

## Plan Overview

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*A Data Management Plan created using DMPTool*

**DMP ID:** <https://doi.org/10.48321/D1S906>

**Title:** Collaborative Research: NNA Research: Interactions of natural and social systems with climate change, globalization, and infrastructure development in the Arctic

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**Funder:** National Science Foundation (nsf.gov)

**Funding opportunity number:** NSF 21-524

**Grant:** Lead 2126792, 2126793, 2126794, 2126795, 2126796, 2126797, 2126798, 2126799

**Template:** Arctic Data Center: NSF Polar Programs

### Project abstract:

Navigating the New Arctic (NNA) is one of NSF's 10 Big Ideas. NNA projects address convergence scientific challenges in the rapidly changing Arctic. The Arctic research is needed to inform the economy, security and resilience of the Nation, the larger region and the globe. NNA empowers new research partnerships from local to international scales, diversifies the next generation of Arctic researchers, enhances efforts in formal and informal education, and integrates the co-production of knowledge where appropriate. This award fulfills part of that aim by addressing interactions among social systems, natural environment, and built environment in the following NNA areas: Arctic Residents, Data and Observation, Forecasting, Global Impact, and Resilient Infrastructure.

Seasonality shifts, thawing permafrost, and the occurrence of extreme weather conditions in the Arctic today have led to cascading effects in the natural and human worlds. Plants and animals are changing their seasonality and ranging patterns. These changes put increased pressure on livelihoods of peoples of the North, whose dependence on the natural world is tied to weather and seasonality. Globalization, such as the growing presence

of industrial and urban centers, also impacts the Arctic tundra and livelihoods of Indigenous peoples as never before. By considering impacts of multiple climatic and socioeconomic drivers on the functioning of an increasingly industrialized Arctic region, this project crystalizes processes that are or represent potential threats to the well-being of Arctic communities relying on reindeer herding economy. This project co-produces knowledge with various stakeholders representing the Indigenous community, regional government, and industry sectors. The project links numerous disciplines and provides training opportunities for the next generation of scientists as well as broader exposure via an inter-institutional course-forum and public outreach events.

The goal of this project is to understand how the natural, social, and built environment systems within a tundra region are linked in their responses to stressors. This project examines how (1) tall vegetation impacts animals and reindeer herders, and feedback mechanisms conditioned on human activities; (2) changing snowpack influences food webs and animal population dynamics, and alters decision-making by reindeer herders and other stakeholders; (3) the built environment affects the reindeer herding system, as well as interactions between industrial workers and indigenous people and perceptions of the environment by these groups; and (4) reindeer management, social institutions, and markets for reindeer products affect community resilience, indigenous traditions and practices, and landscape structure. The Yamal region of Russia is an ideal site as it spans four of the five Arctic bioclimatic subzones and has an unprecedented large-scale survey of Yamal in the late 1980s as well as voluminous Soviet-era anthropological research on reindeer herders. This project works with regional stakeholders to test hypotheses of multi-system responses to changes in summer and winter heating, growing presence of industrial activities, and increasing social complexities in peoples of the North.

**Start date:** 01-01-2022

**End date:** 12-31-2026

**Last modified:** 01-18-2024

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## **Collaborative Research: NNA Research: Interactions of natural and social systems with climate change, globalization, and infrastructure development in the Arctic**

The project's principal investigators, Drs. Valeriy Ivanov, Peter Ungar, John Ziker, Aleksey Sheshukov, Jingfeng Wang, Desheng Liu, Mary Hessel, and Colin Wren, will ultimately be responsible for all of the data management. Team lead PIs will be responsible for training and data management compliance: Valeriy Ivanov is responsible for Abiotic data management; Peter Ungar is responsible for the Biotic data; and John Ziker is responsible for the Human Subjects data. Drs. Sheshukov, Ungar, Liu, and Ziker have received training through the NSF Arctic Data Center. The PIs may delegate data management duties to the project postdocs and graduate (MS, PhD) students. The NSF Arctic Data Center will provide data archival, preservation, access and metadata authoring services for the project.

- **DATA TYPES**

- *Historical Data*

Historical continuous and remote-sensing meteorological and ecological data from three core sites will be available for use in the project. Borehole data, seasonal thaw layer depth, permafrost lithology characteristics will be digitized for thirty survey plots available from Yamal exploration in the 1980s.

- *Remote Sensing Data*

High resolution stereo images from the DigitalGlobe constellation of satellites (e.g., WorldView-1,2,3, QuickBird) will be used in conjunction with other satellite data (e.g., Landsat-8 and Sentinel-2 and ICESAT-2) to derive vegetation type/height maps. AVHRR Polar Pathfinder and IceBridge will be used to derive maps of snow characteristics. Unmanned aerial vehicle (UAV) multi-spectral imagery will be obtained at different sites. Ground data to complement airborne terrain data will include differential GPS ground control points and photogrammetry RGB images of plant individuals.

- *Field Observations*

**Abiotic Data:** Continuous (at sub-hourly resolution) monitoring of meteorological and ecological variables will be collected from energy-budget towers (one at each core site in Yamal: Kharp (66.8°N, 66.4°E), Erkuta (68.2°N, 69.2°E), and Sabetta (71.2°N, 71.5°E).) and ground-heat stations (two per surface type, six total at each core site) including short- and longwave radiation, temperature, liquid precipitation, wind speed, humidity, active layer soil moisture and temperature, ground heat flux, snow depth, and water equivalent. Additionally, spatial data on active layer depth (CALM design) and snow hardness will be collected. Borehole temperature data will be collected (if cost-feasible).

**Biotic Data** will be generated at three core sites (see above). Subsampling will occur in both tall shrubs and open tundra microhabitats. Data on diversity and abundance of species will be gathered using visual community composition surveys, camera traps, feces counts for larger mammals, and snap traps for rodents (the latter made available through ongoing study by the Russian collaborators). Fox and reindeer ranging patterns will be documented using GPS collars. In addition, point counts of breeding birds and nest surveys will be used. Diets will be documented using pellet and feces dissections, stable isotope analyses of fur, and tooth wear study (of carcasses purchased from fur traders) in the laboratory. Reindeer nutritional stress will be measured by carcass survey and enamel hypoplasia analysis. Ground-based vegetation will be sampled for elemental and isotopic analysis; plant community composition, height, and extent will be measured non-destructively, with stem diameter values informing allometric growth equations. Visual assessments of herbivory impacts will be scored to assess reindeer

pressure.

- ***Human Subjects Data***

Human subjects data will be collected in reindeer herding groups in proximity to the three cores sites in Yamal, nearby communities and infrastructure points, and selectively in larger towns and cities. Field notes and audio recordings will be converted to digital word processing documents. Images from participatory mapping exercises will be stored as raw image files which can be converted into GIS files for analysis. Social network and vulnerability data will be recorded on paper and electronic forms.

- ***Model Based Data Products***

1. High resolution maps of vegetation height and type derived from remote sensing data.
2. Species distribution models developed to explain landscape locations of tall vegetation.
3. Snow dynamics, surface heat fluxes, permafrost and active layer temperature and water content from freeze-thaw model validated on historical and newly collected field data.
4. Agent based models with reindeer herder decision-making rules developed in Netlogo.

Each team will have various numbers of files and file sizes.

1. descriptions of field and laboratory sampling times and locations
2. descriptions of field and laboratory sample collection methods
3. descriptions of field and laboratory sample processing methods
4. descriptions of any hardware and software used (including make, model, and version where applicable)
5. sampling units
6. quality control procedures
7. explanations for why the particular components detailed above were chosen for this project

- **DATA AND METADATA STANDARDS**

The quality of the data will be assured through checks and inspections by respective subteams. Data will be accurately and thoroughly described using the appropriate metadata standards. Specifically:

**Field observation abiotic data:** Continuous dataserries of meteorological variables from energy-budget towers will be collected using equipment-specific software (such as Loggernet for Campbell Scientific dataloggers) and exported to CSV format files for storage along with the metadata.

**Geospatial data:** we will use Content Standard for Digital Geospatial Metadata (CSDGM), Ver. 2 (FGDC-STD-001- 1998), that is a standard directed for use by Federal agencies to document geospatial data. Native metadata of the agency/organization that produced data sets will be translated to CSDGM Ver. 2, if necessary. The standard was developed for the documentation of GIS vector, raster and point data.

**Biological data:** Biological data will be archived in standard accessible formats. Stable isotope and elemental data will follow metadata requirements proposed for organismal biology and ecology in IsoBank standards and tracking data will follow formats prescribed by the Movebank data repository.

**Human subjects data:** We will utilize a metadata tool, DDI-Lifecycle 3.3, designed to document and manage human-subjects data across the entire life cycle.

During the course of the project, data files will be stored in laboratory repositories and/or shared project Google

drive folders. The data will initially be stored in Excel files and transferred to CSV files where appropriate. At the end of each year of data collection, the data files will be deposited to a shared file system on Google Drive where all team members can access the files.

Survey data taken during interviews with the local residents are expected to need provisions for confidentiality due to ethical restrictions and the protection of indigenous knowledge. This sensitive data is governed by an Institutional Review Board policy. Additionally, this project deals with endangered species, so similarly sensitive data, particularly location data, will also be exempted from the archiving requirements set for Arctic Sciences research due to confidentiality and species protection.

Metadata and deidentified human subjects data will be shared to the extent it cannot be used to reveal individual identities or locations of animals.

The data will be released within two years of data collection.

We anticipate that researchers from various fields will be interested in different parts of our project data as well as local stakeholders and others interested in convergence science.

The data from this project might be used to support indigenous sovereignty, natural resource management, and interdisciplinary scholars.

All data and metadata will be released under either the CC-0 Public Domain Dedication or the Creative Commons Attribution 4.0 International License (CC BY), with the potential exception of social science data that have certain sensitivities related to privacy or confidentiality. In cases where legal (e.g., contractual) or ethical (e.g., human subjects) restrictions to data sharing exist, requests to restrict data publication must be requested in advance and in writing and are subject to the approval of NSF, who will ensure compliance with all federal, university, and Institutional Review Board policies on the use of restricted data.

A description of metadata, full data sets, and derived data products, and information describing how to access them, will be submitted to the NSF Arctic Data Center (<https://arcticdata.io>) within the same time frame. Human subjects data will be publicly archived according to the preferences of the project participants to the extent possible without sacrificing the confidentiality of individuals and households participating in the research in an appropriate repository (e.g., ICPSR and ELOKA) with links and descriptions on how to access these data submitted to the NSF Arctic Data Center repository. Links to metadata and data used in publications will be included in peer-reviewed publications as supplemental online materials. Publications will be reported in the annual and final reports with DOIs. In addition, we have budgeted for open access publications for our general findings.

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