over the ability to maintain longterm monitoring of Arctic change, which makes restoration of pan-Arctic collaborative research particularly urgent. The necessity of pan-Arctic vegetation monitoring was recently emphasized in the resolution of the Circumpolar Arctic Vegetation Science Initiative (CAVSI) workshop held in Boulder in April 2025. This interest was reconfirmed during our meeting in Geneva, where participants from all countries expressed their support for overcoming barriers to coordinated work in data archiving, taxonomic harmonization, species distribution modeling, and the development of common vegetation protocols for biodiversity monitoring. We identified two key pan-Arctic projects to advance: the development of an updated and comprehensive Pan-Arctic Species List (PASL), and a coordinated research approach to permafrost–vegetation interactions, with a common field protocol consistently applied across the Arctic.

Based on the discussions held during the Cooperating on Arctic Biodiversity Challenges meeting in Geneva (2–3 December 2025), we have agreed on the following resolution:

Acting in a spirit of international scientific cooperation,

Acknowledging existing limitations and restrictions,

and striving toward the reestablishment of collaboration among Arctic biodiversity scientists,

we agreed to:

1. Start and maintain continuous dialogue between Russian and international Arctic biodiversity scientists, and develop common research priorities and coordinated efforts to address the most pressing challenges in Arctic terrestrial biodiversity research and conservation in preparation for IPY5;
2. Welcome the reestablishment of the CAFF Flora Group, and encourage broader inclusion of relevant regional experts in its work;

3. Support the publication and dissemination of high-quality Arctic biodiversity and environmental research necessary to maintain a pan-Arctic perspective, regardless of the country in which the research is conducted;

4. Support cross-border networking and interactions among early-career researchers with the mentoring and support of senior scientists, and aspire to establish a pan-Arctic early-career network in biodiversity based on the existing Arctic Vegetation Early Career Scientists (AVECS) network;

5. Update and publish a new Pan-Arctic Species List (PASL) to account for recent taxonomic changes in order to serve as a tool for ensuring consistent and comparable environmental sampling toward IPY5;

6. Ensure full and consistent coverage of terrestrial vegetative taxonomic groups, including vascular plants, mosses, liverworts, lichens, fungi, terrestrial algae, and potentially cyanobacteria in the updated PASL, develop DNA barcode libraries and other genomic resources;

7. Include conservation, alien or invasive status, geographical distribution, plant functional types, and other relevant information to broaden available applications of PASL;

8. Support the publication of regional checklists, red and black lists of plants and fungi in preparation for the compilation of the new PASL;

9. Promote inclusion of Indigenous names and traditional knowledge in PASL to support community monitoring and co-management in collaboration with Indigenous rights-holders and with full respect for Indigenous data rights;

10. Advance pan-Arctic data and protocol harmonization for plants and fungi building on the Arctic Vegetation Archive, ITEX+, and other related efforts, and access to digital herbaria information;

11. Progress toward a common minimal vegetation sampling protocol that is scalable and suitable for pan-Arctic monitoring and data archiving, that accounts for interests of other environmental and social sciences, local and Indigenous communities, and the broader public;

12. Give special attention in the new protocol to measurements relevant for studying vegetation-cryosphere interactions and include key biotic and abiotic parameters in the new protocol, such as plant height, vegetation cover, microclimate, moss and organic layer thickness, thaw depth, soil carbon and nitrogen content, soil moisture and acidity;

13. Work toward establishing a regular Arctic-Alpine field school to train early-career scientists in up-to-date methods and new standardized protocols, and investigate potential locations, infrastructure, and resources available for establishing the school. Develop the field school curriculum, including training in geobotanical field methods, bioinformatics and GIS;

14. Leverage the role of neutral countries as forums for dialogue and collaboration in order to support the maintenance of connections between researchers from all Arctic countries, and welcome the involvement of researchers from neutral countries in Arctic science;

15. Increase the presence and visibility of Arctic biodiversity science at United Nations events, including climate and biodiversity COPs, and use these opportunities for cross-border meetings and knowledge exchange;
16. Explore connections with relevant Antarctic research to identify synergies toward IPY5.

Appendix 1

Proposal for future research on vegetation-permafrost interactions and development of a common protocol

Rationale

Climate is changing in the Arctic at 3-4x the global average (Rantanen *et al.* 2022). Temperatures are rising drastically, and precipitation is increasing both during summer and winter, particularly as rain rather than snow (Hanssen-Bauer *et al.* 2019; McCrystall *et al.* 2021). In addition, an increase in extreme events is observed (Zhang *et al.* 2025), with potentially widespread effects on vegetation. These changes will affect Arctic ecosystems at multiple levels. Permafrost underlays vast areas of the Arctic, and during recent years, thawing of the permafrost has resulted in a deepening of the active layer, the creation of permafrost slumps and erosion (Liu *et al.* 2023; Li *et al.* 2024). This results in the release of greenhouse gases from organic carbon which is currently locked in the permafrost - and drier top soils once the active layer is deepening (Painter *et al.* 2023; Georgievski *et al.* 2025). At the same time, the Arctic is greening, shrubs are increasing in many parts of the Arctic at the expense of cryptogams, community composition and phenology are changing, and invasive species are spreading, often facilitated by expanding infrastructure (Bjorkman *et al.* 2020; Myers-Smith *et al.* 2020; Wasowicz *et al.* 2020; Silva *et al.* 2025). Related to these changes in vegetation are changes in ecosystem functions that feed back onto the environment. Discussed interactions between community composition and permafrost include (Figure 1):

- Changes in plant community composition (e.g., increase in shrubs and invasive species, decrease in lichens and mosses) and structure (e.g. plant and moss height) affect the insulative capacity of vegetation and its snow-trapping potential (Sturm *et al.* 2001; Elmendorf *et al.* 2012; Ulsted *et al.* 2025).
- Vegetation type affects summer land surface albedo, net radiation and its partitioning into latent, sensible, and ground heat flux. Therefore, a change in vegetation modifies air temperature and the amount of energy available for further thawing of permafrost (Oehri *et al.* 2022).
- Shrubification can lead to increased winter soil temperatures (Myers-Smith & Hik 2013), deepening of the active layer, and further nutrient release and accessibility (Reyes & Lougheed 2015), which in turn results in a short-term increase in plant growth (Ogden *et al.* 2023; Li *et al.* 2025).

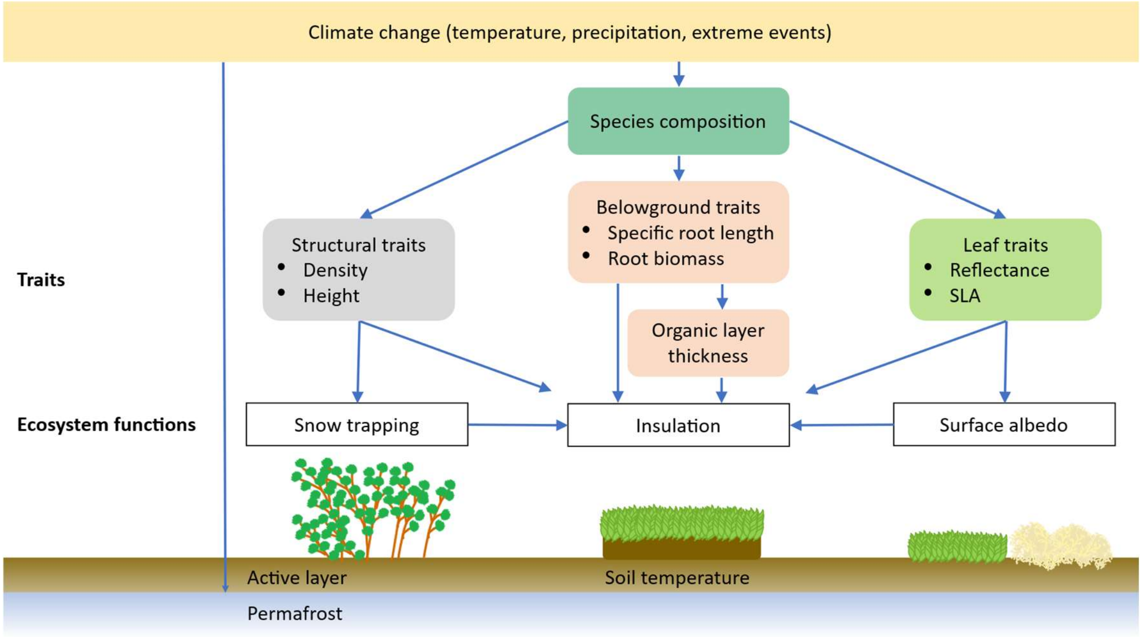

Figure 1. Overview of potential interactions revolving around the proposed studies of permafrost-vegetation interactions.

Considering the vast array of changes in ecosystems when permafrost is thawing, we propose a focus on Arctic-wide studies of permafrost-vegetation interactions. As different species and genera show widely deviating effects on insulation, we need information on biodiversity (species composition, abundance, richness) and vegetation structure. This knowledge is key to answering a multitude of ecological questions, and such a dataset may thus be used for many additional applications, e.g., relating to plant-pollinator and plant-herbivore interactions and conservation. Yet the current state of taxonomy often hinders this aim, making syntheses across pan-Arctic regions hard-to-impossible. We thus propose updating the Pan-Arctic Species List (PASL) including vascular plants, mosses, liverworts, lichens, fungi and terrestrial algae. We further suggest developing and distributing common sampling and monitoring protocols for community composition, vegetation structure, and environmental variables that can be used across the Arctic tundra biome. We propose measuring traits that relate to numerous important ecosystem functions, with a particular emphasis on permafrost insulation.

Development of a common protocol

Arctic-wide, many protocols on vegetation recording are in use, ranging from the ITEX manual (Molau & Mølgaard 1996) to the AVA protocol (Walker *et al.* 2017). Data collection can deviate from pin-point to percent cover method and resulting data cannot always be easily compared (Mamet *et al.* 2016). Rare species may be underestimated with the pin-point method while percent cover can lead to substantial observer biases, especially when repeated measurements are being conducted by different observers. Similarly, diverse approaches exist for collecting vegetation and abiotic data in relation to permafrost which work with different resolution of plant diversity or use of different functional groups; see, e.g., the initiatives https://permafrostthaw.org/data-collection/ and INSULATE - UNIS. For trait measurements, consensus is already established through the trait handbook (Pérez-Harguindeguy *et al.* 2013). Yet which main traits to assess in an overarching protocol remains to be determined.

We assembled a preliminary list of biotic and abiotic measurements (Figure 2) some of which have already proven to be important in determining insulation (Gornall *et al.* 2007; Schuuring *et al.* 2024).

Figure 2. List of potential biotic and abiotic measurements.

- Species composition and abundance including vascular plants, bryophytes and lichens. We encourage species-level surveys whenever possible, as species-specific information allows the most flexibility in determining ecosystem function impacts of vegetation change. In addition to vegetation, surveys should include cover of other categories such as:
    - Bare ground
    - Rock
    - Litter
    - Cryptogamic crust
- Morphological and chemical traits of plants directly impact numerous ecosystem functions (Figure 1). Traits related to plant height and structure influence soil temperature through their effect on snow accumulation in winter and shading in summer, while leaf traits influence energy fluxes. Both leaf and root traits influence soil insulation through their impact on organic matter input, decomposability, and thermal conductivity. We encourage measurement of the following functional traits:
    - Plant height (per species, plant functional group (PFT), or overall vegetation)
    - Leaf traits: Specific leaf area, leaf area, leaf dry matter content, C/N ratio
    - Belowground traits: Rooting depth, specific root length
    - Plant moisture content
    - Plant (or PFT-level) thermal conductivity (under different conditions: moist, dry)
    - Leaf optical properties (reflectance, transmittance, absorptance)
- Moss/bryophyte thickness
- Biomass and dead organic matter weight (if possible)
- Organic layer thickness
- Microclimate: Soil temperature, soil moisture (if possible)
- Thaw depth
- Soil carbon, nitrogen
- Soil moisture (following Raup's finger method (Raup 1969) or using soil moisture meters)
- Snow melt date
- Maximum snow depth
- Grain size soil

Recommendations and action points for the future

- Future work will include assembling protocols that are currently in use and sending this draft to the ecological community. We will further inquire which key traits should be measured. We will engage with Indigenous knowledge holders and Arctic communities to guide our priorities in developing research questions, and choosing which traits to measure, with the goal of improving the value and relevance of research outcomes to local people. We will also involve the permafrost community to gather expertise on measurement of abiotic variables. Modellers will be included in the inquiry to assess which key variables are currently missing.
- We will further conduct a survey among potential users about their ability to differentiate Arctic mosses. Mosses are extremely important in insulating the frozen ground, yet there is a large knowledge gap in species identification. Based on the survey, we can prepare a brief manual for non-specialists to measure essential variables of the moss cover. Further, eDNA-based methods for moss species determination are currently under development and might be integrated into the protocols in the future.
- Similar work will be done for other underrepresented groups such as fungi. We will contact experts and identify which essential variables should be covered in a common protocol.

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