Form B: IGEM-HERC Full Proposal Cover Sheet

Idaho State Board of Education

PROPOSAL NUMBER: (to be assigned by HERC)	TOTAL AMOUNT REQUESTED: **$127,900**
Proposal Track: **Initial Startup**	

TITLE OF PROPOSED PROJECT: Turning Data into Action: Stress Testing the SCARECRO Sensing System			
SPECIFIC PROJECT FOCUS: This project focuses on wireless sensing network technology reliability and usability testing, specifically to focus on Microelectronics, Human-Environment Interactions, and AI.			
PROJECT START DATE: July 1st, 2025		PROJECT END DATE: June 30th, 2026	
NAME OF INSTITUTION: University of Idaho		DEPARTMENT: Computer Science	
ADDRESS: 1000 W. Garden Avenue, Hedlund Building, Room 202, Coeur d'Alene, I			
E-MAIL ADDRESS: meverett@uidaho.edu		PHONE NUMBER: (208)-791-0745	
	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR	Mary Everett	Research Scientist	Mary Everett
CO-PRINCIPAL INVESTIGATOR	Robert Keefe	Associate Professor of Forest Operations	Robert F. Keefe
NAME OF PARTNERING COMPANY: Laurel Grove Wine Farm		COMPANY REPRESENTATIVE NAME: Jaclyn Mommen	
SIGNATURE: Jaclyn Mommen			
Authorized Organizational Representative:	NAME: Sarah Martonick, Director, OSP	SIGNATURE: Sarah Martonick	

Section 1: Primary Idaho Public Institution

This project is under the University of Idaho.

Section 2: Project Title

The title of the project is "Turning Data into Action: Stress Testing the SCARECRO Sensing System".

Section 3: Name and Institution of Principal Investigator and Key Personnel

The Principal Investigator of the project is Mary Everett, a Research Scientist in the Department of Computer Science (College of Engineering) at the University of Idaho (UI). The Co-PI is Robert Keefe, Faculty and Director of the UI Experimental Forest in the College of Natural Resources. The Key Personnel include John Shovic, Research Faculty in the Department of Computer Science, and Kyle Nagy, Superintendent and Orchards Operations Manager at Sandpoint Organic Agriculture (SOAC) in the College of Agricultural and Life Sciences.

Section 4: Total Amount Requested

The total amount request for this project is $127,900.

Section 5: Significance of Project and Project Objectives

<u>Project Significance:</u>

Agriculture and forestry are two industries highly relevant to Idaho. Agriculture accounted for 1 in every 9 jobs in the state in 2022 (Ellis, 2024) with over 24,000 farms and 11.5 million acres of agricultural land (Jamal, 2024) across the state. Idaho has 21.5 million acres of forest (Idaho Forest Products Commission, n.d.) and the forest industry provided more than 28,000 jobs across the state in 2023 (Idaho Forest Products Commission, 2024). As Idaho continues to lose farmland, technological advancement and automation have been noted as important factors in increasing productivity of the remaining land (Idaho Department of Labor, 2024). Efficient use of farming inputs will continue to be important for the states as most farm-gate receipts for crops were down in 2024 compared to 2023 (Ellis, 2025). Additionally, forest fire management and prevention are very important to Idaho industries.

<u>Project objectives:</u>

The overall objective of this project is to test the Sensor Collection and Remote Environment Care Reasoning Operation (SCARECRO) system reliability, accessibility, and utility to relevant stakeholders over a 5-month experimental period in spring/summer 2026 (See Figure 1). This project continues the prior HERC award for integrating new features and communication structures into the system. Receiving concrete data about the system's performance in 3 real-world deployments will provide feedback on how the system meets stakeholder needs and identify any major issues with commercialization going forward.

Figure 1: SCARECRO deployment in Sandpoint Organic Agriculture Center

The specific project objectives are as follows:

1. Finish System Integration:
The first objective will involve finishing the integration of disparate parts of the system. While 90% of this objective is expected to be completed by the end of the current grant period, there may be some remaining bugs or minor feature integrations to finish before stress testing the system.

2. Write System Stress Tests:
The metric-collecting software for the stress test period will need to be written. Most of the system reliability metrics are already in place as part of the network, but uptime and outage tracking software for the database and dashboard will need to be developed.

3. Deploy Systems:
Two of the systems are already deployed, at Laurel Grove Wine Farm and at Sandpoint Organic Agriculture Center. The SOAC system will need to be upgraded, and UI Experimental Forest system will need to be built and deployed in Moscow, Idaho.

4. Conduct Reliability, Accessibility, and Utility Experiment:
Over the course of 4 months, the 3 deployments will be continuously monitored for reliability, accessibility, and utility. The reporting rates and uptime of equipment will be monitored, while the usage of the tools will be logged monthly by our collaborator stakeholders. During this period, project personnel will be collecting data and making any adjustments or repairs needed for failing or faulty equipment.

5. Evaluate and Document Results:
During and after the 4-month experiment, metrics will be tabulated and compiled to determine success rate based on the criteria established in Section 8 of the grant. Final results will be reported along with any and all improvements needed and lessons learned. All code will be documented and available in Github.

Section 6. Specific Project Plan and Timeline (1 Year)

The goal of this renewal grant is to take the system from being a technology demonstrated in a relevant environment (TRL 6) to being a prototype demonstrated in an operational environment (TRL 7). To complete this goal we are proposing a 1-year grant to set up and test a 4-month experiment to measure the system's reliability, accessibility, and utility. In addition, since one of the main components of the system is to be versatile to multiple applications, we propose conducting versions of this experiment in three different areas, two for precision agriculture (a vineyard and an apple orchard) and one in precision forestry (an experimental forest).

The specific project plan for the objectives is as follows:

Objective 1: Finish System Integration (June – December 2025)

- Conduct comprehensive interviews with stakeholders as to which visualizations and information are most relevant to decisions and actions they need to take during the March-June study period

- Ensure all sensor information requested by stakeholders has a feature-complete data pathway through the SCARECRO system
- Ensure all visualizations/analytic tools requested by stakeholders are integrated into the dashboard
- Ensure all alerts requested by stakeholders are set up to reach the stakeholders

Objective 2: Write System Stress Tests (August-September 2025)
- Write automatic python script to scrape gateway and middle agent uptime reporting data for all deployments
- Write independent script to monitor dashboard uptime
- Write independent script to monitor database accessibility uptime

Objective 3: Deploy Systems (January/Early March 2026)
- Upgrade the solar panel and battery system at SOAC. Add sensors to installation
- Install SCARECRO gateway with wildland fire sensors at UI Experimental Forest
- Help with any needed repairs/fixes at Laurel Grove Wine Farm

Objective 4: Conduct Reliability, Accessibility, and Utility Experiment (March 2026-June 2026)
- Check system performance daily, remotely for all three deployments
- Monitor and fix any issues that arise
- Collect reporting and uptime data from the system (daily) and usage data from stakeholders (monthly)

Objective 5: Evaluate and Document Results (May-June 2026)
- Collect and compile all data
- Calculate uptime and accessibility reliability rate
- Compile qualitative stakeholder evaluations of accessibility and utility
- Write results and comprehensive report of system performance, next steps, and lessons learned. The system must meet or exceed the criteria measured to be considered sufficiently reliable, accessible, and useful for continued movement toward commercialization.
- Document all code on Github

Section 7: Potential economic impact

The particular applications of precision agriculture and precision forestry are highly relevant to Idaho, with agriculture comprising 13% of the state's gross domestic product in 2020 (Donahue & Foster, 2022) and the forest products industry contributing $2.5 billion dollars to the same in 2021 (Idaho Forest Products Commission, 2022). Artificial intelligence, machine learning, and data-driven approaches are expected to assist in the increasing demands on these industries, but are currently inaccessible to the vast majority of stakeholders in terms of technical complexity or prohibitive expensiveness. Creating methods to assist adoption of more efficient and site-specific management practices is therefore necessary to meet stakeholder needs in these industries. For the forest industry, improved management practices are also expected to assist with wildfire prediction and prevention, which is important to the state, as current firefighting costs for Idaho Department of Lands-managed areas are between $30-$100 million per year (Clark, 2025).

The researchers believe the system could prove profitable in 3-5 years by early adopters collecting year over year site data to make long-term decisions. The researchers believe the system will be useful earlier in the deployment cycle by allowing users to explore system dynamics over the course of a single season and their impact on agriculture and ecological outcomes.

Section 8: Criteria for Measuring Success

The major features of the SCARECRO being evaluated during this project period are the reliability, accessibility, and utility of the system.

Reliability will be measured with straightforward calculations of the system uptime. The reporting period for each sensor and device will be recorded quantitatively and compared to the number of observed records during the experimental phase. The number of recovery records and periods will also be observed and logged. Additionally, database and dashboard uptime will be recorded separately. All outdoor sensors are expected to be reliably working and reporting data for at least 80% of the time during the experimental period (an acceptable rate for outdoor environments), and must not have an outage lasting longer than 2 consecutive days without data recovery to for this metric to be met successfully. For the dashboard and database, a rate of 95% uptime must be observed to succeed. The data analysis to determine if metrics are met will occur during the experimental period and tabulated and reported at the end of the experimental period.

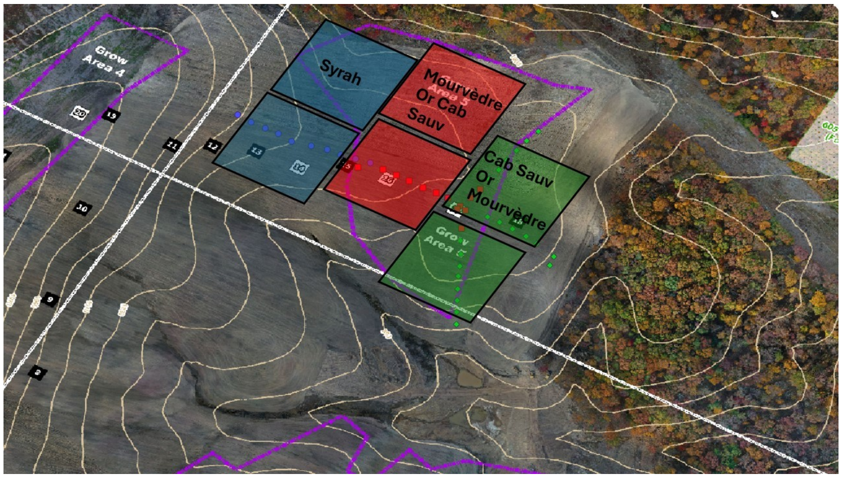


Figure 2: Vineyard microclimate clustering and varietal recommendation based on data from SCARECRO system.

Accessibility will be measured qualitatively during the study period with monthly surveys to stakeholders with deployments (our industry partner vineyard manager and UI-internal collaborators orchard manager and forest manager). The surveys will be straightforward and ask the managers what they used, liked, and disliked on the front end applications (dashboard and/or mobile app). Utility will be measured during the same study, with managers asked about actions taken based on their use of the system tools and what alerts they did/did not respond to (see Figure 2 for example). Where possible, the value of the actions (inputs applied to processes, outputs quantified as a result of inputs) will be tallied and weighed against the actions that would have been taken in the system’s absence to get an idea of real-world value per application domain.

Section 9: Anticipated Development Challenges/Barriers

Outdoor environments, particularly in farming and forestry environments, are inherently unstable and provide challenges for unexpected weather events include storms or potential wildfires. Because of this, time will be allotted to students and the PI to travel to deployment sites to make necessary repairs. Additionally, the entire project team will be expected to pitch in and help respond to any major issues with the deployment. The experimental period is also planned for the end of the project period, to allow to troubleshoot performance issues at the beginning of the grant period.

Section 10: Budget

The budget spreadsheet is attached to the submission. We are asking for $129,900 for personnel on the project, travel to deployment sites, and materials to extend and repair deployments.

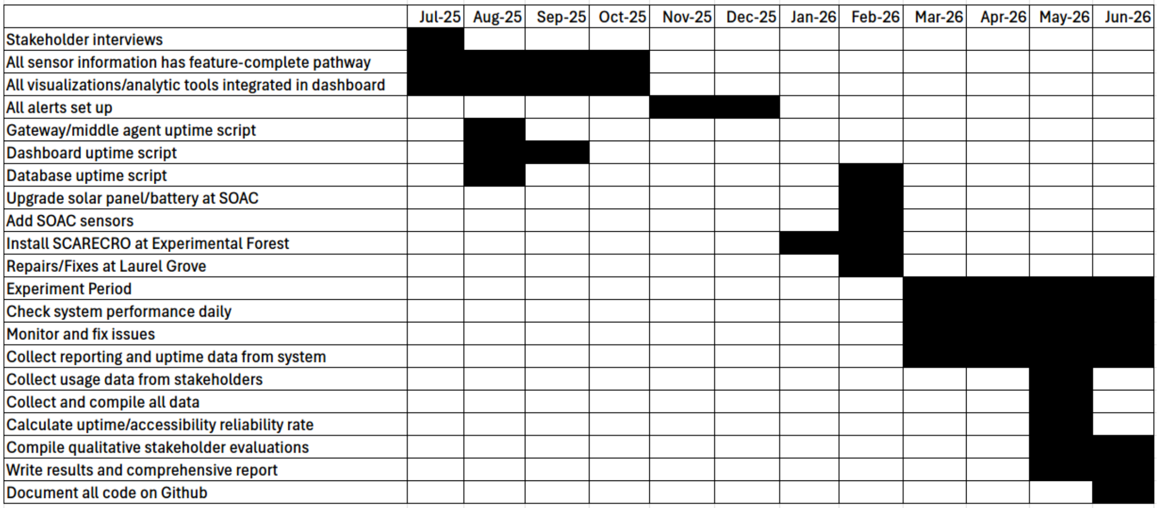
Section 11: Budget Justification

LINE ITEM REQUEST	JUSTIFICATION	TOTAL REQUEST
Personnel (salary and fringe)	This covers 1 month of Co-PI Robert Keefe's time, and 1 month of Key Personnel Kyle Nagy's time, as they are monitoring SCARECRO deployments and providing evaluations and feedback of the technology at SOAC and the UI Experimental Forest. This also covers two graduate students ($19,000 stipend for 20 hours/week during the school year, plus 12 weeks in the summer, $25/hour, 40 hours per week), who will be responsible for hardware development, network monitoring, and testing. This covers an undergraduate student (20 hours/week for 36 weeks during the school year, 40 hours/week for 12 weeks in the summer, $18/hour) to assist with the dashboard development for the project duration.	$99,200
Equipment	No equipment is requested.	$0
Travel	Two site visits for each location (Experimental Forest and SOAC) is budgeted for the period. We expect 3 students at each visit (likely February and May 2026), and it costs about $100 in gas from Coeur d'Alene to both sites). This includes $55 per diem as it is likely these will be all-day trips.	$1,900
Participant Support	Tuition for both graduate students as part of a research assistanceship to work on this project is request. The 2025-2026 tution is estimated at $11,140 per student.	$22,300
Other Direct Costs	$3,000 is requested for materials and supplies to help buy the necessary	$4,500

	materials to build the UI Experimental Forest SCARECRO deployment and sensors, and assist in repairing and fixing any issues with the SOAC and Laurel Grove deployments. Additionally, this project is expected to generate publications, so $1,500 is requested to cover publication costs. The materials may be used beyond the project scope to continue to monitor the ecosystems the networks are deployed in.	
		$127,900

Section 12: Project management

Please see the below GANTT chart for the project timeline and development milestones.



<u>Management Structure:</u>

The PI for the project will be the primary manager of the project, and the graduate and undergraduate students will report directly to the PI. The PI will also be responsible for scheduling all update meetings with collaborators. For the industry partnership, meetings will occur monthly throughout the course of the project to ensure project milestones are being met. Meetings will occur with internal UI collaborators at least once every three months, and once a month during the experimental period.

This grant includes two graduate students and one undergraduate researcher in additional to the PI, senior personnel, and collaborator stakeholders. The graduate students will be responsible for the primary development of the hardware components, including writing and executing the test and data collection scripts. The undergraduate researcher will be responsible for the dashboard development aspects of the project. The PI, Co-PI, and senior personnel will supervise the research, assist with deployment and sensor network maintenance and repairs. The entire project team will assist with monitoring the system performance during the experimental period. The stakeholders will provide feedback on the system throughout the experimental period. The graduate and undergraduate research team alongside the PI will be responsible for receiving and compiling stakeholder feedback, as well as completing final reports and documentation.

Section 13: Additional Institutional and Other Sector Support

UI-CDA:
The major project performance location is at the University of Idaho-Coeur d'Alene campus. The facilities include lab space for the PI and graduate and undergraduate students, as well as several laboratories. These include a microelectronics soldering laboratory, small components assembly space, and 3D printers. Additionally, the CDA computer science program has agreements in place with both the UI and NIC work study programs, which can provide matched students with funding to contribute to the project. The UI-CDA campus has access to several supercomputer servers. Two of these servers are internal to the site, but the program also has access to the Falcon Supercomputer shared with the Idaho National Lab.

Industry Partners:
Laurel Grove Wine Farm is providing space for the SCARECRO sensor network across their 120-acre vineyard, including 8 gateway devices and multiple Data Gator and weather sensor devices. Laurel Grove will also be providing regular feedback regarding the Dashboard during the experimental period, as well as information about any noticed device failures during the experimental period.

UI-Internal Collaborators:
The UI Sandpoint Organic Agriculture Center and UI Experimental Forest will providing space for a SCARECRO deployment, as well as feedback for the Dashboard and noticed device failures during the experimental period.

Section 14: Future Funding

There are several additional sources of funding that will be sought for the continuation of the project in order to move it along the TRL continuum. The USDA National Institute of Food and Agriculture (NIFA) sends out an annual request for proposals for a variety of agriculture-related projects, including technology and data-science based projects. The project team currently has a New Investigator grant submitted with this solicitation (specifically looking at degree day modeling), and plans to submit a renewal or re-submission grant through the program the following year depending on granting status. Additionally, the Northwest Center for Small Fruits Research (NCSFR) submits an annual request for proposal for Pacific Northwest small fruits research (including grapes). The project team has a proposal in with this agency, which it plans to renew or resubmit next year. The NASA Idaho Space Grant Consortium funded a student during the 2024 summer period to work on the SCARECRO system, and another student is submitting an application for the same program for the 2025 period. Finally, the IDeA Network of Biomedical Research Excellence (INBRE) program is funding summer interns, and one of the students working on the SCARECRO project has submitted a summer 2025 application for this program. The program is also seeking to submit a Cyber-Physical Systems grant with the National Science Foundation (NSF) to continue the development of the system.

Either of the USDA-NIFA or NSF Cyber Physical Systems grants would provide considerable support to move the project along the TRL continuum. The smaller regional and state grants provide necessary incremental support to move the project along the continuum one stage at a time.

Additionally, the project team is currently participating in the NSF I-Corps program for the Desert and Pacific Region. This program is expected to help the team identify ways to viably improve the SCARECRO system and seek additional funding opportunities on the way to commercialization. As mentioned in the previous grant, the SCARECRO system is planned to be released open-source for public use. One of the goals is for the system to be adopted by industry companies who will package the necessary components for its implementation and provide technical support. These factors are currently missing from the system and are a necessary step for the system to be complete and qualified and move to TRL level 8. Adoption from a company would also allow its full use in an operational environment for TRL level 9. The researchers hop the I-Corps program can provide pathways forward for this goal.

Section 15: References

Clark, B. (2025, February 13). The crippling costs of wildfires: Why Idaho can't afford to take over Federal Lands | Opinion. Idaho Statesman. https://www.idahostatesman.com/opinion/opn-columns-blogs/article300204719.html

Donahue, Kelsea, Foster, Megan. Idaho At a Glance: Idaho's Economy and Climate Change (2022). University of Idaho McClure Center for Public Policy Research. https://www.uidaho.edu/-/media/UIdaho-Responsive/Files/president/direct-reports/mcclure-center/Idaho-at-a-Glance/idg-economy-and-climate.pdf

Ellis, S. (2024, August 22). Report shows massive impact of AG on Idaho's economy. Idaho Farm Bureau. https://www.idahofb.org/news-room/posts/report-shows-massive-impact-of-ag-on-idaho-s-economy/

Ellis, S. (2025, January 13). 2024 a mixed bag for Idaho Agriculture. Idaho Farm Bureau. https://www.idahofb.org/news-room/posts/2024-a-mixed-bag-for-idaho-agriculture/

Idaho Department of Labor, & View all posts by Idaho Department of Labor. (2024, August 26). Idaho's agricultural evolution: Insights from the U.S. Census. Idaho at Work. https://idahoatwork.com/2024/06/27/idahos-agricultural-evolution-insights-from-the-u-s-census/

Idaho Forests Products Commission. (n.d.). Idaho's Forests Archives · Idaho Forests Products Commission. Idaho Forests Products Commission. https://www.idahoforests.org/forest-information-topic/idahos-forests/

Idaho Forests Products Commission. (2022). Economic Impact of Idaho's Forest Products Industry Idaho Forests Products Commission, 3 Oct. 2023, www.idahoforests.org/content-item/economic-impact-of-idahos-forest-products-industry-2022/. Accessed 18 Oct. 2024.

Idaho Forests Products Commission. The forest products industry adds to Idaho's quality of life. Idaho Forests Products Commission. (2024, October 16). https://idahoforests.wpengine.com/?post_type=content_item&p=29743

Jamal, M. (2024, November 15). Agriculture in Idaho: An overview. College of Business and Economics. https://www.boisestate.edu/cobe/blog/2024/11/agriculture-in-idaho-an-overview/

Appendix A: Facilities and Equipment

The University of Idaho computer science department in Coeur d'Alene includes office space for faculty, graduate, and undergraduate students, as well as a microelectronics assembly and soldering laboratory. The students also have access to the robotics laboratory, project assembly space, a 3D printer, and a CNC machine for custom building needs. The University has access to the Falcon supercomputer, which allows for significant processing power on artificial intelligence models to be handled by the cluster. Students have access to a Gizmo makerspace membership, allowing use of more sophisticated power and machining tools. The UI Experimental Forest and Sandpoint Organic Agriculture Center also are providing space for sensor network deployments.

Appendix B: Biographical Sketches

Please see the following pages for the PI and Co-PI biographical sketches.

IDENTIFYING INFORMATION:

NAME: Everett, Mary

ORCID iD: https://orcid.org/0009-0001-8606-1271

POSITION TITLE: Research Scientist I

PRIMARY ORGANIZATION AND LOCATION: University of Idaho, Coeur d'Alene, Idaho , United States

Professional Preparation:

ORGANIZATION AND LOCATION	DEGREE (if applicable)	RECEIPT DATE	FIELD OF STUDY
University of Idaho, Coeur d'Alene, Idaho, United States	Postdoctoral Fellow	07/2023 - 07/2024	Computer Science
University of Idaho, Coeur d'Alene, Idaho, United States	PHD	12/2023	Computer Science
University of Idaho, Coeur d'Alene, Idaho, United States	MS	05/2023	Computer Science
University of Idaho, Moscow, Idaho, United States	BS	05/2020	Marketing

Appointments and Positions

2024 - present Research Scientist I, University of Idaho, Coeur d'Alene, Idaho , United States

2023 - present Associate Director, Center for Intelligent Industrial Robotics, University of Idaho, Coeur d'Alene, Idaho, United States

2023 - 2024 Postdoctoral Fellow, University of Idaho, Coeur d'Alene, Idaho, United States

Products

Products Most Closely Related to the Proposed Project

1. Everett ML. Exploration of Artificial Intelligence Techniques for Model Usability With Multivariate Time Sequence Data. [Internet]. Moscow, ID: University of Idaho; 2023 December. Available from: https://www.proquest.com/openview/086327aefafc8603b922650105772199/1?pq-origsite=gscholar&cbl=18750&diss=y PMID: 9798381172461
2. Everett M, Wells G, Shovic J. The SCARECRO system: open-source design for precision agriculture adoption gaps. In: Stafford JV, editor. Precision agriculture'23 [Internet] Netherlands: Wageningen Academic; 2023. 415-421p. Available from: https://www.wageningenacademic.com/doi/pdf/10.3920/978-90-8686-947-3_fm PMID: 9086869475
3. Everett M. Explainable Neural Network Alternatives for AI Predictions: Genetic Algorithm Quantitative Association Rule Mining. Proceedings of the 16th International Conference on Precision Agriculture [Internet] Manhattan, Kansas: International Society of Precision Agriculture; 2024. Available from: https://www.ispag.org/proceedings/?action=abstract&id=10099&title=Explainable+Neural+Network+Alternatives+for+Ai+Predictio

Other Significant Products, Whether or Not Related to the Proposed Project

1. Everett M, Wells G, Shovic J. Artificial Intelligence and Wireless Sensor Network Usability Considerations for Forest Operations. 2024 Council on Forest Engineering Annual Meeting; 2024 May 22; Moscow, ID, United States of America.
2. Huender L, Everett M. Dimensionality Reduction and Similarity Metrics for Predicting Crop Yields in Sparse Data Microclimates. Proceedings of the 16th International Conference on Precision Agriculture [Internet] Manhattan, Kansas: International Society of Precision Agriculture; 2024. Available from: https://www.ispag.org/proceedings/?action=abstract&id=11224&title=Dimensionality+Reduction+and+Similarity+Metrics+for+Pred
3. Wells G, Everett M, Shovic J. Data Gator: a Provisionless Network Solution for Collecting Data from Wired and Wireless Sensors. Proceedings of the 16 International Conference on Precision Agriculture [Internet] Manhattan, Kansas: International Society of Precision Agriculture; 2024. Available from: https://www.ispag.org/proceedings/?action=abstract&id=9856&title=Data+Gator%3A+a+Provisionless+Network+Solution+for+Coll
4. Huender L, Everett M, Shovic J. Valley-Forecast: Forecasting Coccidioidomycosis incidence via enhanced LSTM models trained on comprehensive meteorological data. J Biomed Inform. 2025 Feb;162:104774. PubMed PMID: 39827998.

Certification:

I certify that the information provided is current, accurate, and complete. This includes but is not limited to current, pending, and other support (both foreign and domestic) as defined in 42 U.S.C. § 6605.

I also certify that, at the time of submission, I am not a party to a malign foreign talent recruitment program.

Misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§ 287, 1001, 1031 and 31 U.S.C. §§ 3729-3733 and 3802.

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IDENTIFYING INFORMATION:

NAME: Keefe, Robert F

ORCID iD: https://orcid.org/0000-0003-0136-1951

POSITION TITLE: Director, University of Idaho Experimental Forest and Associate Professor of Forest Operations

PRIMARY ORGANIZATION AND LOCATION: University of Idaho, Moscow, Idaho, United States

Professional Preparation:

ORGANIZATION AND LOCATION	DEGREE (if applicable)	RECEIPT DATE	FIELD OF STUDY
University of Idaho, Moscow, Idaho, United States	PHD	05/2012	Natural Resources
University of Idaho, Moscow, Idaho, United States	MS	05/2004	Forest Biometrics
University of New Hampshire, Durham, New Hampshire, United States	BS	12/1999	Forestry

Appointments and Positions

2018 - present Director, University of Idaho Experimental Forest and Associate Professor of Forest Operations, University of Idaho, Moscow, Idaho, United States

2012 - present Director, University of Idaho Experimental Forest and Associate Professor of Forest Operations, University of Idaho, Moscow, Idaho, United States

2012 - 2017 Director, University of Idaho Experimental Forest and Assistant Professor of Forest Operations, University of Idaho, Moscow, Idaho, United States

2007 - 2011 Graduate Research Assistant and Teaching Assistant, University of Idaho, Moscow, Idaho, United States

2006 - 2006 Principal, Rob Keefe Forest Services, Moscow, Idaho, United States

2004 - 2006 Forest Biometrics Research Associate, University of Maine, Orono, Maine, United States

Products

Products Most Closely Related to the Proposed Project

1. Sparks A, Smith A, Hudak A, Corrao M, Kremens R, Keefe R. Integrating active fire behavior observations and multitemporal airborne laser scanning data to quantify fire impacts on tree growth: A pilot study in mature Pinus ponderosa stands. Forest Ecology and Management. 2023 October; 545:121246-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0378112723004802 DOI: 10.1016/j.foreco.2023.121246
2. Becker R, Keefe R. Development of activity recognition models for mechanical fuel treatments using consumer-grade GNSS-RF devices and lidar. Forestry: An International Journal of Forest Research. 2022 July; 95(3):437-449. Available from: https://academic.oup.com/forestry/article/95/3/437/6520703 DOI: 10.1093/forestry/cpab058
3. Lyon Z, Morgan P, Stevens-Rumann C, Sparks A, Keefe R, Smith A. Fire behaviour in

masticated forest fuels: lab and prescribed fire experiments. International Journal of Wildland Fire. 2018; 27(4):280-. Available from: http://www.publish.csiro.au/?paper=WF17145 DOI: 10.1071/WF17145

4. Smith A, Kolden C, Tinkham W, Talhelm A, Marshall J, Hudak A, Boschetti L, Falkowski M, Greenberg J, Anderson J, Kliskey A, Alessa L, Keefe R, Gosz J. Remote sensing the vulnerability of vegetation in natural terrestrial ecosystems. Remote Sensing of Environment. 2014 November; 154:322-337. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0034425714001850 DOI: 10.1016/j.rse.2014.03.038
5. Eitel J, Keefe R, Long D, Davis A, Vierling L. Active Ground Optical Remote Sensing for Improved Monitoring of Seedling Stress in Nurseries. Sensors. 2010 March 29; 10(4):2843-2850. Available from: http://www.mdpi.com/1424-8220/10/4/2843 DOI: 10.3390/s100402843

Other Significant Products, Whether or Not Related to the Proposed Project

1. Zimbelman E, Keefe R. Lost in the woods: Forest vegetation, and not topography, most affects the connectivity of mesh radio networks for public safety. PLOS ONE. 2022 December 7; 17(12):e0278645-. Available from: https://dx.plos.org/10.1371/journal.pone.0278645 DOI: 10.1371/journal.pone.0278645
2. Wempe A, Keefe R. Characterizing Rigging Crew Proximity to Hazards on Cable Logging Operations Using GNSS-RF: Effect of GNSS Positioning Error on Worker Safety Status. Forests. 2017 September 23; 8(10):357-. Available from: https://www.mdpi.com/1999-4907/8/10/357 DOI: 10.3390/f8100357
3. Strand E, Bunting S, Keefe R. Influence of Wildland Fire Along a Successional Gradient in Sagebrush Steppe and Western Juniper Woodlands. Rangeland Ecology & Management. 2013 November; 66(6):667-679. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1550742413500789 DOI: 10.2111/REM-D-13-00051.1
4. Zimbelman E, Keefe R, Strand E, Kolden C, Wempe A. Hazards in Motion: Development of Mobile Geofences for Use in Logging Safety. Sensors. 2017 April 10; 17(4):822-. Available from: http://www.mdpi.com/1424-8220/17/4/822 DOI: 10.3390/s17040822
5. Keefe R, Zimbelman E, Wempe A. Use of smartphone sensors to quantify the productive cycle elements of hand fallers on industrial cable logging operations. International Journal of Forest Engineering. 2019 February 04; 30(2):132-143. Available from: https://www.tandfonline.com/doi/full/10.1080/14942119.2019.1572489 DOI: 10.1080/14942119.2019.1572489

Synergistic Activities

1. Coordinated Idaho FFA State Forestry Career Development Event for over 120 Idaho high school students for 12 years
2. Facilitated Idaho Forest Owners Field Day four times between 2012 and 2023
3. Developed and instructed undergraduate curriculum for four forestry classes in the University of Idaho College of Natural Resources
4. Reviewed manuscripts submitted to seven peer-reviewed forest science journals.

5. Advised approximately 50 undergraduate and graduate (MS, PhD) students through successful completion of their degree programs.

Certification:

When the individual signs the certification on behalf of themselves, they are certifying that the information is current, accurate, and complete. This includes, but is not limited to, information related to domestic and foreign appointments and positions. Misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§ 287, 1001, 1031 and 31 U.S.C. §§ 3729-3733 and 3802.

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Appendix C: Senior Personnel

John Shovic: John Shovic is research faculty at the University of Idaho, and serves as the director of the Center for Intelligent Industrial Robotics at the University of Idaho. He has experience commercializing technology developed at UI, and has successfully used it in businesses on 3 separate occasions. Dr. Shovic teaches the robotics classes in the computer science department. Dr. Shovic will assist in supervising the technology development and documentation, and managing the research team.

Kyle Nagy: Kyle Nagy is the Superintendent and Orchard Operations Manager at Sandpoint Organic Agriculture Center, an organic orchard which grows more than 68 varieties of heritage apples. His research interest include organic agriculture, pomology, pollination, and regenerative agriculture. He has assisted in the initial implementation of the SCARECRO system in the orchard and will be providing feedback and guidance for the data pathways and features for SCARECRO.

Graduate and Undergraduate Students: These students undergo research training from the Center for Intelligent Industrial Robotics on how to prepare papers and presentations, and receive mentorship and guidance from faculty and staff. Additionally, there a robotic, microelectronic, and AI bootcamp hosted at the beginning of each summer where students can receive training in a variety of computer science topics.

Appendix D: Other Sector Resource Commitments

Please see the below letter of support from Laurel Grove Wine Farm.

LAUREL GROVE

WINE FARM

November 8th, 2023

To: USDA AFRI Review Panel
RE: Data Science for Food and Agriculture Program
Subject: AI Seasonal Forecasting for Agriculture

To whom it may concern,

I am Jaclyn Mommen, a regenerative farmer and environmental activist based in Winchester, Virgina. Our farm consists of permaculture vineyards and orchards with fruits, nuts and berries. We also have a market garden and U-Pick operation that supports our farm market, Patti's Place at Laurel Grove.

I am writing this letter to support the research at the University of Idaho proposed by the "Stress Testing the SCARECRO System" grant. I believe this project has potential benefits across all our farm pursuits and the agricultural industry in general.

I have been invited to collaborate on this grant and would like to provide input and domain expertise in my industry, which I believe will benefit the design and implementation of this project. Additionally, I believe that as farming moves towards more sustainable solutions, in depth weather forecasting and data collection will be critical to helping farmers, like myself, avoid harmful inputs thus leading to more nutritious food, healthier communities, decreased health care costs, and exponential environmental benefits. I think weather-specific computer science can make a huge difference if we continue to invest in it yet has a long way to go before the benefits of research can be meaningfully applied to my business. This research aims to accelerate that process and as such, we are eager to participate in pushing such an effort forward.

I am willing to attend stakeholder meetings during the project's run and provide feedback and evaluation for the developed technology, as relevant to my industry. I support the focus of this research and will aid the researchers in making sure it is applicable to the regenerative agriculture domain.

Sincerely,

Jaclyn Mommen
Owner and Operations Manager

Laurel Grove Wine Farm
3074 Laurel Grove Road
Winchester, VA 22602
917.79.4406

LAUREL GROVE