



# Convergent Arctic Research Perspectives and Education (CARPE)

Ruth Varner (PI), Katharine Duderstadt (PC), Jerker Bexelius, Julie Bryce, Elizabeth Burakowski, Alexandra Contosta, Jessica Ernakovich, Meghan Howey, Jennifer Jacobs, Charina Knutson, Michael Palace, Denise Pouliot, Paul Pouliot, Elena Sparrow, Katie Spellman, Cameron Wake



ruth.varner@unh.edu

## Goal

CARPE trains graduate students, using a convergence research framework and approach, to more fully investigate and understand the interwoven impacts of changing seasonality on Arctic natural and human systems.

**Vision:** "CARPE promotes transformative graduate training where convergent scientific research and mutually beneficial partnerships with Indigenous and local communities becomes the norm rather than the exception."



## Changing Seasonality in the Arctic

The cascading effects of climate change on natural and human systems are more evident in the Arctic than anywhere else on Earth. Rising temperatures, dramatic sea ice reductions, glacier and ice sheet mass loss, and thawing permafrost influence Arctic peoples' and ecosystems' daily activities and well-being. Particularly profound changes result from shifts in seasonality including the timing of cultural, biological, physical, and chemical events.

- **Spring:** Earlier snowmelt, ice out of lakes, thawing of the soil profile and the initiation of plant photosynthesis and soil nutrient cycling
- **Fall:** delays in leaf senescence, fruit ripening, animal migration, soil freezing, snowpack development, and the icing in of lakes and rivers
- **Implications:** phenological mismatches as well as effects on Arctic residents' hunting and foraging, fishing, shipping, mobility, and community infrastructure.



## Courses and Training

CARPE trainees will:

- **Design and conduct convergent research projects** focused on the impacts of changing seasonality on the Arctic's natural and human systems
- **Build capacity to engage with Arctic Indigenous and local people**

### 5 New Courses:

- **Arctic Seminar** – Introduction to Arctic Systems Science and changing seasonality
- **Arctic Research Methods I & II** – Develop skills in cold regions research methods and community engagement
- **Arctic Convergence I & II** – Co-develop and conduct convergent research projects with community partners.

### Skills and Competencies

- Science communication
- Science of team science
- Research ethics
- Convergence theory and practice

### Workshops and Training

- Arctic Climate Change and Community Collaborations winter workshop in Fairbanks, AK (UAF)
- Cold regions field training (Mt. Washington)
- Decolonizing Science workshops (Gaalteje)

**Disciplines:** Earth Sciences, STEM Education, Natural Resources and Environment, Anthropology and Archaeology, Civil and Environmental Engineering, Sustainability, Indigenous Knowledge

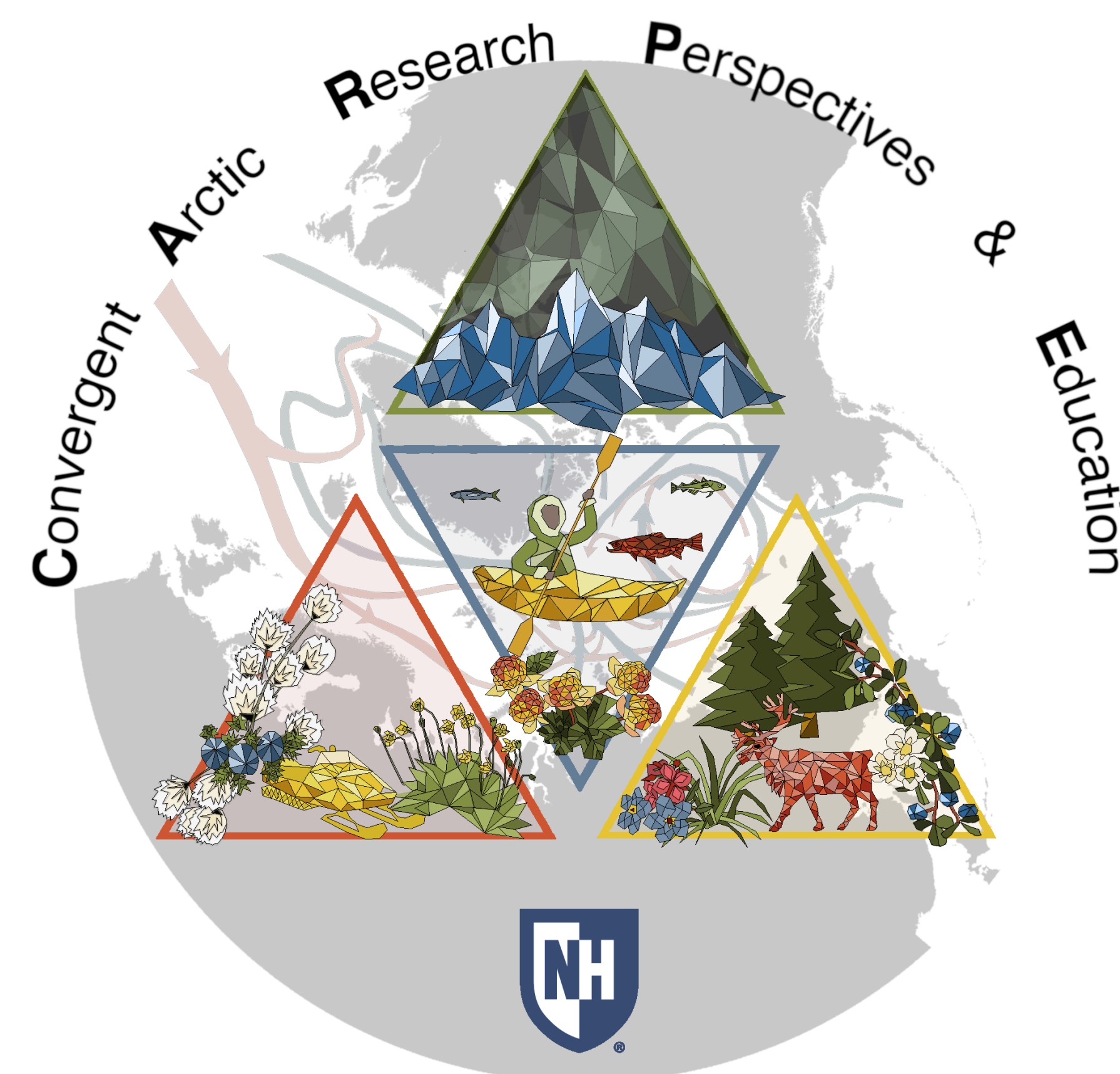
## Learn More and Apply



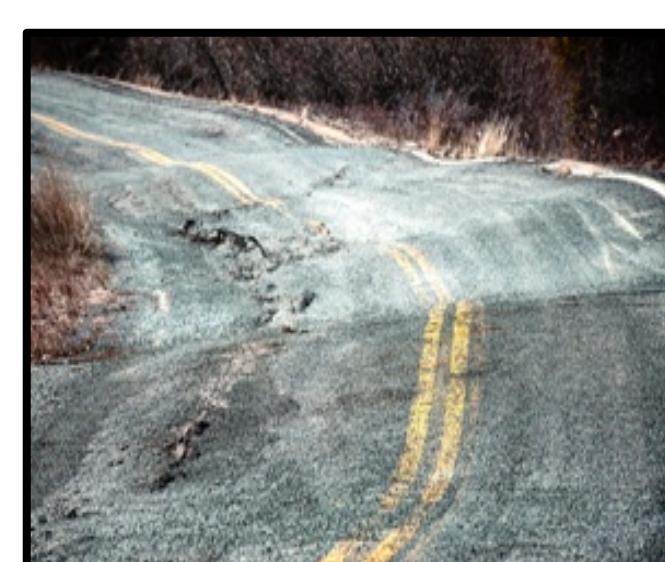
Please visit the CARPE website: <https://marine.unh.edu/carpe-nrt>  
Questions? [carpe-nrt@unh.edu](mailto:carpe-nrt@unh.edu)



This project is supported by the National Science Foundation Research Traineeship (NRT) and Navigating the New Arctic (NNA) programs (NRT-NNA #2125868, PI Varner)



## Research Themes



**Infrastructure and Mobility:** Travel in northern latitudes relies on stable permafrost and winter freezing, on roads and frozen snow-covered land, lakes, rivers, and coastal waters. Changes in Arctic climate are affecting winter mobility with shorter freezing seasons, increased freeze-thaw cycles, ephemeral snowpacks, and rain-on-snow events.

**Pathogens and Toxins:** Toxins and pathogens released from thawing soils and melting ice can move through the environment and ecosystems and potentially affect the well-being of Arctic residents, endangering human and animal health and threatening food supplies.



**Permafrost Biogeochemistry and Food Security:** Foraged foods are an essential source of dietary nutrients. Berries (e.g., blueberries, crowberries, and cloudberries) are a crucial source of phytonutrients for Arctic people, offering affordable access to local nutrients. Changing seasonality has increased the variability in the timing and yield of berry harvests and may affect the nutrient profile of berries.

**Aquatic Ecosystems and Greenhouse Gas Exchange:** Arctic aquatic ecosystems are important sources of methane, a strong greenhouse gas. Altered seasonality is driving earlier ice out and longer ice-free seasons, leading to earlier release of methane trapped under lake ice and in lake sediments. Declining ice thickness and timing of ice-out impact tourism and fishing activities as well as animal migration. Permafrost thaw is also causing "old" stored carbon to become available for decomposition.



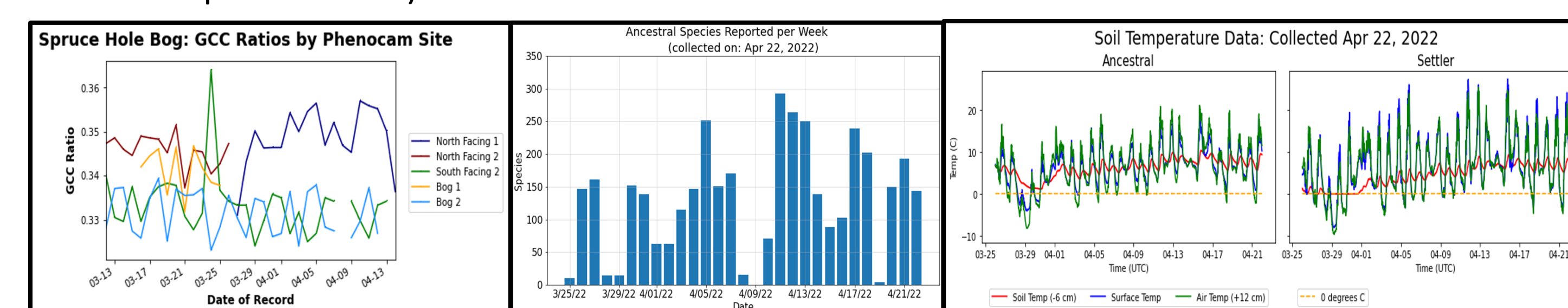
**UNH Land Acknowledgement** – As we all journey on the trail of life, we wish to acknowledge the spiritual and physical connection the Pennacook, Abenaki, and Wabanaki Peoples have maintained to N'dakinna (homeland) and the aki (land), nebi (water), olakwika (flora), and awaasak (fauna) which the University of New Hampshire community is honored to steward today. We also acknowledge the hardships they continue to endure after the loss of unceded homelands and champion the university's responsibility to foster relationships and opportunities that strengthen the well-being of the Indigenous People who carry forward the traditions of their ancestors.

## Year 1



After a semester planning, CARPE welcomed its first cohort of trainees in Spring 2022 with a course co-led by UNH faculty J. Ernakovich, A. Contosta, and M. Howey in collaboration with Denise and Paul Pouliot of the Cowasuck Band of the Pennacook-Abenaki People, addressing:

- **Foundational understanding about how changing seasonality is altering Arctic systems** – exploring the ways humans interact with the changing environment through lectures, literature, guest speakers, and interdisciplinary small group projects.
- **Knowledge co-production with communities and stakeholder groups** – including working with Abenaki colleagues to co-develop research question and engaging the town of Durham to develop protocols for monitoring on kettle hole bog conservation lands.
- **Decolonizing Science** – learning about Sámi communities and concerns as well as the theory of decolonizing science and Indigenous engagement through a workshop designed by Charina Knutson and Jerker Bexelius of the Gaalteje Foundation.
- **Hands-on experience building sensor suites to monitor environmental change** – installed sensors at Spruce Hole Bog as well as neighboring Abenaki and settler archeological sites (air temperature, relative humidity, soil temperature & moisture, acoustic recorders, and time-lapse cameras).



CARPE hosted a retreat at Appledore Island in August, 2022 where trainees drafted Individual Development Plans, discussed convergent Arctic research ideas, and engaged in team-building activities.



## Year 2

As Year 2 begins, new trainees (Cohort 2) are learning about Arctic systems and seasonal change through an Arctic Seminar taught by R. Varner and J. Bryce. Meanwhile, Cohort 1 trainees are developing convergent group research proposals in a course designed by J. Ernakovich and C. Wake and will carry out convergent projects in spring 2023.

PI Varner and CARPE trainees traveled in September to northern Sweden to initiate new relationships and strengthen existing ones with Indigenous Sámi community representatives and liaisons, learning about current research needs surrounding the effects of deforestation on traditional reindeer herding.

In November, CARPE will send a group of faculty and students to the Navigating the New Arctic annual meeting in Anchorage. In January, CARPE trainees will travel to Alaska for an "Arctic Climate Change and Community Collaborations" workshop led by K. Spellman and E. Sparrow at the University of Alaska Fairbanks. These events also aim to develop links and synergies between the CARPE NRT, Tamamta NRT (UAF), and Saunna NRT (UMaine).

**Preliminary Data** courtesy of the CARPE Cohort I students Emma Burkett, Tim Hoheneder, Cheristy Jones, Tamara Marcus, Mahsa Moradi Khaneghahi, Jess Steketee, and Megan Verfaillie. **CARPE logo** designed by trainee Emma Burkett.

