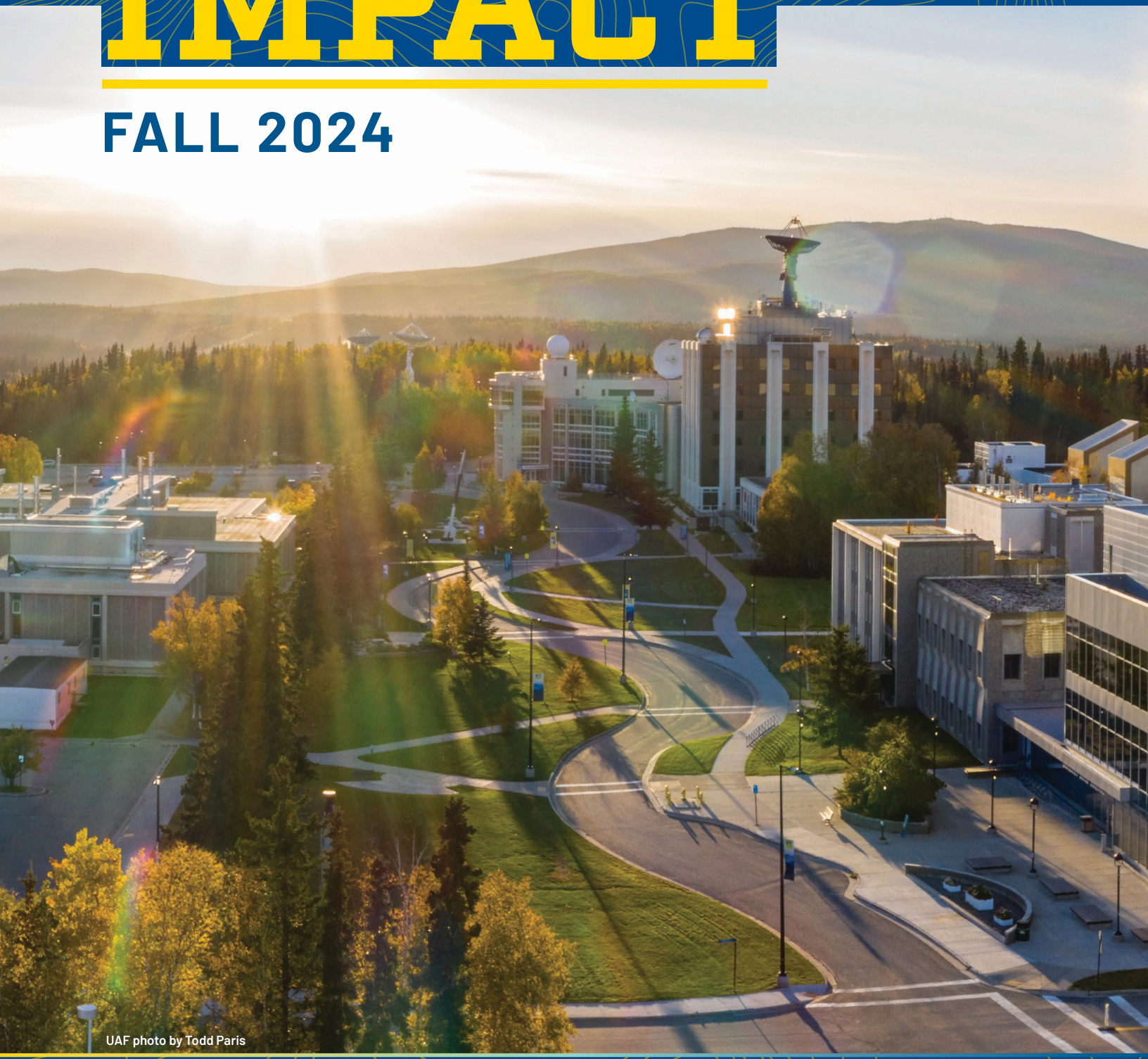
RESEARCH
University of Alaska Fairbanks
OFFICE OF THE VICE CHANCELLOR

IMPACT

FALL 2024



UAF photo by Todd Paris

Vice Chancellor for Research Report

Dr. Nettie La Belle-Hamer

I am pleased to introduce the first volume of our newly imagined research newsletter. This first edition of *Impact* serves as a testament to the transformative research and creative work flourishing at UAF — a reminder of the innovation and pursuit of knowledge taking place at America's Arctic university. Future editions will spotlight impactful researchers at all stages of their careers, innovative projects, and new initiatives fueled by UAF research. From the heart of the Troth Yeddha' campus to remote campuses, field sites, and explorations of the vast wilderness that surrounds us, UAF remains a fundamental cornerstone of Arctic research.

At UAF, we are not just observers. We are architects of change, leaning into the future of our state, our Arctic region, and our country. Whether it is pioneering 3D-printed concrete homes, applying cutting-edge machine learning to wildland fire mitigation or training the next generation, the impact of our research expands beyond classrooms and labs. It is shaping our world in collaboration with the communities who have been here for thousands of years. This is the work of many hands, minds, and hearts — scientists, students, and collaborators from every corner of the globe.

In 2024, UAF maintained its reputation as a world leader in Arctic research. As we move into 2025, UAF's inclusive research community is committed to growth, pushing the boundaries of ingenuity, and addressing the challenges facing the Arctic and beyond.

I invite you to join us - enroll at UAF now for the adventure of a lifetime!

– Dr. Nettie La Belle-Hamer
Vice Chancellor for Research, University of Alaska Fairbanks

CONTENTS

Toolik Field Station
UAF photo by Brian Sevald

Bridging Research & Community

JULY

UAF photo by Eric Engman.

IANRE Annual Farm Days

July 30th–August 1st

The Institute of Agriculture, Natural Resources, and Extension hosted its first annual Fairbanks-based Farm Day at the Georgeson Botanical Gardens and the second annual Palmer-based Farm Day at the Matanuska Experiment Farm this past summer. Community participants visited research plots on the farm and spoke with scientists conducting active research in agricultural studies while experiencing the grounds on interactive tours.

AUGUST

Photo courtesy RED Photography Fairbanks.

Alaska Defense Forum

August 26th–28th

The Alaska Defense Forum unites military, community, and business leaders to address challenges facing installations, families, and communities. Attendees heard from senior officials on Alaska's role in national security. This year's theme, "Operation Innovation," highlighted UAF's research with Department of Defense-focused tours of its labs and facilities.

SEPTEMBER

UAF photo by Marina Santos.

ACUASI Nenana Drone Hangar Opening

September 16th

UAF opened a new 4,800-square-foot hangar for the Alaska Center for Unmanned Aircraft Systems Integration, providing space for year-round drone storage, maintenance, and testing. This facility supports communication among airspace users and serves as a base for drone cargo test flights between Fairbanks and Nenana, fostering the development of autonomous systems technology within the ACUASI Emerging Technologies Test Range Network.

OCTOBER

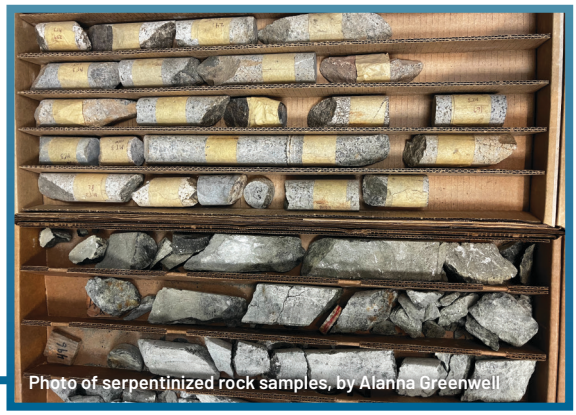


Photo of serpentinized rock samples, by Alanna Greenwell

Geologic Hydrogen Workshop

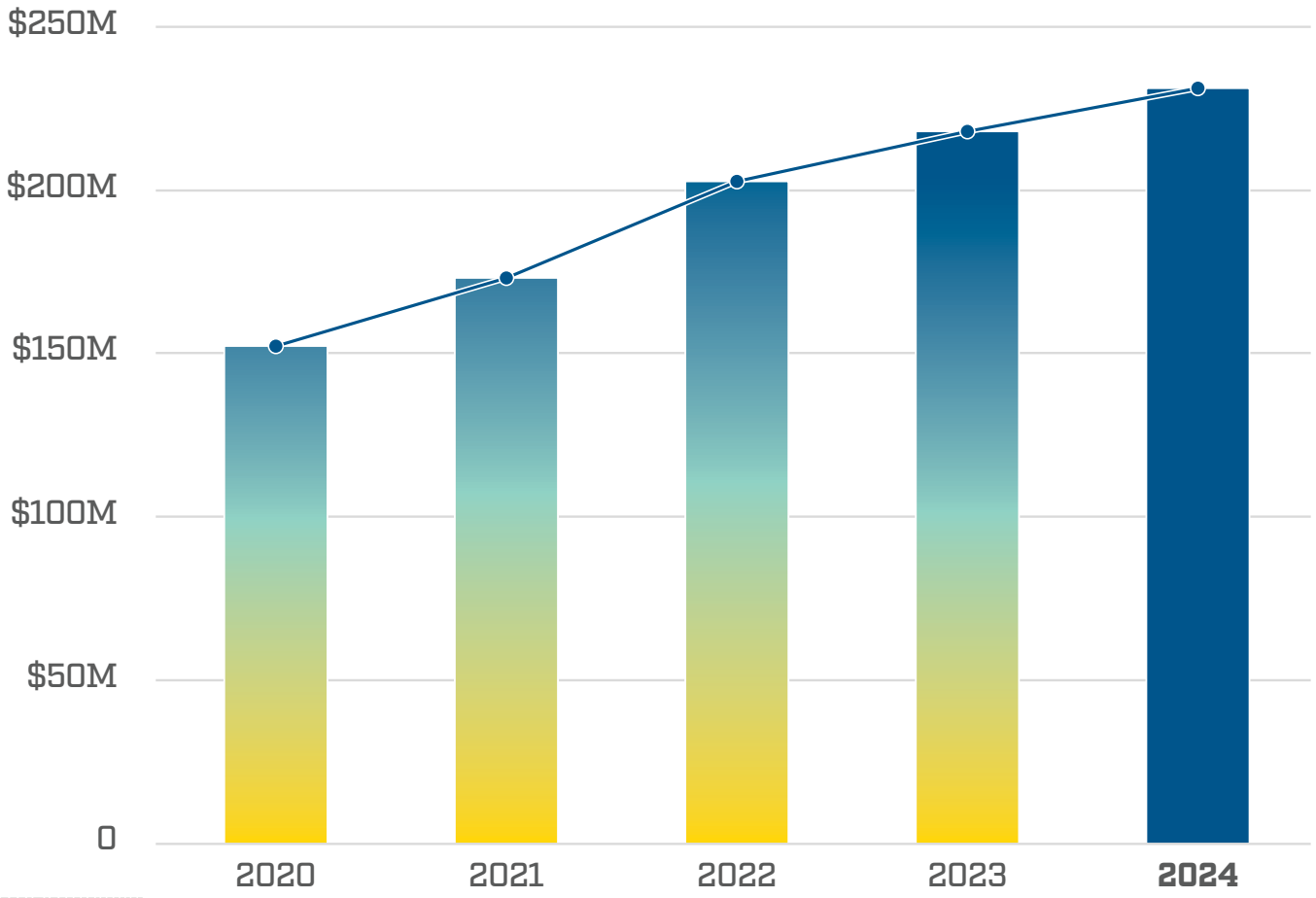
October 29th–31st

The Geologic Hydrogen Workshop, hosted by the U.S. Arctic Research Commission and UAF's Geophysical Institute, brought together experts to advance research on Alaska's potential for geological hydrogen as a clean energy source. Focus areas included sustainable assessment, utility, economics, storage, transportation, and the necessary policy framework for exploration, development, and future research efforts.

TOTAL FY24 RESEARCH FUNDS

$231,367,000

RESEARCH EXPENDITURES BY FISCAL YEAR



Total Research Expenditures

Research expenditures shown above are dollars spent to conduct research at UAF. This total includes all UAF research projects funded by federal, state, and private sources. They can be thought of as dollars coming to Alaska directly from UAF's research activities, making these dollars impactful not only for the research itself, but also for Alaska's economy.

The National Science Foundation publishes this number annually for U.S. colleges and universities through the Higher Education Research and Development (HERD) Survey. UAF's expenditures from NSF's HERD are shown for 2020-2023. For 2024, the research revenue reported here is based on National Center for Higher Education Management Systems categories (not on a HERD basis) and this includes state capital research funds.

UAF Research

UAF research is focused within several high-profile research institutes. A few of the institutes are embedded in colleges, but all collaborate across colleges and other institutes. Collaborations are a key component of our success.

Alaska Center for Energy and Power

ACEP develops solutions to address Alaska's energy challenges, serves as a hub for energy initiatives at UAF, and collaborates with local, national, and international partners to tackle energy needs both within Alaska and globally.

Center for One Health Research

The Center for One Health Research investigates the interdependence of human, animal, and environmental health, recognizing that a holistic approach to the well-being of all will lead to improved health outcomes and enhanced resilience.

Geophysical Institute

The GI studies Earth and space-related processes, from the Earth's core to the sun, focusing on issues such as climate change, natural hazards, and energy resources. Research conducted at the GI provides data and insights that inform policies and decisions, particularly for Alaska, the Arctic, and the United States.

Institute of Agriculture, Natural Resources and Extension

IANRE enriches the lives of Alaskans through research and outreach in agricultural systems, natural resources, and home and community development. Experts share their knowledge with communities through public workshops, presentations, and consultations.

Institute of Arctic Biology

IAB produces world-class research on life in the changing North, ranging from molecular and physiological adaptation to extreme environments, ecosystem-climate feedbacks, and the health and resilience of Alaskan communities. Its Toolik Field Station is a world-renowned Arctic climate change research station located in the northern foothills of the Brooks Range.

Institute of Marine Science

IMS researchers study marine, estuarine, and freshwater ecosystems, focusing on human interactions with these environments. Their studies involve environmental monitoring, controlled experiments, and developing models to understand ecological systems and changes.

Institute of Northern Engineering

INE conducts research across various engineering disciplines, including energy production, mechanical systems, environmental engineering, and infrastructure. Their team collaborates with natural scientists, social scientists, and anthropologists to address significant societal issues.

International Arctic Research Center

IARC's focuses on solving Arctic-related problems that extend beyond the scope of any single nation. Its scientists study the Arctic's ocean, ice, atmosphere, land, and society, recognizing that changes in the Arctic have a global impact.

Here on Troth Yeddha'

Wildfire Walk

By Heather McFarland

On July 11 UAF celebrated the opening of a new interpretive trail on the Troth Yeddha' campus at the 2021 Yankovich Road Fire site, where 3.5 acres burned within 100 yards of a residential neighborhood. The Wildfire Walk educates visitors about the fire site through nine interpretive signs that describe the relationships between wildfire and the boreal forest, fire science and climate change, and wildfire prevention.

The event was hosted by the UAF Alaska Fire Science Consortium, which partnered with the U.S. Bureau of Land Management's Alaska Fire Service and other organizations to create the walk.

Beyond the unique educational opportunity presented by the Yankovich Road Fire, its proximity to UAF allows for close study of how the boreal forest changes after a fire. Managers and scientists return regularly to the fire site to measure and track changes in vegetation and permafrost.

UAF photo by Leif Van Cise

The Wildfire Walk was funded by the federal Joint Fire Science Program, National Science Foundation, U.S. Department of Agriculture National Institute of Food and Agriculture, and the State of Alaska.

REFERENCES:

McFarland, Heather. (2024, July 8). *UAF invites people to take a wildfire walk*. University of Alaska Fairbanks.

New Concrete 3D Printer

UA News

A new 3D printer for building with concrete was installed in the College of Engineering and Mines' high bay in July. UAF is collaborating with Xtreme Habitats Institute, X-Hab 3D, Penn State, and other key partners to explore how 3D printing technology can be used to create durable, affordable housing tailored to Alaskans' unique needs.

3D construction printing technology combines robotics, software, and advanced concrete composite materials to automate the construction process. This innovative approach could become an alternative to traditional "stick-built" construction, addressing challenges such as skilled labor shortages, rising costs of building materials, short building seasons, energy efficiency, durability, and total cost of ownership.

This project is not just about advancing construction technology; it's about creating solutions that utilize locally sourced materials and are adapted to Alaska's distinct environment and culture.

REFERENCES:

UA News Center. (2024). *Did You Know 3D Printing is Shaping the Future of Housing in Alaska?* Retrieved Oct. 4, 2024, from University of Alaska News.

Photos courtesy UA News Center

From the Field

From the Water

By Anna Lionas

During summer 2024, the R/V *Sikuliaq* stopped off in Nome after a three-week trip in the Bering and Chukchi Seas as part of the Arctic Collaborative Ecosystem cruise. The cruise aimed to assess the health of the region's ecosystems, with researchers deploying UAF and NOAA automated moorings off the ship to gather year-round data.

Scientists aboard noted no harmful algal blooms this year and observed changes in marine mammal populations, including previously unreported sightings of humpback whales along the international dateline. The researchers also linked heavy rainfall in the region to freshening seawater near the surface, likely due to increased river runoff.

R/V *Sikuliaq*, [pronounced see-KOO-lee-auk], is a 261-foot oceanographic research ship capable of bringing scientists to the ice-choked waters of the Arctic. *Sikuliaq*, one of the most advanced university research vessels in the world, can break ice up to 2.5 feet thick.

Sikuliaq is homeported in Seward, Alaska, at UAF's Seward Marine Center. The vessel is owned by the National Science Foundation and operated by the College of Fisheries and Ocean Sciences at UAF as part of the U.S. academic research fleet.

STATISTICS FOR SIKULIAQ IN FY23-FY24 SEASON:

- **27,000** nautical miles traveled
- **227** days at sea
- **142** Days in the Arctic (as defined by the Arctic Research and Policy Act of 1984)
- **40** Days in the ice
- **254** Net tows
- **260** Corings collected
- **190** Bottom Samples collected

REFERENCES:

College of Fisheries and Ocean Sciences. (n.d.). *About R/V Sikuliaq*. Retrieved Oct. 4, 2024, from University of Alaska Fairbanks.

Lionas, Anna. Excerpts from "Sikuliaq researchers share preliminary findings." *The Nome Nugget*, Sept. 5, 2024, p. 5.

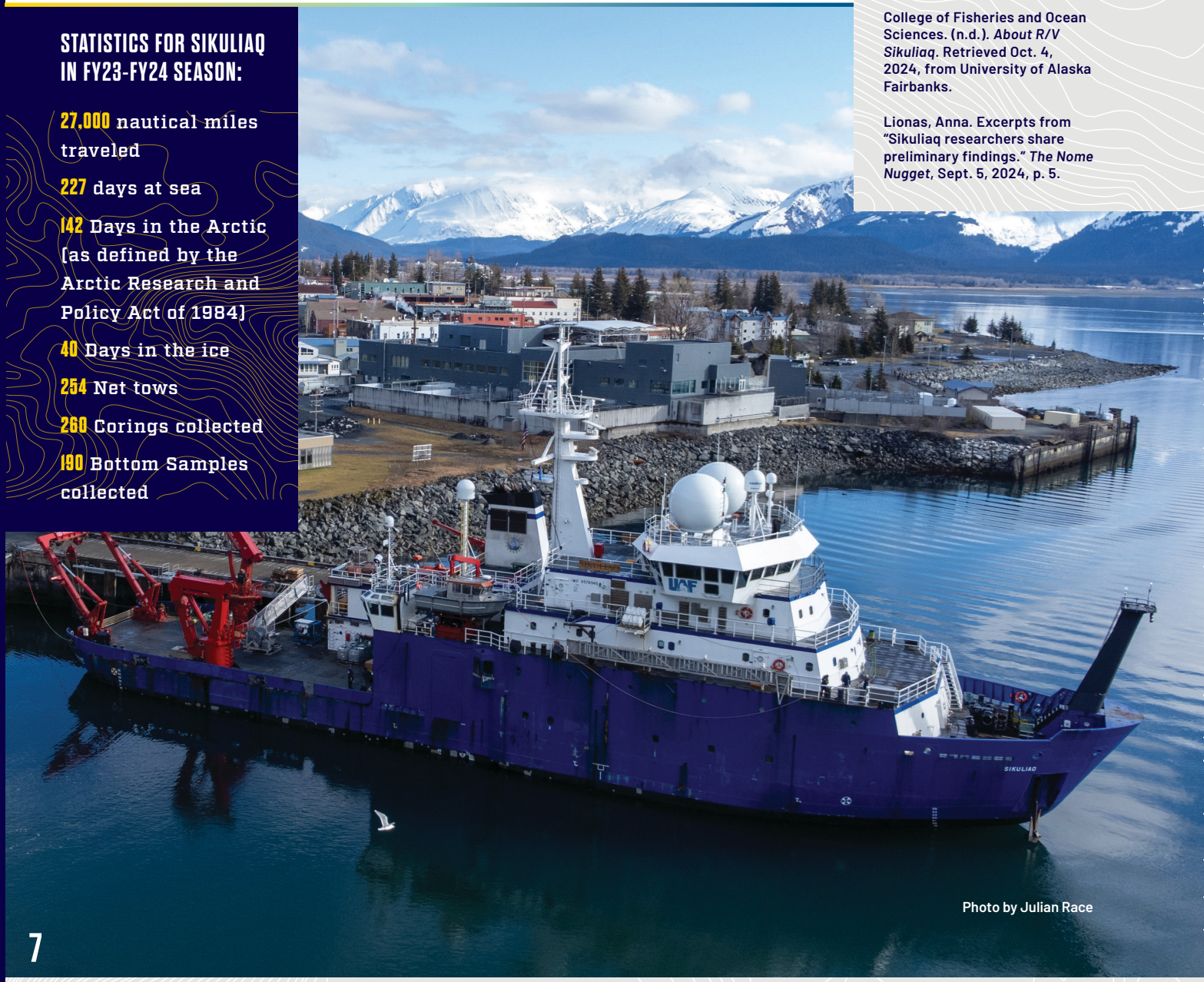


Photo by Julian Race

From the Land

By Laura Weingartner

The small grains trials project at the Fairbanks Experiment Farm, led by UAF agronomist Mingchu Zhang, conducted its harvest day on August 6. The project focuses on identifying barley, wheat, and canola varieties that can thrive in Alaska's short summer growing season. Researchers are particularly interested in finding a malting barley variety suitable for local brewers, as well as spring wheat for bread flour and canola for soil improvement and oil production.

The project evaluates nearly 80 different crop varieties based on their ability to mature early, yield high amounts of grain, and stand upright during harvest. Specific traits such as kernel size, nitrogen content, and resistance to grain shattering are crucial factors for barley's use in brewing, with two-row barley varieties generally preferred for beer due to their larger kernels.

After harvest, the research team analyzes the seeds to assess their quality through measures such as bushel weight, protein analysis, and nitrogen content. Only the most promising varieties are sent for further malting tests in commercial labs. These selected crops will then be grown again in the following year to study how different environmental factors, such as weather conditions, affect their performance. The ultimate goal is to develop locally grown crop varieties that benefit both farmers and consumers by reducing import costs and improving product quality.

Photo by Mingchu Zhang. From left, Charles Ashlock, Nathan Simms and Inga Peterson harvest grain using a combine harvester on Aug. 6 at the Fairbanks Experiment Farm's small grain trial plots.

REFERENCES:

Weingartner, Laura. (Aug. 9, 2024). *UAF researchers aim for quality, quantity in small grains project*. University of Alaska Fairbanks.

Photo by Yuan Tian. A heavy beetle infestation in this spruce tree is revealed by holes in the bark and orange and brown clumps of boring dust.

Researcher Spotlight

Simon Zwieback

By Rod Boyce

A new machine-learning system developed at the University of Alaska Fairbanks can automatically produce detailed maps from satellite data to show locations of likely beetle-killed spruce trees in Alaska, even in forests of low and moderate infestation where identification is otherwise difficult.

The automated process can help forestry and wildfire managers in their decisions. This is critical as the beetle infestation spreads. The Alaska Division of Forestry and Fire Protection calls the spruce beetle "the most damaging insect in Alaska's forests."

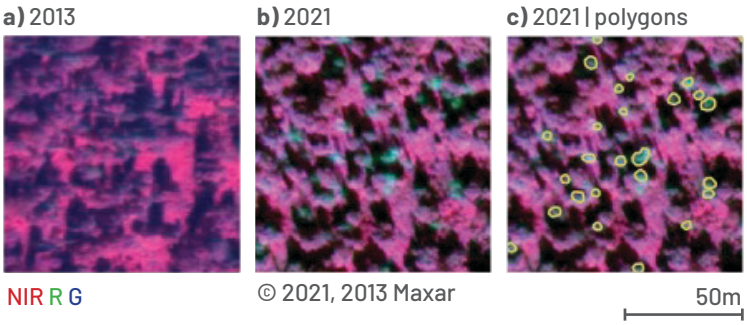
The identification system, developed by assistant professor Simon Zwieback at the UAF Geophysical Institute, was detailed in the *ISPRS Journal of Photogrammetry and Remote Sensing* on May 18. Zwieback is also affiliated with the UAF College of Natural Science and Mathematics.

This work fills a knowledge gap: how to automatically map likely spruce beetle infestations in areas of low to moderate severity. "We lack comprehensive statewide maps of beetle-killed trees because existing products largely rely on expert observations from airplanes, which are expensive and restricted in space and time," Zwieback said. "This limits stakeholders' ability to respond to the ongoing outbreak."

Alaska foresters currently use survey flights, time-consuming manual interpretation of high-resolution imagery, and automated analysis of coarser satellite imagery to find dead spruce in mixed forests. While coarser imagery can identify entire stands of dead trees, it cannot pinpoint individual dead trees.

None of those identification methods, including Zwieback's, can determine the cause of an individual tree's

Photos by Bob Gabbitas. Specimen from UAM:Ento:14619



Dead spruce trees have a teal appearance in image (b), a false-color satellite image used to train the computer algorithm. Image (c) shows the manually delineated dead spruce in preparation for training the algorithm. Image (a) is a false-color image of the area prior to beetle infestation

death. The likelihood of beetle infestation is inferred based on its well-known presence and the damage already caused.

Zwieback's method combines the efficiency of automation with the detail of high-resolution satellite images. "Using machine learning and high-resolution imagery is the way to go in mixed forests," Zwieback said.

Machine learning is a type of artificial intelligence that focuses on developing algorithms and statistical models that enable computers to learn from and make predictions or decisions based on data. Zwieback's machine-learning algorithm is trained using known locations of dead spruce trees. During training, the algorithm learns to recognize dead spruce based on their characteristic shape and color, as well as contextual clues such as shadows. Once satisfactorily trained, it can rapidly and automatically identify dead spruce trees.

Zwieback tested the method on images of an approximately 167-acre study area west of a line from Talkeetna to Byers Lake. The forested regions of the study area consist of mixed stands of spruce and birch.

Zwieback's method can aid in decisions about fire prevention and suppression. Additionally, concerns include the decreased value of timber resources and the aesthetic deterioration of the landscape. "I would like to implement this for the entire state whenever new images come in," he said. "Remote sensing can help us understand the outbreak dynamics and inform our response to it, especially as it migrates into the Interior."

The work was funded by NASA EPSCoR and National Science Foundation EPSCoR, the Established Program to Stimulate Competitive Research.

Photo by Simon Zwieback. Co-author stands next to a dead spruce tree near Cantwell, Alaska

REFERENCES:

Boyce, Rod. (June 12, 2024). *New way to spot beetle-killed spruce can help forest, wildfire managers.* Geophysical Institute, University of Alaska.

Photo provided by Bill Hauer, 2024. Image displays the city of Fairbanks, alongside the Tanana River

Research Group Showcase

Geophysical Institute's Remote Sensing Group

UAF has dozens of research programs and facilities, including the Remote Sensing Group at the Geophysical Institute. With $13 million in active research projects, the GI's remote sensing research extends across the globe, from the Arctic to the Himalayas.

At the GI, remote sensing research is primarily funded by NASA, NOAA, and the Department of Defense. The remote sensing group consists of 25 faculty, staff, and students engaged in research, collaborating across 13 national and international institutions.

Research Capacity

The GI's remote sensing researchers study Arctic sea ice, permafrost, wildfires, and geohazards such as earthquakes, floods, and volcanoes, using microwave remote sensing technologies, including synthetic aperture radar, to image the Earth's surface. They also utilize Unmanned Aerial Systems drone technology and artificial intelligence to collect and analyze data.

OPERATIONAL FACILITIES

Alaska Satellite Facility

ASF is the largest operational facility at the GI, supporting NASA, NSF, and DoD remote sensing projects. It boasts a 24/7 operations center that downlinks data from polar orbiting satellites and operates the NASA archive of synthetic aperture radar data from various satellites and aircraft, providing data and analysis algorithms to researchers around the world.

Geographic Information Network of Alaska

GINA's data is used by federal agencies that monitor weather, wildfires, and volcanoes. GINA scientists use satellite data to produce near real-time maps and data visualizations across Alaska and the Arctic. GINA operates two antennas to downlink the satellite data that goes into its products.

Poker Flat Research Range

PFRR is best known for being the world's largest land-based rocket range and the only university-owned rocket range. Remote sensing researchers study both the sun and the aurora from the PFRR facility, located 45 minutes from the Troth Yeddha' campus. PFRR hosts a variety of remote sensing instrumentation, including an incoherent scatter radar for monitoring and studying the effects of space weather on the Earth's upper atmosphere.

REFERENCES:

Alaska Satellite Facility. Retrieved Oct. 4, 2024. https://asf.alaska.edu/

Geographic Information Network of Alaska. Retrieved Oct. 4, 2024. https://gina.alaska.edu/

Poker Flat Research Range. Retrieved Oct. 4, 2024. https://www.pfrr.alaska.edu/content/welcome-poker-flat

Project Showcase

NISAR: a joint mission between the United States and India

NASA has joined forces with India's space agency ISRO for an ambitious mission to create high-resolution imagery of the Earth using Synthetic Aperture Radar technology. The NISAR satellite —**N**ASA-**I**SRO-**SAR** — will continuously scan the Earth's surface, producing 50 petabytes (equivalent to 52,428,800 gigabytes) of data that will be processed by NASA's Jet Propulsion Laboratory and distributed by UAF's Alaska Satellite Facility.

ASF's Chief Scientist Franz Meyer has been part of the NISAR science team since 2012 and has helped develop the sensor calibration and validation plans for the satellite. SAR data is especially useful for monitoring the planet's most complex systems, including ecosystems, ice sheets, and natural hazards such as volcanoes, earthquakes, and floods. NISAR's launch is scheduled for 2025.

UAF remote sensing research continues to shape the future of global research, driving new discoveries and applications in remote sensing technologies that are critical for understanding Earth's systems, both in the Arctic and across the globe.

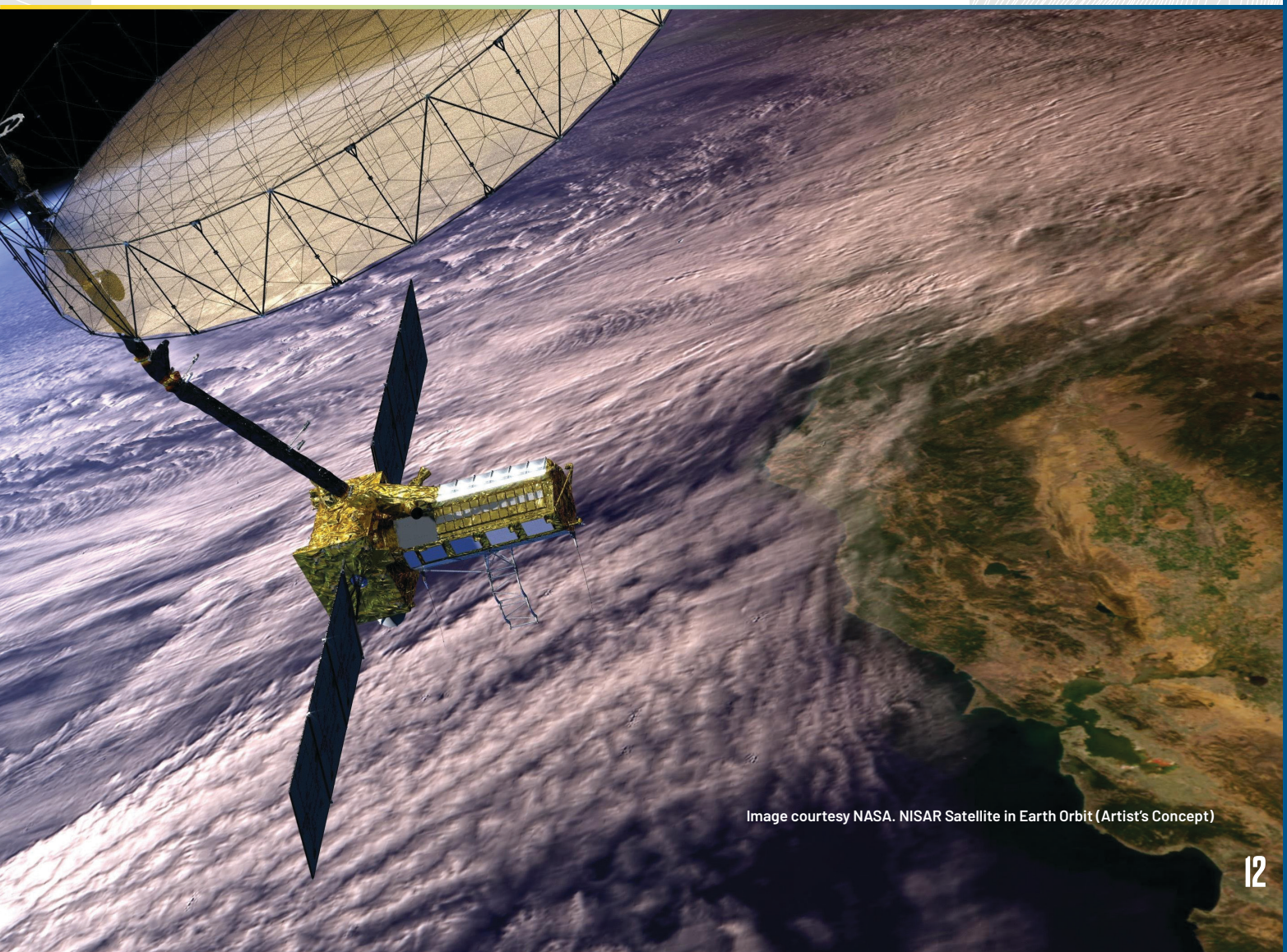


Image courtesy NASA. NISAR Satellite in Earth Orbit (Artist's Concept)

Appointments & Honors

NASA Space Tech Catalyst Prize

Dr. Denise Thorsen

Professor of Electrical and Computer Engineering, Associate Dean of the College of Engineering and Mines, Director of Alaska Space Grant

Dr. Thorsen was awarded NASA's Space Tech Catalyst Prize for her proposal addressing the educational challenges faced by underserved students in Alaska due to the state's vast geography. She will receive $25,000 and the opportunity to collaborate with NASA's Goddard Space Flight Center to enhance inclusive space technology ecosystems.

Election to the National Academy of Sciences

Dr. Diane O'Brien

Professor of Biology and Wildlife, Director of the Institute of Arctic Biology

Dr. O'Brien has been elected to the National Academy of Sciences for her contributions to public health and ecology through stable isotope analysis. Her research connects traditional diets to health outcomes in Alaska Native communities, highlighting her transdisciplinary approach and making her the second Alaska-based researcher honored by the Academy.

Fulbright Scholar

Dr. Eugénie Euskirchen

Associate professor of Ecology, Institute of Arctic Biology

Dr. Euskirchen received a Fulbright Scholar grant to study how extreme weather impacts Arctic carbon cycling. Her work examines potential climate-warming feedback loops and will advance understanding of high-latitude ecosystems through continued collaboration in Finland.

The Beynon Medal

Dr. Craig Heinselman

Research Professor of Physics at the Geophysical Institute, Former Director of the European Incoherent Scatter Scientific Association

Dr. Heinselman received the 10th Beynon Medal for his leadership in advancing the EISCAT_3D radar system. His expertise in aeronomy and contributions to international ionospheric research over the past decade have significantly enhanced understanding of space weather phenomena.

IEEE Education Award

Dr. Franz Meyer

Professor of Radar Remote Sensing, Chief Scientist of Alaska Satellite Facility

Dr. Meyer received the Education Award, one of the major awards of the IEEE Geoscience and Remote Sensing Society, for his impactful contributions to education and outreach. His work includes developing online courses, leading international training sessions, and creating educational materials integrated into curricula at universities in Central and South America.

REFERENCES:

Boyce, Rod. (March 19, 2024). UAF space engineering program director wins NASA prize. University of Alaska Fairbanks Geophysical Institute.

Loeffler, Amy. (May 13, 2024). Diane O'Brien elected to the National Academy of Sciences. University of Alaska Fairbanks.

Boyce, Rod. (July 11, 2024). UAF physicist receives top honor from European science association. University of Alaska Fairbanks.

Boyce, Rod. (July 24, 2024). UAF remote sensing scientist receives international award. University of Alaska Fairbanks.

Summerlin, Kristin. (June 12, 2024). UAF research scientist selected as Fulbright Scholar to Finland. University of Alaska Fairbanks.

Photo by Anne Ruggles

Publication Highlight

Alaska Berry Futures

Alaska Berry Futures is dedicated to enhancing understanding of Northern berry species, identifying knowledge gaps, and equipping Alaskans to adapt to changing berry resources. In a significant initiative in collaboration with the Alaska Climate Adaptation Center, Alaska Berry Futures has released five reports, each titled after a specific Northern berry for Alaska pickers that integrates traditional knowledge with scientific insights.

The reports delve into critical aspects of berry growth, including flowering, pollination, fruit and seed development, and the roles of mutualists like fungi in nutrient acquisition, alongside threats from herbivores and pathogens. Additionally, they discuss human usage and highlight the challenges and opportunities each plant life cycle stage faces amid climate change.

Berries, regardless of species, are a huge part of rural Alaska's subsistence lifestyle. They are often the only fresh, local fruit available in remote villages. A warming climate means where and how people harvest berries is changing, and over the years, communities across Alaska have developed climate change adaptation and mitigation plans.

To learn more, visit the Alaska Berry Futures website.

https://sites.google.com/alaska.edu/alaska-berry-futures/home

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UAF News and Information. Assessing future of Alaskan berries in changing climate. Retrieved Oct. 4, 2024.

Alaska Berry Futures. Homepage. Retrieved Oct. 4, 2023.

Schwing, Emily. (Sept. 20, 2023). New 'berry booklets' for Alaska pickers combine traditional knowledge and science. Alaska Public Media.

Publication layout by Putman, Molly. Geophysical Institute Design Services.

The University of Alaska Fairbanks Troth Yeddha', 'potato ridge,' campus is located on the ancestral lands of the Dena people of the lower Tanana River.

UNIVERSITY OF ALASKA FAIRBANKS

Read more at
uaf.edu/research

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