2019 Annual Report of Accomplishments and Results

University of Alaska Fairbanks
Institute of Agriculture, Natural Resources and Extension (IANRE)
composed of
Cooperative Extension Service (CES) and
the Agricultural and Forestry Experiment Station (AFES)

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. **Executive Summary** (Optional)
As a result of a university reorganization in July 2019, CES and AFES became an entity now known as the Institute of Agriculture, Natural Resources and Extension (IANRE). The realignment allows for greater coordination. The programs of IANRE, provided by personnel of AFES and CES, play a vital role in linking the knowledge generated at the university to meet the needs and interests of Alaskans. Please see our 2021 Plan of Work submission for more background on our goals for Alaska. Recent updates to the narrative are extracted below for emphasis.

Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates
1. The Merit Review Process	Based on recommendations received from NIFA last year, all new and revised Hatch (and McIntire-Stennis) project proposals undergo scientific peer review. The blind peer review panel is composed of a minimum of **three** members and consists of competent authorities in the discipline of the proposal/publication/annual report or related disciplines.
2. The Scientific Peer Review Process	No updates

II. Stakeholder Input

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	In addition to providing traditional feedback options including email, surveys, open houses and discussions, IANRE has increasingly utilized citizen science activities to engage stakeholders in local agriculture topics. Such activities make use of faculty-designed phone applications to enhance the experience, such as Grow & Tell and Alaska Weeds ID. Smartphone apps are a contemporary way to attract stakeholders to participate in pest mapping and variety testing while IANRE gains insight into lay understanding of Alaska's critical issues.
2. Methods to identify individuals and groups and brief explanation.	A primary goal of the University of Alaska Fairbanks 2019-2025 strategic plan is to "solidify our global leadership in Alaska Native and Indigenous programs." IANRE has built strong relationships with Native groups across the state, from Fort Yukon to Dutch Harbor, and has two FRTEP agents that advise the unit on tribal community needs. IANRE has been proactive over the past several decades, providing culturally relevant and responsive programming, advising on cold climate housing and air quality, researching and writing publications on traditional foods like walrus and bullwhip kelp, offering culturally relevant youth activities like dog mushing and trapping, and teaching hands-on skills for community gardening, reindeer processing, and more.
3. Methods for collecting stakeholder input and brief explanation.	In FY19, IANRE reconvened a renewable Resources Extension Act (RREA) advisory group.
4. A statement of how the input will be considered and brief explanation of what you learned from your stakeholders	New insights on stakeholder information needs and concerns regarding emergency preparedness and community response were gathered during the emerging issue of the Anchorage earthquake.

III. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	IANRE increases Alaskan agronomic crop producers' ability to understand and assess best management practices of cereal crop production.	**Issue (Who cares and Why)** Food security and climate change are serious issues in Alaska. With over 90 percent of food imported, transportation costs add considerably to prices. If transportation were interrupted, it is widely acknowledged that Alaska has three days of food on grocery shelves. Thus, it is critical that Alaska is able to produce more local food crops. A challenge to increased production is changes to the landscape due to variations in water and soil temperatures. Growers see the impact of climate on agricultural performance. Planning for crop and animal management is highly influenced by climate predictions. Research and outreach is needed regarding crop adaptability in changing climates. **What has been done** Over the course of three years, 72 northern European cereal varieties were tested for their adaptability to Alaska's climatic conditions. Adapted cultivars of feed barley, hulless barley, red spring wheat, common oat and Polish canola	1. Agriculture & Food Security

		were all compared to standard test varieties. Field experiments were carried out at Palmer and Fairbanks experiment farms, with weather data collected at a Delta site. The research team compared six machine learning algorithms and used the Decision Supporting System for Agrotechnology Transfer (DSSAT) to enhance their understanding of the impact of climate change on cereal crops in Alaska. Presentations of results were made at workshops for small grain growers in Alaska, disseminated through mass and social media, presented at conferences, published in journals and shared with regional collaborators like Washington State University. **Results** Research suggests some imported varieties of spring wheat have the potential to grow in Alaska. The DSSAT data predicts that climate change will advance the growth stages of current cultivars of cereals, but yield will be reduced. The 2019 season was cooler than the long-term average, with greater precipitation, at the Fairbanks location. The Palmer location was warmer than the long-term average, resulting in more growing degree days, but with 3.14 inches less precipitation by the end of the season. Average yields for all spring grain and oilseed varieties at both farms were roughly equal to the standard test varieties.	
2.	IANRE increases Alaskan growers' ability to understand and assess optimum production practices.	**Issue (Who cares and Why)** Horticulture is the largest agricultural industry in Alaska, amounting to more than 50 percent of cash receipts for all agricultural crops. Alaska imports most of its food and costs are high, particularly in rural areas. Dependence on imports poses a food security risk if supply lines are interrupted. Teaching more Alaskans research-based methods for gardening or growing crops increases food quality and can lower the risk of food insecurity. Demand for support is on the rise, with the latest agricultural census data showing 990 farms in Alaska in 2017, a 30 percent increase from 2012. **What has been done** Workshops in multiple locations, including rural areas, helped inform the public on best practices for augmenting the growing season. Extension trained 173 new Master Gardeners. IANRE personnel had hundreds of contacts with the public through gardening workshops, including seed starting and basic gardening, weed-free forage and pesticide safety trainings, greenhouse tours	1. Agriculture & Food Security

		and more. Extension provided 485 soil test interpretations. Three conferences coordinated by Extension brought together more than 300 agents, researchers, agency representatives, farmers and other stakeholders to share the latest information about sustainable agriculture and invasive species. **Results** Extension continues to be a trusted source of research-based agricultural and horticultural advice. Three attendees of the FY19 Harvest Wrap-Up reported changes in practices as a result of past participation, such as "changed fertilizer rates and seed varieties based on research presented." A retired farmer who successfully completed the Master Gardener course online wrote a blog entry endorsing the program. The gardener notes one of the benefits of enrolling is "you will learn how to properly source gardening information," and also states "just about everything you need to know to plan and successfully grow a garden in Alaska" is covered. There are also social benefits; the blog writer notes the interaction with other students "helps you to become both a better communicator and a better listener," which are both important skills for the hundreds of volunteer hours that Master Gardeners generate in Alaska communities.	
3.	IANRE helps Alaskans identify and monitor invasive species and pests	**Issue (Who cares and Why)** Alaska hosts thousands of visitors every year. The state also imports most of its food and many horticultural products, so it remains vulnerable to imported pests. Retail sales of plant materials contaminated with a variety of pests continue to challenge the state. Invasive weed infestation can reduce land values and agricultural productivity and negatively impact recreation, tourism and subsistence harvesting. Improving public, farmer and land manager ability to assess effective management of invasive plants and pests is critical to the sustainability of Alaska's ecosystems and agricultural ventures. **What has been done** Seasonal IPM technicians, with support from faculty and staff, provided community education and technical assistance. IPM technicians had over 800 consultations with Alaskans, most of which were requests for plant and insect identification. The IPM program maintained a reporting web portal where the public submitted over 100 digital photos. They also assisted with community	1. Agriculture & Food Security

		weed pulls, camps and Master Gardener classes. A YouTube video on Prunus padus (Bird Cherry) and Prunus virginiana (Chokecherry) invasion in Alaska has had 1741 hits over the last two years. By request, an invasive plants instructor presented information on invasive species at several meetings of an alliance of tribal conservation districts. The 20th annual Invasive Species Workshop hosted by Extension and the Alaska Invasive Species Partnership had over 80 attendees. **Results** Several local assembly members are now supportive of increased chokecherry management after an invasive plants instructor made presentations and coordinated weed pulls targeting the invasive tree. Ninety-four percent of 54 post-event survey respondents rated the knowledge gained at the October 2018 Invasive Species Workshop as good or excellent. Almost 67 percent said “yes” and 31 percent said “maybe” they intend to use information from the conference in their management practices, including plans to form a cooperative weed management area, apply new treatment techniques and adopt survey protocols. The workshop consistently leads to behavior change. Seventy-five percent of 21 returning attendees reported making changes to their practices already, including establishing partnerships, modifying experiment designs, improving data gathering and altering herbicide application timing.	
4.	IANRE assesses crop variety suitability for Alaska’s extreme climate	**Issue (Who cares and Why)** Variety trials are time-consuming. Seed companies tend to develop their products for the market at-large in the Lower 48. Though varieties described as cold-tolerant may be offered, they are rarely tested in growing seasons as extreme as Alaska's. As a result, Alaskan growers struggle with identifying viable crop varieties in their growing zones, and some tried-and-true varieties are no longer available. Alaska’s university experiment farms, with their established test plots and tours for the public, are excellent venues for researching adapted crops and sharing results with local stakeholders, saving growers the time and money of individual trial and error. **What has been done** An Extension agent utilized Experiment Farm facilities to grow and assess cultivars. In 2019, beans, carrots, celery and corn were grown in replicated trials in a randomized complete block design, while Brussels sprouts were grown in	1. Agriculture & Food Security

		unreplicated, preliminary trials. Each cultivar was evaluated at least once for plant vigor, susceptibility to bolt, uniformity, and pest and disease resistance. Updated signage and labeling helped the public learn about the trial crops, which are viewable at a local Interior botanical garden. The research team also conducted blind taste tests with volunteers who rated for flavor and texture. Results were published on the Agriculture and Forestry Experiment Station website and publicized through social media. The public was also invited to participate by downloading a Grow & Tell phone application developed by the agent to track gardener successes. **Results** Publicly funded variety trials reduce the expense, time and effort gardeners and farmers need to put in to figure out which cultivars will be successful. FY19 trial results such as those summarized here have been disseminated to help growers make informed choices. Overall, higher yielding varieties also had correspondingly high ratings in other areas, while lower yielding varieties tended to bolt more. For carrots, Bolero yielded the highest with an average weight of 3.1 pounds/row foot, and was one of the highest scoring for taste after two months of storage. For celery, although slugs were observed across all varieties, little sustained damage was observed. Merengo had the greatest yield, with an average of 5.8 pounds/row foot. Corn is historically considered a marginal crop, but above-average temperatures allowed all of the trial varieties to produce mature ears, with Legend's 1.7 pounds/row foot the highest yield.	
5.	IANRE increases reindeer producers' ability to understand and utilize optimum production practices	**Issue (Who cares and Why)** Remote areas face challenges to economic development and food security. Alaska has the range and forage resources to produce substantial quantities of red meat through reindeer production, and past sales have shown there is healthy demand for reindeer meat. Yet, current processing options compromise entrepreneurial efforts to bring quality meat to market. A lack of government inspectors means that producers cannot sell reindeer as "inspected meat," which would bring the highest price. The regulations allowing in-state sale of field-slaughtered, non-inspected reindeer meat require carcasses to be immediately frozen, toughening the meat and lowering its market value. **What has been done**	1. Agriculture & Food Security

		A natural resource economist and the reindeer research program manager worked with remote communities interested in building capacity for reindeer production. The economist analyzed multiple scenarios, including field and government-inspected slaughter, and sales of whole carcasses or cuts of meat. The calculations considered amounts and costs of fuel needed by workers on snowmachine to locate herds, slaughter and process animals, as well as labor costs. The program manager consulted stakeholders on animal care and demonstrated slaughter methods that help retain the meat's market value. **Results** Four residents with a reindeer operation in Savoonga slaughtered reindeer three times in the field using the university's USDA mobile processing unit, and the cuts of meat sold out almost immediately. The economist was able to determine what prices reindeer meat must sell at in multiple slaughter method scenarios for a business to break even. Results were shared with Savoonga so that the community can make informed decisions about future business plans. Some of the communities assisted by the reindeer program manager intend to apply for reindeer grazing permits on state and Bureau of Land Management lands along the Yukon River, which had historic reindeer herds over 70 years ago. Large commercial reindeer operations are also being proposed and developed in Delta and a few Yukon River communities. These new businesses have the potential to improve food security and cash employment.	
6.	IANRE tests new lighting technologies to improve controlled environment vegetable production	**Issue (Who cares and Why)** Enhancing local vegetable production is desirable due to Alaska's short field seasons and vulnerable delivery systems. Controlled environments extend the short Alaska growing season, but challenges exist when growing in-demand crops, such as spinach, which may bolt quickly and flower under the long Alaska summer days. Such crops may respond to altered lighting schemes. In particular, LEDs have shown promise as a replacement for current supplemental greenhouse lighting options. Light and lighting systems are a significant investment and ongoing expense in controlled environments, and determining the most effective LED configurations, wavelength compositions, durations and intensities will improve production advice and save money for Alaskan growers. **What has been done**	1. Agriculture & Food Security

		A horticulture researcher evaluated the nutritional content of fresh store-bought produce in Interior Alaska in comparison to locally grown produce, including tomatoes, colored bell peppers, English cucumbers, kale, and butterhead and romaine lettuce. The produce was tested for mineral nutrition, with Brix analysis used to determine levels of soluble solids and sugar content. Three cultivars of the culinary herb basil were grown from seed over 50 days in six light qualities and evaluated for mineral and sugar content; six light treatments included blue LEDs, red LEDs, blue/red LEDs, white LEDs, T5 fluorescent light and natural greenhouse light supplemented with high-pressure sodium irradiance. **Results** The analysis showed produce grown locally or obtained from the farmers market generally had greater Brix values, to suggest higher sugar content than produce from local stores. There was a trend for higher Brix under blue LEDs among cultivars. Results, including protocols developed, enhanced postsecondary courses on applied plant science, sustainable agriculture and greenhouse management. The latter included substantial information on modern control and management techniques for greenhouses and controlled environments, essential for efficient northern crop production. Trial results and lessons learned on the efficient use of LEDs and the nutritional values of locally grown produce have been shared at producer-oriented gatherings and state, national and international scientific meetings, adding to the body of knowledge on efficient lighting options.	
7.	IANRE helps growers protect feed and seed grains by controlling noxious weeds	**Issue (Who cares and Why)** It is essential for grain growers to keep their crops as weed-free as possible in order to sell quality products. The legal sale of whole feed and seed grain in Alaska depends on harvests staying within weed contamination tolerance limits. Yet in the early stages of weed spread, infestations may be too light to justify broadcast applications or expensive, targeted herbicides. Wild oats, a restricted noxious weed, reached a point after six years of reported infestations in the Interior that it is economically and practically feasible to test and employ field-wide applications specific to its control. Farmers need assistance to address the problem before it worsens.	1. Agriculture & Food Security

		What has been done An agricultural instructor facilitated grower meetings, met with a farmers cooperative board, and researched appropriate seed-cleaning equipment capable of separating wild oat seed from barley, wheat and tame oats. The instructor also worked closely with the local soil and water conservation district to implement a crop improvement plan focused on managing wild oats. Participating farmers agreed to follow Extension's herbicide recommendations and allow scouting of their fields for weed control results. **Results** The cooperative used the results of the instructor's equipment comparisons to purchase sophisticated seed-cleaning equipment, set up at the cooperative's facility for use by area farmers. This marked the first time local farmers had access to this type of technology, and they reported being very pleased with the cleanliness and quality of seed they were able to plant for 2019. Cost share incentives mitigated the additional expenses of wild oats herbicides for farmers participating in the crop improvement program. Field scouting efforts for the 2019 seasons showed excellent control of wild oats, and the crop improvement program is now planned for a five-year trial.	
8.	IANRE engages Alaskans in natural resource management and increases good stewardship	**Issue (Who cares and Why)** Alaska is a great natural classroom that attracts students who love the outdoors. To reverse the effects of climate change, it is essential to educate youth to care for the environment. We must communicate the need for sustainable management. Alaska's educators need support in engaging Alaskans in natural resource management activities that inspire good stewardship and career paths that will build state capacity to manage natural resources well. Nationwide, there is an increased interest in local and sustainable production and interdisciplinary approaches to managing ecosystems and combatting the effects of climate change. **What has been done** 4-H'ers completed natural resource-related activities including 676 Junior Master Naturalist projects. A 4-H agent coordinated the youth track at the Alaska Forum on the Environment (AFE). 4-H also partnered with the Sitka Conservation	2. Natural Resources, Ecosystems & Sustainable Energy

		Society (SCS) to offer the Alaska Way of Life program, which offers activities throughout the year for youth to learn about the history of the Tongass National Forest. The SCS program partners with other community groups and expert naturalists to teach about the food web, stream and forest ecology, wildlife awareness skills, mushroom identification and more. Research faculty supported several undergraduate and graduate research projects that can lead to long-lasting engagement in natural resources. **Results** A climate researcher specializing in wildfires hired four students, two at the undergraduate level, to assist with a project on science communication and knowledge co-production with Alaska Native tribes. To further promote and develop integrated undergraduate and graduate research conducted in partnership with stakeholders, a hands-on, project based curriculum for NRM-647, Global to Local Sustainability was created that will be launched in fall semester 2020. Other researchers hosted a recruiting event demonstrating soil texture, water filtration and ecological footprint calculation, where four current students were able to talk to 12 prospective students. Researchers kept the community engaged in natural resources through Forest Fest, where students volunteered to help faculty and staff put on logging events. At AFE, 40 youth from all over the state, including Utquiavik, Wrangell and Shishmaref participated, and many of the youth gained skills presenting natural resource information.	
9.	IANRE increases community awareness about the use of biomass and other sustainable energies	**Issue (Who cares and Why)** Sustainable energy is an increasingly popular issue in Alaska where transportation and heating costs are prohibitive. In the face of declining oil prices and production, there is a need for Alaska to invest in alternative energies. A fundamental shift in the state's energy focus requires constituent support to gain momentum. Community-level change begins with improving knowledge and awareness at the individual level, and IANRE has the research capabilities, content experts and partnerships to help communities assess emerging options for biomass use in Alaska. **What has been done** The energy specialist held workshops on topics including biomass, biochar, hydroelectricity, emergency energy and greenhouse-heating at venues like the	2. Natural Resources, Ecosystems & Sustainable Energy

		experiment farm and conferences. Faculty consulted with communities and organizations regarding the use of biomass and with individuals interested in biomass production. An interdisciplinary researcher evaluated the market readiness of four types of small-scale, combined heat and power (CHP) generators. Biomass samples were sent to a vendor of the single gasifier on the market considered "turnkey," and the researcher observed the performance. While the generator's efficiency was acceptable, the level of labor and expertise needed to keep it properly running made it a poor candidate for deployment in a rural setting. **Results** Research and outreach efforts addressed public education on the sustainability of biomass harvesting, new technologies and community planning. Applications of these findings have the potential to contribute to energy self-sufficiency, job creation, local food production, student learning and engagement, and climate change mitigation. Research will inform decision-making for cold-region, electrically islanded communities with biomass resources for potential heat and power generation. An academic paper and public briefing are planned.	
10.	IANRE helps Alaskan communities become adaptable to climate change	**Issue (Who cares and Why)** NOAA states that July of 2019 was Alaska's warmest month on record. Alaska has seen retreating sea ice, melting permafrost, increased wildfires and other signs over the last several decades of a warming trend. While these changes have had negative effects on wildlife, the warmer weather has also extended the growing season. Research is needed on how best to navigate projected changes to Alaska's average temperatures and the subsequent effect on growing degree days. IANRE's experiment farms are well-suited for trials and observations that will help Alaska's farmers prepare to adapt their varieties and practices. **What has been done** A researcher evaluated crosses of an Alaska local hard red spring wheat variety "Ingal" with three Canadian hard red spring wheat varieties. Field experiments were carried out at Palmer and Fairbanks experiment farms, with weather data collected for comparison in Delta Junction. Three plant physiologic growth stages were used along with weather data to measure crop adaptability, emergence,	2. Natural Resources, Ecosystems & Sustainable Energy

		heading/flowering and maturity. Presentations of results were made at workshops for small grain growers in Alaska. Poster presentations were made at national conferences. The researcher presented FY19 results to 20 attendees at the Harvest Wrap-Up. **Results** Emergence, heading/flowering, and maturity occured close to the long-term average at both growing locations for all wheat varieties and breeding lines. Maturity of crosses was comparable with parents at both locations. A master's student mentored by the researcher used crop modeling techniques and climate change projections to identify how anticipated changes in climate over a 50-year period might affect the ability of Interior farmers to grow wheat in the future.	
11.	IANRE helps Alaskans understand changing weather patterns	**Issue (Who cares and Why)** Reliable weather data is critical to scientists studying climate change, developing models and predicting effects on agriculture and ecosystems. The most valuable data are observations collected from the same location over a long period of time. It is challenging to maintain a long-standing weather station as personnel and priorities change over time. The data must also be made widely available to be of use to the scientific community. Well-established organizations like experiment stations are extremely valuable sources of long-term weather data, and are well-networked with partners who can make use of such data. **What has been done** The World Meteorological Organization, a United Nations agency supporting the collection for reliable weather data for science, recognized the Fairbanks Experiment Farm as one of seven U.S. "centennial stations" for collecting weather data in one location for more than 100 years. The farm's weather station is unique in that the site has been virtually the same since 1911. The current farm manager for the farm has been the principal data collector for 13 years, measuring evaporation, wind volume, precipitation and snow depth as applicable every morning. The data is shared with any stakeholders requesting it, such as farmers and researchers.	2. Natural Resources, Ecosystems & Sustainable Energy

		Results The reliable weather data provided by IANRE's long-term collection site has been used by researchers across multiple disciplines to move scientific knowledge forward. A climate scientist with the International Arctic Research Center (IARC) is using the weather record to study changes in snow cover, while a climate specialist with IARC is looking at changes in the growing season statewide, including at the station. An emeritus forest ecologist is using the data to study how climate change is affecting tree growth in boreal forests. The data set is allowing insights into everything from agriculture and forest management to community adaptation.	
12.	IANRE improves national recreation data analysis for public lands managers	**Issue (Who cares and Why)** Public lands in the United States provide an opportunity for Americans to realize the benefits from outdoor recreation. A lack of a standardized, efficient approach to measure these beneficial outcomes has hampered management. Likewise, recreation management frameworks to explicitly manage for beneficial outcomes have been developed, but are in early stages of adoption by federal agencies. Research is needed to provide a framework linking these beneficial outcomes to management. Such a framework can inform policy decisions relating to public health. **What has been done** The instruments and protocols developed throughout this five-year project ensured data consistency, allowing for analysis of trends across multiple sites. This multistate project filled a gap by providing efficient measures of beneficial recreational outcomes, lowering financial costs through economies of scale. In this final year of the project, progress was made on development of a database that combines 21 existing studies, and the datasets were examined to identify common variables. The data continue to be shared with stakeholders. The researcher initiated a new project to collect data from users of a greenbelt system connected to the Matanuska Experiment Farm and Extension Center. **Results** Bureau of Land Management staff were included in discussions related to issues involved with combining existing datasets. A database of issues related to combining previously gathered data was distributed to key BLM staff to improve	2. Natural Resources, Ecosystems & Sustainable Energy

		future endeavors. This expanded their knowledge of data management. Information from this project was incorporated into recreation management training sessions conducted by the BLM. Continued meta analysis has the potential to add to the understanding of the relationship between recreation settings and beneficial outcomes, and to allow for improved allocation of recreation resources.	
13.	IANRE immerses stakeholders in natural resource issues through OneTree	**Issue (Who cares and Why)** Various species of trees and the forest products that can be derived from them are just some of the many renewable natural resources that Alaska has to offer. AFES provides research that meets the needs of the private, state and federal stakeholders and with Extension assures that stakeholders are engaged with UAF in the application of research. Extension promotes economic development and meets other community and rural needs. Buy-in from communities is critical to ensuring this happens. There is a mutual benefit when research can be conducted in a participatory manner. **What has been done** OneTree Alaska, part of IANRE, is an Alaska Center for Energy and Power partner for science, technology, engineering, art and math programs sponsored by the Office of Naval Research. The state-certified OneTree Alaska kitchen is a production space for local forest products, including birch syrup, caramels and birch sticks made from sap collected by a volunteer cooperative. Funds raised are used to sustain the OneTree program, which offers forestry outreach activities. Members of the Fairbanks Birch Sap Cooperative may also use the kitchen to work on their own projects or start-up companies. The OneTree faculty coordinator has been working with a climate specialist at the Alaska Center for Climate Assessment and Policy, who has developed an algorithm to predict green-up. With the help of the cooperative, the faculty continued to track degree-days (AHS = accumulated heat sum) and the number of degrees above 32°F (using maximum daily temperature) to predict the timeline of stages of sap flow. **Results** Fifty-seven participants, including households, K-12 classrooms and homeschool families, delivered 3,750 gallons of birch tree sap to OneTree's sap-to-syrup	2. Natural Resources, Ecosystems & Sustainable Energy

		production facility. The sap produced more than 20 gallons of syrup. OneTree Alaska received first place at the April, 2019 Birch Syrups World Challenge in Russia. This is the organization's second victory; it also won in 2017. Research at the OneTree lab strives to give greater predictability for when the birch sap season will start, peak and end. This has the potential to provide greater certainty for producers to know when to set and pull taps.	
14.	IANRE increases knowledge of soil remediation among cold climate scientists and engineers	**Issue (Who cares and Why)** Water quality is increasingly threatened as human populations grow, industrial and agricultural activities expand, and climate change threatens to significantly alter water flow and distribution. With climate change deteriorating Alaska's ice and permafrost, soil and groundwater contamination is emerging as a great concern. Non-Newtonian fluids, or those with non-constant viscosity, present a possible avenue for better addressing soil contaminants. However, the flow of such fluids like Guar gum solution has not been well studied in cold temperatures. To address soil contaminants, the scientific community needs more information on whether Newtonian fluids like water, non-Newtonian fluids like Guar gum solution, or a combination of both is most effective for remediation. **What has been done** In the first phase of the project in FY18, viscosity differences and other characteristics of various concentrations of Guar gum and Xantham gum were tested at five different temperatures, and based on initial results, three temperatures were chosen to study flow characteristics of both Newtonian and non-Newtonian fluids. Dichlobenil, an herbicide, was chosen as a candidate contaminant and injected into a synthetic porous media. Both water and guar gum solution were allowed to pass through in separate experiments to assess remediation. Gas chromatography-mass spectrometry analysis revealed how much herbicide was removed by each fluid type at 19 degrees Celsius. **Results** Within this limited set of experiments at one temperature, water was the most effective in remediating 2, 6-Dichlorobenzonitrile from synthetic porous media in comparison to 0.5 g/l Guar gum and 0.5 g/l Xanthan gum. A graduate student in geological engineering completed his master's thesis based in this project in FY19,	2. Natural Resources, Ecosystems & Sustainable Energy

		and the results were disseminated in multiple venues including the 2019 Society of Mining, Metallurgy and Exploration annual conference and the 11th Interpore Annual Meeting and Jubilee in Valencia, Spain, which included attendance from professionals working on cold region issues.	
15.	IANRE helps Alaskans build physical strength and manage chronic disease	**Issue (Who cares and Why)** Alaska's senior population must remain active and healthy in a difficult environment. Alaska, per capita, has one of the fastest-growing population of seniors in the nation, and the state expects the number of seniors to double in the next 30 years. All of Alaska is considered medically underserved, and costs to individuals for medical care are higher than the national average. It is imperative that Alaskans focus on health strategies to maintain health and independence throughout life. **What has been done** StrongWomen, Chronic Disease Self-Management and Diabetes Self-Management are high demand, evidence-based programs that have increased community capacity through train-the-trainer opportunities. Fifty-eight volunteer leaders in over 20 StrongWomen programs received support from Extension. In Mat-Su borough and Anchorage municipality, volunteers spent 3768 hours organizing and leading strength training programs, a value of over $100,000 in Alaska, according to Independent Sector estimates. StrongWomen continued to have hundreds of participants across the state, with over 350 continuing past one year, a few of whom have been exercising with their group for over a decade. A Fairbanks-based agent trained program leaders and lifestyle coaches from multiple cities to offer chronic disease or diabetes self-management programs. **Results** StrongWomen participants across 10 groups in settings like libraries, churches and senior centers were surveyed about their experiences with the program. Results indicated positive improvements including becoming more social, more active and having more energy. On a 1 (Not at all) to 5 (Very much) rating scale, participants agreed that they feel physically stronger (average of 4.36) and their overall health was much better (average of 4.47), with the StrongWomen class as the main reason for health improvements (average of 4.53). Comments included	3.Healthy Individuals, Families & Communities

		"I go to the doc far less often now" and "this class has helped build my strength and stamina and get me back to full health."	
16.	IANRE trains Alaskans to prepare food more safely	**Issue (Who cares and Why)** Many Alaskans live a subsistence lifestyle or supplement their diets with fish and game meat. Alaska also has a large military population, and most have not previously preserved game meat or fish. Alaska has one of the nation's highest rates of botulism, which occurs in low-acid foods. The state has an average of at least one death every three years, with the most recent occurring in 2019. It is particularly important to teach people how to safely preserve local staples. The state requires that all food establishments in Alaska have at least one certified food protection manager on staff to ensure food safety. **What has been done** Agents delivered 72 food preservation and food safety classes in 25 communities to 1,098 people from Nome to Sitka. Topics covered a wide range of foods, including those beyond the grocery store, from canning moose and caribou to smoking salmon and preserving Alaska's wild berries. The Bethel agent continued to offer education on lead rifle ammunition contamination in game meat. The Certified Food Protection Management (CFPM) class was attended by over 100 people, some in remote areas using videoconferencing. The Mat-Su agent coordinated with environmental health officers, tribal communities, village schools, nutrition services and others to assess training needs. Agents and program assistants also answered canning and food safety questions in person and by phone and email, and offered canner gauge testing to the public. **Results** Participants in food preservation classes immediately build skills through hands-on training with equipment, and many expressed an intent to use the information and share the information with others. The majority of respondents surveyed after food preservation and safety classes indicated increased	3. Healthy Individuals, Families & Communities

		knowledge and confidence. Clients had 590 canner gauges tested with many needing adjustment and some needing replacement, highlighting the importance of this service. Participants in Certified Food Protection Management had a roughly 80 percent pass rate on the exam, and the classes helped them gained skills needed to keep existing jobs or pursue new jobs or promotions. The videoconference training helps individuals in remote communities avoid expensive travel to attain certification.	
17.	IANRE works with partners to improve public health	**Issue (Who cares and Why)** To manage costs, Alaskans want to keep winter heat loss to a minimum in their homes. This is a challenge, particularly in rural areas where some Alaskans rely on diesel generators. Natural gas is not yet available statewide, and wood burning has caused concerns about air quality. Many look for ways to make their home "tighter," which can be more energy efficient. But tight homes allow for less clean air circulation and higher concentrations of radon, a rare radioactive gas formed as a decay product of uranium that can cause lung cancer over time. Radon is a health concern in Alaska, where many homes built in the Interior's hills are known to have elevated radon levels. Thus, homeowners should be educated about radon and air quality in conjunction with building efficiency. **What has been done** The energy specialist distributed 800 short-term radon tests, 394 of which were tested by a lab. The Bethel agent partnered with the Yukon Kuskokwim Health Corporations Office of Environmental Health to offer radon testing in Grayling, a community that had not recorded testing before. He procured a Rad-Elec Ep-Perm device that allowed for greater flexibility in testing schedules, to accomodate weather delays in delivery to and from remote areas. Together the specialist and agent provided over 900 consultations on radon topics to the public in FY19 and taught 19 radon classes. The energy specialist collaborated with the Northern Arizona University's Institute of Tribal Environmental Professionals for a joint healthy homes discussion with 20 tribes.	3. Healthy Individuals, Families & Communities

		Results Two of the 4 buildings tested in Grayling came back with radon levels exceeding the federal action level of 4 picocuries/liter. Once the elevated results were discovered, the Bethel agent was able to save homeowners money by guiding them to appropriate and cost-effective mitigation responses. The agent also gave a presentation on radon at the community center, and set up more test devices in public buildings and private homes. He spoke with individual homeowners and inspected several homes in the area to better understand the construction methods that were common in that community, informing plans to expand radon testing and education. In December 2019, the Extension radon site had over 1,400 visitors and the radon publication was downloaded 626 times. This points to the efficacy of Extension's announcements on the need to check radon levels following the large Anchorage earthquake in November 2019.	
18.	IANRE prepares Alaskan communities for effective earthquake response	**Issue (Who cares and Why)** Alaska can experience over 50,000 earthquakes a year. While most are of a small magnitude, there is a need to maintain community emergency preparedness to limit loss of life and property when a larger quake comes along. The Alaska Earthquake Center reports that 2018 was a record-breaking year for the number of earthquakes in Alaska. In November 2018, the state experienced a magnitude 7.1 earthquake 10 miles north of downtown Anchorage, Alaska's largest city. The quake resulted in power outages and significant building, road and railway damage. In 2019, Alaska was still registering thousands of aftershocks from the quake, some as large as magnitude 5.0, and Alaskans needed advice on how to safely engage in clean up efforts while remaining prepared for further disruptions. **What has been done** In response to the Anchorage earthquake, Extension provided resources on how to manage an emergency water supply, assess hazards, deal with trauma, choose contractors and test for radon. Guidance including an Extension publication on emergency water was made available at many sites in Anchorage and Mat-Su,	3. Healthy Individuals, Families & Communities

		online, including grocery stores, libraries and building supply stores. Resources posted through social media were viewed by more than 60,000 Alaskans in two weeks. Efforts were bolstered by Extension's existing partnerships with the Extension Disaster Education Network and UAF's Homeland Security and Emergency Disaster program. When Anchorage schools closed for a week, 4-H volunteers and the Loussac Library teamed up to provide daily "Rock the Quake" STEAM activities, attended by 200 community members. **Results** Faculty rallied to offer workshops in Anchorage to immediately address environmental and healthy homes concerns. Extension's quick response to the Anchorage earthquake built community capacity for sharing research-based information on emergency preparation and response. The energy specialist's PSA on radon retesting after earthquakes was picked up by the Associated Press, and a viewpoint article written on the events was featured in the Disaster Recovery Journal. As a result of Extension's radon education efforts, national building standards for radon retesting are set to be included in the state's earthquake management plan going forward.	
19.	IANRE welcomes diverse youth with culturally relevant programming	**Issue (Who cares and Why)** CNN reported in 2015 that Alaska has the top three most diverse census tracks in all of the U.S. Furthermore, Alaska's children are more diverse than its adults; as of 2016, 50 percent of youth ages 0 to 17 are non-white, compared to only 35 percent of Alaskan adults, according to the Alaska Children's Trust. Outside of cities, there are many areas with minority youth that can only be reached by boat or plane. Thus, in many rural communities, activities for youth are limited. As the 4-H Essential Elements note, the youth development field recognizes that positive development requires structure, support, skill-building, and "strong links between families, schools and broader community resources." 4-H is uniquely positioned in Alaska to provide such opportunities to underserved youth. **What has been done** 4-H harnessed the power of carefully screened volunteers and evidence-based curricula to provide guidance from caring adults in underserved locations like	4. 4-H & Youth Development

		Dillingham and Bethel. 4-H taught workforce development skills and healthy relationships programming to groups including youth in foster care and 50 teens in youth facilities. 4-H also maintained partnerships with Title 1 schools to deliver after-school programming. A full quarter of children enrolled in Alaska 4-H are from towns under 10,000 people, including rural and non-farm areas. Culturally relevant programming such as Yu'pik language and dance, fur trapping, dog mushing, skin sewing, birding and culture camps encourage youth participation by allowing them to celebrate cultural traditions and build a stronger community identity. **Results** The most recent ES237 documents increased minority participation. There was a rise in enrollment of almost 800 over the previous year, and enrollees generally reflect the youth diversity in the state. Aggregate percentages for all youth reporting ethnicity and race in FY19 were 11 percent Hispanic or Latino, 6 percent Asian, 14.5 percent American Indian or Alaska Native, 4.8 percent Black or African American, 5 percent Hawaiian or other Pacific islander, and 16 percent more than one race. The percent of youth in Alaska 4-H who identified as white only is 53 percent, down from 59 percent in FY18.	
20.	IANRE builds capacity for Alaska's afterschool programming	**Issue (Who cares and Why)** Creating environments in which youth have a sense of belonging, experience independence, master skills and give back to the community becomes more complex each year with changing environments. According to Alaska Children's Trust, 45,000 Alaska children do not have access to an afterschool program, yet 78 percent of Alaskan parents say such programming helps working families. This gap can be filled through partnerships and programming based on positive youth development. 4-H faculty and staff must utilize their understanding of the Essential Elements of 4-H and their skills in volunteer management to connect schoolchildren with quality programs led by a cadre of caring adults. **What has been done** Agents and program assistants collaborated with other youth-serving agencies and organizations, including Alaska Native associations, military installations, schools, and National Guard and Reserve. Compared to the	4. 4-H & Youth Development

		prior season, there were almost 60 more adult volunteers enrolled in FY19. Volunteers were trained and assistance was provided to teachers and afterschool providers. Programming and promotion utilized distance technology and social media. Activities supported life skill development of youth through experiential learning in science, healthy living and citizenship. As the Alaska Afterschool Network notes, afterschool educators "connect kids to their culture, empower teens, create collaborative team approaches, support families in crises, and expand STEM learning in afterschool." **Results** An Alaska 4-H volunteer leader in the small gold rush-era town of Hope was one of five recipients of the 2019 Afterschool Superheroes Awards from the Alaska Afterschool Network. She introduced youth to new topics like robotics and archery. The leader stated, "I went from being a stay-at-home mom, to now I'm an afterschool educator. I realized there's so much more I can do so that I can help improve STEM and afterschool programs in rural Alaska." The leader says she has observed improvements in parent-child relationships and family stress management inspired by 4-H participation.	
21.	IANRE improves the nutrition knowledge and behaviors of Alaskan youth	**Issue (Who cares and Why)** Childhood obesity continues to be a major concern in Alaska. Alaska Department of Health and Social Services, 2017-2018 data from students in grades K, 1, 3, 5 and 7 in two Southcentral school districts documented an obesity rate of over 18 percent, which means the state's Healthy Alaskans 2020 objective of 15 percent or less has not been met. Helping caretakers and students learn about better nutrition and eating habits is essential to combating obesity in Alaska's youth and reducing the negative health outcomes associated with obesity. **What has been done** Nutrition educators based in Anchorage, Bethel, Fairbanks, Palmer and Soldotna presented USDA-approved curricula and activities in one-time and multipart programs at public schools, Head Start programs, shelters, WIC	4. 4-H & Youth Development

		programs, community centers, public housing and libraries that reached a combined total of 1,644 youth. 4-H'ers completed 194 foods and nutrition projects. Nutrition lessons paired with cooking lessons taught life skills to teens at a shelter for homeless youth. SNAP-Ed educators partnered with 4-H Healthy Habits through a Walmart grant to provide nutrition programming and healthy camp experiences to 118 youth. Teens as well as school district teachers helped lead the camp. A tribes Extension agent offered programming through the Alaska Summer Research Academy (ASRA which was supported by a grant from the Women and Minorities in Science, Technology, Engineering and Mathematics Fields Program. **Results** Through ASRA, Alaska Native high schoolers attended "What's for dinner: Why we eat what we eat in Alaska and what it means for our health." Three teens responded to a survey about their ASRA experience, rating the Alaska food program as high quality. Comments included that it was fun, educational, and they enjoyed the cooking portion. Responses to retrospective pre-post questions showed that after attending, the teens felt they could better identify food that is healthy, find information about Alaska food policy, and were more likely to consider helping change food policy. Teens in a 4-H afterschool program chose cooking and baking as their favorite activity. Through the course of making recipes, they were observed to have improvements in positivity and confidence, and some asked to come back as mentors after graduation.	
22.	IANRE increases youth civic engagement in Alaska	**Issue (Who cares and Why)** Research has long noted the dangers of social isolation and the long-term benefits of social support and community connectedness. Civic engagement can be one avenue for gaining a sense of belonging. National 4-H notes civic engagement is important for helping youth to "be well-informed citizens who are actively engaged in their communities and the world" and "build decision-making skills and develop a sense of understanding and confidence in relating and connecting to other people." A record of public service and strong communication skills is also looked upon favorably by future	4. 4-H & Youth Development

		schooling and employers. But youth need caring adults to provide opportunities to build such skills and get real-life experience. **What has been done** Nine 4-H'ers and their chaperones from Interior and Southeast Alaska went to Juneau for the annual Youth in Governance (YIG) program in February 2019. Students met with legislators, attended committee meetings, learned how bills become law and acted as pages for a day. Five teens from Kodiak's 4-H Club gave presentations on healthy relationships, cyberbullying, natural gas and other issues in Washington, D.C., at the 4-H National Conference. The teens met with Alaska's legislators to advocate for public circulation of a 2020 commemorative dollar coin featuring Alaska civil rights leader Elizabeth Peratrovich (Tlingit nation). 4-H'ers across Alaska also completed various service projects throughout the year to stay engaged in their communities. **Results** In addition to direct opportunities to speak to their representatives, two youth who participated in YIG previously were able to intern in the legislative offices. At the national conference, youth were able to present to a wide audience of policymakers including representatives from the Federal Trade Commission who will potentially use some of their ideas. 4-H'ers connected with their communities in multiple ways through volunteering as camp counselors, collecting trash, weeding community gardens and even setting up fencing for the start of the Yukon Quest sled dog race. Some service opportunities have persisted for decades. The annual Cordova 4-H music camp just celebrated 25 years of summer programming. In Kodiak, 30 4-H members ages 5-18, with the support of 20 adult volunteers, served food to 368 fellow community members at the 32nd annual sourdough pancake breakfast.	