PACIFIC NORTHWEST AGRICULTURAL SAFETY & HEALTH CENTER

YEAR END REPORT

FISCAL YEAR 2024
9/30/23 - 9/29/24

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CONTENTS

Our Vision

The PNASH Center, established in 1996, is housed within the University of Washington's School of Public Health. We conduct research and promote best occupational health and safety practices for Pacific Northwest farming, fishing and forestry. One of twelve regional NIOSH Agricultural Centers, PNASH works throughout Washington, Idaho, Oregon, and Alaska, integrating expertise from multiple integrated disciplines, institutions and community partners. Our vision is: **Research for healthy workers, strong communities and productive agriculture.**

2023–24 Year End Report

This report provides an overview of the PNASH Center's progress during the first year of this program cycle.

Thank You to our partners, advisors, and research participants. Your collaboration makes our work possible and ensures it is relevant and meaningful for ag communities.
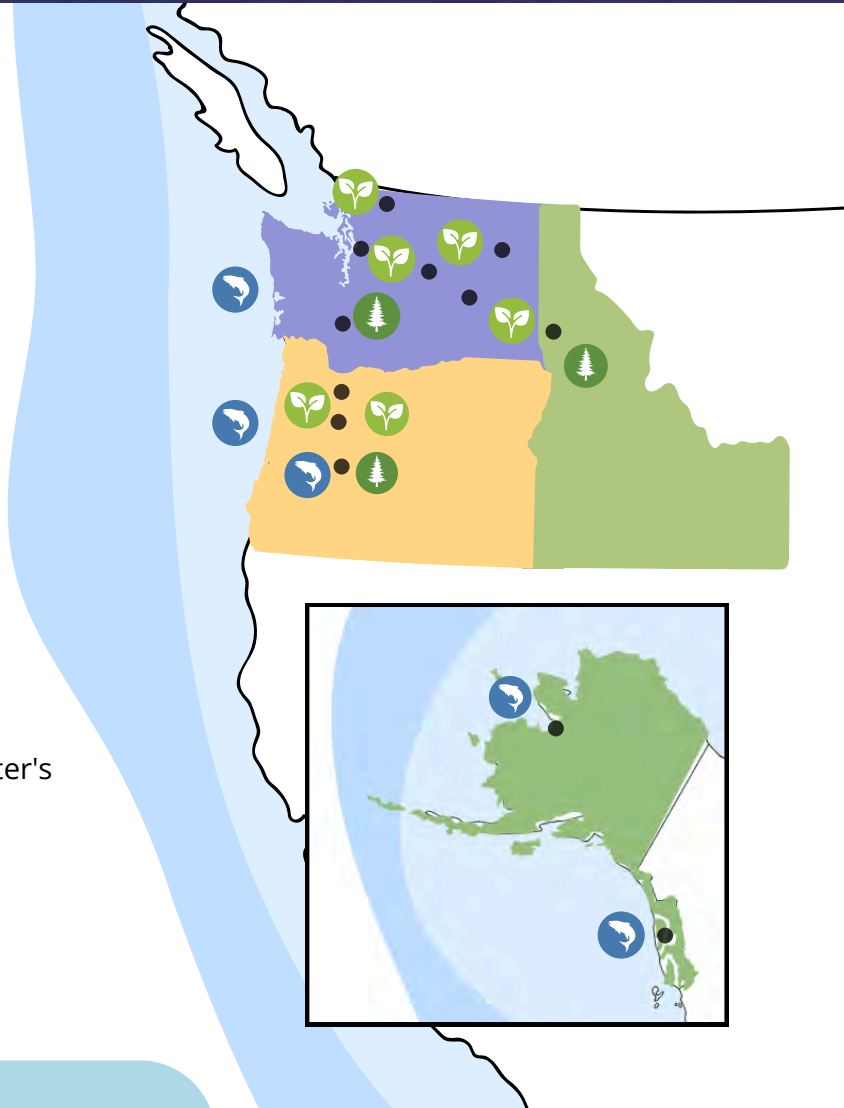
What is the injury burden in AgFF?

Forestry
28x

Forestry workers are 28 times more likely to die on the job. [5]

Fishing
22x

Fishing workers are 22 times more likely to die on the job. [5]

Farming
7x

Farming workers are 7 times more likely to die on the job. [5]

Did you know?

- Alaska produces **60% of seafood** in U.S.[1]
- Idaho produces over **13 billion pounds** of milk annually. [2]
- Oregon produces **28% of plywood** in the U.S. [3]
- Washington is the top producer of apples, **producing 6.5 billion pounds annually.** [4]

Sources
1. National Oceanic and Atmospheric Administration. 2020 Fisheries of the United States Report.
2. Idaho Department of Agriculture. Idaho Facts and Statistics, 2021.
3. Oregon Forest Resources Institute. Oregon Forest Facts 2023-24 Edition.
4. National Agriculture Statistics Service 2019. 2017-Census_Fruit_TreeNut_Berry_Production.pdf. p. 2. Report No.: ACH17-6.
5. U.S Bureau of Labor Statistics. Census of Fatal Occupational Injuries (CFOI) – Current and Revised Data 2018. Washington, DC.

Research Projects

Eloise Zimbelman conducts research in the forests of Idaho.

Use of Location- and Wearable-based Occupational Activity Recognition to Quantify on-the Job Digital Health and Safety Metrics for the Forestry Workforce

YEAR 2 of 5 (2022-2027)
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Eloise Zimleman, Ph.D.
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🖥️ https://deohs.washington.edu/pnash/forestry-workforce-location-and-wearable-based-activity-recognition-quantify-job-digital-health-and

Figure 1. Participants in the COFE 2024 National Meeting observing heavy equipment and safety demonstrations on the University of Idaho Experimental Forest, May 2024.

Challenge

Logging is among the most dangerous professions in the United States, with fatal work injury rates ranging from 68.9 to 135.9 cases per 100,000 full-time equivalent workers between 2015 and 2020 (U.S. Bureau of Labor Statistics 2021). Fatalities and near-fatal incidents are particularly common among ground workers such as cable rigging crews and timber fallers working with chainsaws, since these workers are not protected in modern equipment with enclosed cabs (Lefort et al. 2003, Shaffer and Milburn 1999, Lagerstrom et al. 2017). For example, manual timber felling and rigging crew workers on conventional cable logging operations accounted for over 47% of injury claims in Idaho and Montana from 2011 to 2014 (Lagerstrom et al. 2017, Lagerstrom et al. 2019). Equipment operation accounted for the next-highest category of injuries after manual felling and rigging crew work (22.35%) (Lagerstrom et al. 2017). Equipment operators have limited visibility due to dense, young vegetation, topography, weather, and other factors, and are often unaware of the exact locations of ground workers. There is a clear need to reduce fatal and near-fatal injuries that frequently result from interactions among ground workers, heavy equipment, and dynamic operational-, terrain- and weather-related hazards on active logging operations. Loggers could have improved situational awareness if they had a system that made it possible for the locations of all resources, including individual workers, to be displayed in real-time on a digital map in the cabs of equipment. The sensors on smartwatches are capable of detecting and characterizing human movements, so an app that quantifies the particular activities workers and coworkers are doing, as well as their potential health and safety exposures during work, could help improve awareness of hazards and reduce the potential for incidents to occur.

Project Overview

The major goals and aims of our project are to develop smartwatch-based recognition of human work activities carried out by logging workers during regular productive operations, and to then program these models into a new smartwatch app prototype that can be used to help improve the health and safety of loggers through increased situational awareness at the jobsite. Additionally, we are improving on an existing system developed through prior NIOSH-funded research with more user-friendly methods to share the locations of ground workers and heavy equipment working together on logging operations in remote areas.

Year 2 Progress

We conducted observational time study sampling on 4 active logging operations in Idaho and Washington in 2024 and are sampling at a fifth location during Fall 2024, completing our first aim collecting primary data to develop HAR models to support new approaches to quantify forestry work productivity, digital health, and safety. Preliminary model development has begun and will incorporate all required data after field sampling is complete. We also initiated sampling for our longitudinal study evaluating perceptions of technology acceptance for use of smartwatches and location sharing on logging operations. The first year of sampling for is continuing through fall and winter 2024, after which initial survey results will be summarized.

We are working on preliminary coding of the smartwatch app that is a key deliverable for the project. This is ongoing work that will continue as models and other supporting analysis of smartwatch sensor data is completed. App development is based on predictive models developed and validated during the earlier stages of the project. Validation of predictive models will be based on new field data collected in an independent sampling effort on 5 new, active logging operations throughout the Pacific Northwest. We are making good progress on the evaluation of location-sharing system for improved situational awareness on cable logging operations. This analysis was moved earlier on the project timeline and initiated during Year 2, rather than Year 3 as planned. We have installed Starlink WiFi systems on each logging operation visited in Year 2, coupled with real-time GNSS-RF radio location devices used to map logging workers and equipment in real time.

We conducted significant education and outreach activities associated with the project in Year 2. Primary investigator Keefe served as Chair of the national Council on Forest Engineering (COFE) Annual Meeting and featured the PNASH Forestry project as a central focus of field tour technical demonstrations for approximately 110 participants. Multiple, situation-based experiences that highlighted NIOSH-funded research evaluating new technologies and methods were shown to forest managers, logging contractors, academic researchers, and safety personnel from NIOSH, AgriSafe, Associated Logging Contractors of Idaho, US Forest Service, Idaho Dept. of Lands, various corporate forest timberland owners, and many others. Additionally, multiple formal research presentations about the Forestry project were presented at COFE. In addition to PI Keefe, the Director of Garmin Health presented as a keynote speaker for the COFE meeting and highlighted past development and future use of smartwatches and other wearable devices in digital occupational safety and health applications.

Figure 2. A rigging crew worker waits while coworkers set wire rope chokers on trees to be yarded up the hill on a cable logging operation with greater than 100% slope in north Idaho, August 2024.

Next Steps

In early Year 3 we are completing the final sampling for Specific Aim 1 and working to develop the associated Human Activity Recognition (HAR) models. We will initiate our second season of sampling, with this new data set serving as validation data for predictive models developed from initial Year 2 data. In Year 3 we anticipate substantial progress developing our prototype smartwatch app (Specific Aim 3) as our predictive models are finalized and can be incorporated into the watch app. Additionally, we anticipate hosting a webinar to train participants on the location-sharing system for improved situational awareness on logging operations. We will complete the first round of survey sampling for our longitudinal survey. We also anticipate completion of 1-2 peer-reviewed publications and 1 outreach publication for the project.

Partners and Collaborators

We developed a number of new partnerships as part of the project. Collaborators include:

- All participants at the Council on Forest Engineering (COFE) Annual Meeting (https://uidahoedugala.cventevents.com/event/2fd7f222-2b4c-4971-9fa7-46393bda2a21/summary)
- Members of the Idaho Forest Products Commission (https://www.idahoforests.org/)
- 25 K-12 teachers who participated in the 2024 Idaho Sustainable Forestry Tour for Teachers (https://www.idahoforests.org/content-item/sustainable-forestry-tour/)
- Idaho Logging Safety (https://dopl.idaho.gov/log/)

Respiratory Health and Indoor Air Quality in the Cannabis Industry

YEAR 2 of 5 (2022-2027)
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🖳 https://deohs.washington.edu/pnash/cannabis-worker-health-and-safety

Figure 3. Recent studies show that cannabis production workers are exposed to a variety of respiratory hazards.

Challenge

Production and processing of cannabis is a rapidly growing industry in the US, however very limited information is available on the occupational hazards faced by workers in this industry. Recent pilot studies have demonstrated that cannabis production workers are exposed to a variety of respiratory hazards, have a high rate of work-related health symptoms, and may be at increased risk of occupational lung diseases, particularly work-related asthma. However, there is still significant uncertainty around the specific causes of work-related health symptoms in these workers.

Project Overview

In this project we will undertake a panel study of cannabis workers to investigate whether exposure to specific airborne contaminants released during cannabis production is associated with adverse health effects. In addition, we will evaluate the effectiveness of engineering control to reduce occupational exposure to respiratory hazards. Based on findings in this study, we aim to develop a guide describing best-practices and incorporate our study findings into worker health and safety training materials. This will help cannabis employers comply with applicable occupational health and safety regulations, and to reduce respiratory exposures within this industry.

Year 2 Progress

We have continued finalizing our field protocols, including preparing a hemp extract to use for the skin prick allergen testing. We have been contacting cannabis workplaces to seek their permission to undertake this study on at their locations. To date, four workplaces have agreed to participate in this study. We are scheduled to start recruiting workers and collecting data at the first of these workplaces in November.

We have visited two workplaces and measured particle mass and volatile organic compound concentrations associated with the pre-roll joint packing process. The measurements were made both with and without an enclosure in place around the joint packing machine (aka "knock-box"). Based on these initial measurements we are developing and testing a local exhaust ventilation system to attach to the knock box enclosure to improve its effectiveness at reducing emissions from the joint packing process and reducing exposure to the workers who undertake this task.

Finally, we are writing a paper based on our pilot data that compares respiratory health effects in cannabis workers, cannabis users who are not exposed to cannabis at work, and a control population who does not use or work with cannabis.

Next Steps

We will continue recruitment of cannabis workers and collect exposure and health data. We will conduct lab and field tests of the local exhaust ventilation system to demonstrate its efficacy to reduce particle mass and volatile organic compound concentrations emissions from the joint packing task. Lastly, we will begin to create cannabis-industry-focused training materials for inclusion in the WISHA 10 for agriculture training. Washington State Department of Labor and Industries' Division of Occupational Safety & Health offers this training for workers to help increase their knowledge of safety and health in agriculture jobs.

Figure 4. Next steps will include industry-scpecific safety training materials for cannabis workers. Photo courtesy of WA Labor and Industries.

Partners and Collaborators

- The Cannabis Alliance: (https://www.thecannabisalliance.us/)
  A Washington state-based non-profit association of cannabis businesses. We have worked with them successfully to recruit cannabis workplaces to participate in our previous studies.
- Washington State Department of Labor and Industries Multicultural Safety and Health Outreach Program (MSHOP program): (https://lni.wa.gov/safety-health/safety-training-materials/workshops-events/wisha-10-for-agriculture)
  We partner with the MSHOP program to adapt their WISHA 10 for agriculture occupational safety and health certification so that it addresses the specific occupational health and safety issues faced by cannabis production and processing workers.

Engineering Solutions to Reduce Pesticide Exposure and Waste on Northwest Fruit Farms

Figure 5: Nede Obviebo presents research at the UW Undergraduate Research Symposium.

YEAR 2 of 5 (2022-2027)
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Lav Khot, PhD, MS,
Associate Professor, AgWeatherNet Director, College of Agricultural, Human, and Natural Resources Sciences, Washington State University

🖥 https://deohs.washington.edu/pnash/index.php/engineering-solutions-reduce-pesticide-exposure-and-waste-northwest-fruit-farms

Challenge

Labor-intensive fruit commodities can put farmworkers and their families at disproportionate risk of pesticide-related illness through pesticide handling, drift, or the take-home exposure pathways. Robots, drones, sensors, autonomous tractors, and other digital technology are quickly changing the landscape of agriculture, including claims related to reducing pesticide use. This work builds off prior work on pesticide application safety from two previous PNASH cycles.

Project Overview

This project focuses on capturing current and planned uses for these new technologies in the Pacific Northwest and center worker expertise and skills in the next generation of pesticide application safety personnel and technology.

Year 2 Progress

The Sprayer Technology Adoption and Related Skills (STARS) Survey continues to provide insights into the practices, challenges, and technological adoption within the tree fruit industry, particularly in Washington's agricultural regions. The results from the STARS Survey highlight a growing alignment between technological advancements and worker safety in the agricultural industry. While current practices are still effective, the industry is showing a clear shift towards adopting new technologies that promise increased safety and efficiency in pesticide application. This shift is reinforced by a demand for educational resources and support, reflecting a commitment to continuous improvement in occupational safety and health. Expanding educational outreach and ensuring that new technologies are both practical and beneficial will be critical in facilitating this transition. By focusing on leadership, communication, and conflict resolution, the program also helps bridge the gap between technology adoption and worker well-being. These findings will guide future efforts to enhance training programs and support the integration of safer, more effective sprayer technologies across the Pacific Northwest.
Our key findings from the STARS Survey are:

- Satisfaction with Current Sprayers: A significant portion of growers expressed satisfaction with their current sprayer technology. Many have well-established practices with existing equipment, which they feel meets their current operational needs.

- Interest in New Sprayer Technologies: Despite being satisfied with their current equipment, many growers showed a strong interest in learning about and adopting new sprayer technologies. This reflects a forward-looking attitude, with an openness to explore innovations that can further enhance performance and safety.
- Demand for Safe Spraying Resources: Growers are increasingly seeking educational resources focused on safe pesticide spraying techniques. The demand indicates a clear need for training programs that improve both safety and efficiency in pesticide application, addressing occupational health concerns.
- Technology Acceptance Factors: Using the Technology Acceptance Model (TAM), the findings suggest that growers are more likely to adopt new spraying technologies if they perceive the tools as both useful (improving performance and safety) and easy to use (simple integration into existing practices). This highlights the importance of user-friendly technologies that offer clear benefits.
- Emphasis on Worker Expertise: There is a growing recognition of the need to center farmworker expertise in the development of new technologies. Encouraging collaboration between farmworkers and growers is essential to ensure that innovations address both productivity and safety concerns, particularly in the context of pesticide application.

We have been holding planning meetings with the WSU team for spring and summer 2024 field studies. We have also been meeting with WSDA and WSU to discuss training needs.

Next Steps

We will begin conducting field studies during 2025. We will also foster partnerships between growers and equipment manufacturers to tailor solutions that meet the needs of both large and small-scale farms. We plan to connect with: (1) "Semillero de Ideas" or "Nursery of Ideas", a non-profit dedicated to engaging farmworkers to lead and foster innovation in agriculture. https://www.semilleroideas.org/ and (2) The Agricultural Leadership Program, a 40-hour bilingual course for supervisors, has been successful in preparing farm supervisors to lead in the adoption of new technologies and safety practices. Lastly, we'll develop bilingual educational materials that address leadership and technical skills for farm supervisors and workers, ensuring that they are equipped to manage new technologies effectively.

This cycle of funding has opened up opportunities for future projects. The team is looking to expand connections with Washington State Department of Agriculture's Technical Services and Education Program and Oregon's Department of Agriculture. These programs can offer additional training focused on safe pesticide practices and sprayer technology adoption. With ongoing pilot programs and external grants, there is potential for spinoff projects that address both technological and safety challenges in agriculture (STARS Survey).

Partners and Collaborators

- Washington State Tree Fruit Association (WSTFA): https://wstfa.org
  WSTFA played an essential role in connecting the project with regional tree fruit growers, facilitating communication, and distributing the survey. Their involvement ensured that the findings were representative of the industry's needs.
- Washington State Department of Agriculture (WSDA): https://agr.wa.gov

The WSDA supported the project by providing expertise on pesticide regulations, sprayer technology standards, and agricultural policies. They also assisted in outreach and shared resources to ensure safe pesticide application practices were incorporated.

- Washington State University (WSU): https://wsu.edu
WSU contributed to the project's educational components, particularly through the Agricultural Leadership Program. Their trainers helped develop curriculum focused on leadership, safety, and technology adoption for supervisors and farm managers.

Tracking Agriculture, Forestry, and Fishing Health Indicators: RISC 2.0

YEAR 2 of 5 (2022-2027)
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John Flunker, PhD, MPH, MS
Assistant Professor, Epidemiology, University of Iowa

Figure 6. John Flunker, co-investigator.

🖥️ https://deohs.washington.edu/pnash/tracking-agriculture-forestry-and-fishing-health-indicators-risc-20

Challenge

The agriculture, forestry, and fishing (AgFF) sector have the highest-risk of occupational injury for any sector identified by the United States Bureau of Labor Statistics. Non-fatal injuries and illnesses for this sector were estimated at 5.2 per 100 workers, well above that of the next highest sector, transportation and warehousing, at 4.4 per 100 workers. This project builds off prior work from the 2016-2022 PNASH cycle by expanding the Risk Information System for Commercial (RISC) Fishing data system, which merged multiple sources of injury and fatality data to facilitate the development of fishery-specific approaches to assess hazards, mediate risks, and evaluate interventions.

Effective prevention and control require comprehensive surveillance, paired with active engagement and outreach.
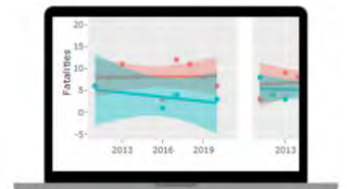
Year 2 Progress

In Year 2, Michael Yost became the primary investigator for the project and John Flunker became Co-Investigator, with the retirement of Viktor Bovbjerg from Oregon State University. Dr. Flunker is also a contractor at the Safety & Health Assessment & Research for Prevention (SHARP) Program in the Department of Labor and Industries (L&I). This allows for streamlined access to L&I workers compensation claims data and state-based surveillance in the healthcare and Emergency Medical Services (EMS) realms. We have established collaborations with SHARP researchers specializing in occupational respiratory health outcomes, work-related musculoskeletal conditions, and EMS and hospitalization data linkages. We have also established collaborations with the WA state Department of Health to access state syndromic surveillance data (Rhino). Connections have also been established with Washington State EMS Surveillance (WEMSIS) to access state EMS data. Ongoing SHARP work to develop occupational-related injury and illness detection methods will be applied to the hospitalization and EMS data. An application has been submitted to the Washington State Institutional Review Board, allowing Dr. Flunker \direct access to workers' compensation data.

Progress to Date

We have created a data analysis plan that follows the National Institutes of Health Data Management and Sharing Plan guidance, which was co-developed by DEOHS and PNASH personnel. We also created a draft dashboard using publicly-available data from the Bureau of Labor Statistics.

Next Steps

We will continue to develop relationships at the Washington state level to further access and expertise related to workers compensation claims data, emergency medical systems, and hospitalization data. We will submit an application to the Washington State Institutional Review Board, and once the request is approved, we will begin to analyze data and interact with PNASH stakeholders

Partners and Collaborators

- NIOSH Western States Division in Alaska (https://www.cdc.gov/niosh/contact/im-wsd.html)
- Oregon Sea Grant (https://seagrant.oregonstate.edu/)
- Washington Sea Grant (https://wsg.washington.edu/)
- Washington State Department of Labor & Industries (https://www.lni.wa.gov/)

Fishermen Led Injury Prevention Program (FLIPP) for Lifejackets Mobile Program

YEAR 2 of 5 (2022-2027)
Laurel Kincl, PhD, CSP
Professor and Associate Dean of Academic & Faculty Affairs,
College of Health, Oregon State University

🖥️ https://health.oregonstate.edu/labs/osh/resources/flipp#lifejackets

Figure 7: Fishermen's Appreciation Day in Newport, OR.

Challenge

In commercial fishing, fatalities have occurred when those lost were not wearing a lifejacket. Commercial fishermen deaths have extended impacts on the coastal communities and families. Nationally, from 2000-2014, the most recent data published, there were 693 US commercial fishermen who died while fishing with vessel disasters with falls overboard accounting for the majority. From the most recent regional data available, 2000-2018, there were 93 fatalities in Washington and Oregon. Only five of the fatalities were wearing a lifejacket and three of those were not wearing it properly.

The success of the Lifejackets for Lobstermen program by the Northeast Center (NEC) for Occupational Health and Safety, which used a social marketing approach and a mobile program to get lifejackets to fishermen in Maine and Massachusetts, led to the development of FLIPP for Lifejackets to fill a need in the Pacific Northwest.

Project Overview

The objective of the FLIPP for Lifejackets project is to better understand the behavior of lifejacket use among commercial fishermen in Oregon and Washington and to promote the use by creating a mobile program for commercial fishermen that increases access to lifejackets that they will wear. We are collecting fishermen's views and experiences related to vessel safety including use of lifejackets and their stage of behavior change related to lifejacket use, adapting an evidence-based intervention to build a region-specific program, implementing, and evaluating the program, and comparing strategies. This project is using a social marketing approach (the 4 P's - Price, Product, Place, and Promotion) to get lifejackets to fishermen.

Year 2 Progress

Key commercial fishing community partners were interviewed between March and December 2023. Fifty-four partners engaged in conversations with us. Interviews were completed for 46 of these partners that included: fishing community/family members, port managers/harbor masters, tribal fishery representatives, vessel and safety training organizations, regional marine suppliers, governmental agencies, media that serves commercial fishing audiences, fishery associations, lifejacket association, and lifejacket manufacturers. The lifejacket perceptions and social marketing details provided by our community partners informed our lifejacket program development. Common perceptions about lifejackets included: 1) A variety of brands/designs with good potential for commercial fishermen exist or have existed, 2) What prevents fishermen from wearing one includes entanglement, bulk, feeling encumbered, feeling invincible so not needed, and cost, and 3) What would make a fishermen consider wearing one included comfort/fit, knowledge, stormy/rough conditions and nighttime, captain enacting a policy, losing

someone they know, fishing alone, if wife says to wear one, working on deck, and witness of someone going overboard. Social marketing that would be effective for Pacific Northwest fishermen included a reasonable price, having several lifejacket styles for fishermen to choose from, having the program where fishermen would already be before season starts and at local events for fishermen. Finally, a variety of promotion approaches would be most effective and should include fishermen testimonials. In addition to hearing from community partners, we surveyed 95 fishermen from Oregon and Washington. We asked various questions related to lifejackets and their use. The fishermen surveyed included almost equal numbers of captains and deckhands, aged 21-67 years and 19 were women. The most common fishery was Dungeness crab and Salmon. We used the answers of the fishermen to categorize them related to their "stage of change" related to wearing a lifejacket. Over half of the fishermen indicated they wore a lifejacket all the time or more frequently recently. The fishermen who reported they were not aware of new lifejacket models were significantly less likely to report wearing a lifejacket. This supports our plan in our lifejacket program to provide the ability to try on and learn about different styles of lifejackets to increase use of lifejackets. At various events around the region held for commercial fishermen, we were able to collect rankings of the various styles of lifejackets. This information is being used to inform the selection of lifejackets that would work for the fishermen and fisheries in the Pacific Northwest.

Figure 8: Gathering feedback from fishermen in Newport, OR.

The FLIPP for Lifejackets Program is planned based on the input from fishermen and community partners. We have made the appropriate connections with lifejacket manufacturers and distributors to arrange to have lifejackets at community and training events. We plan to provide education, a selection of lifejackets, and the ability for the fishermen to try on the lifejackets within training events (drill conducting and first aid courses), and in collaboration with fishermen events, such as appreciation days in various ports. We are collaborating with local marine supply stores, community-based organizations, and AMSEA to provide the lifejackets. We expect as the program gets started in the fall of 2024, that we will continue to expand our opportunities to be at events.

We were able to pilot test a run of the FLIPP for Lifejackets program. In November of 2023, we collaborated with the Newport Fishermen's Wives (Newport, Oregon), Englund Marine, and Kent to bring the popular Kent Rogue lifejackets to the Newport Fishermen's Appreciation Day and a USCG Drill Conductor course. Seventy-one vessels and 175 fishermen received a free Kent Rogue lifejacket. The successful collaboration and interest from fishermen support our plans for the program going forward.

As we developed our plan for the FLIPP for lifejackets program, we are documenting the details of the decisions made based on Aim 1 activities. We will continue to document our modifications as well as the implementation of the program for future analyses.

Next Steps

This Fall 2024, we will be hosting the first PFD advisory board meeting during the Pacific Marine Expo in Seattle, WA. This will be a joint meeting with NEC's PFD advisory board and will be run partly on Zoom and partly in person. This Fall we will also begin trialing 7 different styles of lifejackets with 40 fishermen in Oregon and Washington. Fishermen will wear a lifejacket assigned to them for a month while fishing and report back with their impressions. We will also be completing our remaining stakeholder and fishermen interviews and analyzing the data. We will continue to work with NEC to track modifications we are making based as finalize our plans for what the FLIPP for

Lifejackets program is as well as how it will be implemented. These modifications will be based on stakeholder input and regional needs and will be compared with the approach used in New England with NEC. This will help us design and implement our mobile lifejacket program, tailored to the Pacific Northwest, sometime in 2024.

Partners and Collaborators

- Newport Fishermen's Wives (partner for hosting our program in Newport) https://www.newportfishermenswives.com/
- Englund Marine (retailer that collaborates in several ports to provide a sale/stock of lifejackets for the program) https://www.englundmarine.com/
- Columbia River Inter-Tribal Fish Commission (collaborates with us to engage fishermen in ranking and trying on lifejacket for future program) https://critfc.org/
- Nathan Holstedt (photographer/videographer to help capture fishermen images and video testimonials for social marketing of FLIPP for lifejackets) https://www.facebook.com/nathan.holstedt/
- AMSEA (collaborating with their lifejacket program to bring lifejackets to the trainings in OR and WA to enroll in our FLIPP for Lifejackets evaluation) https://www.amsea.org/

Awards

John Flunker monitors temperature in Prosser, Washington.

PNASH Small Grant Programs

PNASH allocates funding annually to allow us to 1) foster new exploratory research, 2) support stakeholder's outreach and education activities, and 3) respond to emerging needs in our region.

Pilot Project Program (PPP)

The PNASH Center administers the PPP to support new initiatives in research, intervention, and translation. The PPP funds projects through a competitive process for a maximum annual direct cost allocation up to $30,000 and a project duration of 12 months. The PPP participates in the Center-wide program monitoring, tracking progress, activities, and products. Previous awardees have contributed greatly to the success of the PNASH Center through the development of new partnerships, scientific publication, and career development of young investigators. Visit our website for more information: https://deohs.washington.edu/pnash/pilotprojects.

New Pilot Awards

Maria Blancas, Clinical Assistant Professor, Department of Environment and Occupational Health Sciences, University of Washington. **Climate and Mental Health in Agriculture (CLIMA).** Agricultural workers face unique mental health challenges exacerbated by extreme weather conditions and financial instability. Previous research highlighted significant stressors impacting farmworkers, including stress and anxiety due to seasonal work demands and inadequate mental health services. However, the intersection of climate change and mental health among agricultural workers remains under-researched. By addressing the gap in research and resources on climate change and mental health within agricultural settings, this project aims to mitigate the impact of climate change on farmworkers, improve mental health outcomes, and contribute to healthier agricultural workplaces.

Diana Ceballos, Assistant Professor, Department of Environment and Occupational Health Sciences, University of Washington. **Development and evaluation of WISHA 10 cannabis training module.** In the United States, the legal cannabis industry employs 420,000 full-time workers and is rapidly growing as more states legalize cannabis. Working with cannabis plants can cause skin and respiratory health issues. In Washington, there is a need for state-wide formalized training to prevent occupational injuries and illnesses within the cannabis industry. This pilot project aims to form a cannabis-related advisory committee to assess ongoing WISHA 10 training and develop and evaluate a WISHA 10 cannabis training module. The advisory committee will allow for different perspectives to inform the development and evaluation of a new module for the WISHA 10 focus on the occupational health and safety needs of cannabis workers. Findings from this study will enhance WISHA 10 training by broadening and updating its content and evaluation, as well as increasing DOSH's capacity to reach cannabis production workers more effectively.

Denise Damewood, Nurse Consultant for State of Alaska Public Health and Alaska Marine Safety Education Association. **Evaluating an Opioid Overdose Prevention Program for Commercial Fishermen Using the CDC Program Evaluation Framework and a Systems Theory Approach (Project Gabe).** Project Gabe is an opioid overdose prevention program for commercial fishermen. Fishing is physically demanding, with workers enduring long hours in adverse weather and high-stress conditions. Work-related musculoskeletal injuries are common, increasing the likelihood of being prescribed opioids for pain and increasing the risk of opioid dependence and misuse. Project Gabe is a resource for harm reduction, providing opioid misuse awareness and education, opioid antagonist training, and medications to reverse the effect of opioids temporarily. This project will provide fishermen with opioid overdose response tools, including naloxone, opioid misuse education, and recovery resources, in a manner that is accessible, easy to understand, and easy to implement. Project Gabe will be assessed and improved using the CDC Program Evaluation Framework from a Systems Theory Perspective to address the complex needs of the crisis. As a short and long-term outcome, evaluation, development, and improvement of Project Gabe should reduce opioid overdose fatalities in the commercial fishing industry.

Past Pilot Projects

Karie Boone, Applied Social Scientist, Center for Sustaining Agriculture and Natural Resources, Washington State University and Georgine Yorgey, Director, Energy Program; and Senior Research Fellow, Center for Sustaining Agriculture & Natural Resources, Washington State University. **Planning for the "new normal": assessing service organizations' climate-related impacts and resiliency to support farmworkers.** Climate-related environmental hazards, including successive high-heat days

and poor air quality from wildfire smoke, are projected to continue and worsen, increasing occupational risks for farmworkers in Central Washington. Farmworker support agencies are facing related training and resource provision needs while filling associated support gaps. This project sought to (a) better understand farmworker support entities' experiences and attitudes towards ongoing climate change, (b) explore how they observe farmworkers navigating these impacts, and (c) identify opportunities to better prepare support entities for identified impacts.

The team combined data from 24 interviews, two years of farmworker support coalition call meeting notes, and three farmworker assessment reports from the western coastal U.S. in a multi-method qualitative study to gain a comprehensive understanding of how farmworker support organizations (SOs) in central Washington are experiencing climate-related impacts, how they observe frontline tree fruit farmworkers navigating these impacts, and gaps in the farmworker social infrastructure that need attention for equitable climate adaptation. Preliminary data collection had been undertaken with complimentary funding from a NOAA Climate Adaptation Project starting in the fall of 2022. Under this project, additional data were collected through early 2024, and data analysis and summarization were carried out.

Our analysis has identified five preliminary themes:
- Theme 1: Farmworker SOs in Central Washington are filling an increasing number of climate change-related support gaps for frontline farmworkers and this is stretching their capacities.
- Theme 2: Individuals working at farmworker SOs varied in whether they connected support needs that arise during heat and smoke events with climate change; those that did were more likely to participate in support networks and policy efforts.
- Theme 3: Power differentials and cultural norms contribute to a lack of safe lines of communication through which farmworkers can advocate for their health and safety needs.
- Theme 4: New state rules aim to support workers during periods of high heat and smoke, but many SOs feel that the structure of rule development processes did not sufficiently facilitate effective worker participation, that implementation has been challenging, and that in situations when workplaces are not in compliance, enforcement is inadequate.
- Theme 5: SOs recommend 1) additional worker, management, and owner trainings relating to heat and smoke protections and implementation, and 2) bolstering enforcement mechanisms in cases when workplaces are not in compliance.

The project team is finalizing a submission to a peer reviewed journal.

John Flunker, Assistant Professor, Epidemiology, University of Iowa.
Refining spatiotemporal estimates of region ten crop worker exposure to wildfire smoke and heat. U.S. crop workers are increasingly exposed to climate-related hazards, such as extreme heat and wildfire smoke, that pose a significant potential health risk to this vulnerable worker population. This project sought to characterize the Washington State H2A (temporary foreign agriculture) worker population, focusing on the distribution of these workers in time and space and potential exposure to climate-related hazards like extreme heat and wildfire smoke. It also aimed to identify worker groups at risk, inform exposure reduction interventions, and identify areas of potential high exposure and exposure-related health burden.

The project team used publicly available disclosure data from the U.S. Department of Labor (DOL) that details Washington State H2A visa worker applications from 2018-2023. The data had information on H2A visa applications submitted to the DOL including employer information, number of workers certified, worksite location(s), worker housing location, employment duration, and North American Industry Classification System (NAICS) code. Worksite and housing addresses were geocoded, and potential heat and wildfire smoke exposures were estimated for H2A workers at those locations.

The data show a dramatic increase in certified Washington State H2A workers from 2018-2023, with the majority employed in the fruit and tree nut industry. From 2018-2023, counties with the highest H2A worker employment included include Yakima, Grant, Benton, Chelan, and Okanogan. Preliminary data suggests that H2A workers in Yakima County, primarily in the fruit and tree nut industry, experienced the highest number of worker days at risk to heat, wildfire smoke, and heat/smoke co-exposures. The findings suggest that future exposure reduction interventions and research efforts designed to assess individual level health effects should target workers in counties with the highest potential burden of exposure by industry (e.g., Yakima County). The approach used to identify spatial and temporal trends in industries at risk of exposure based on the H2A data set can be applied to additional states and regions, potentially serving as an informative intervention and policy evaluation/development tool.

The project team continues to analyze data on heat exposure and wildfire smoke data to explore differences in exposure patterns by industry, location, and time. They are drafting a peer-reviewed manuscript. Results will be shared with partners and stakeholders within the state.

Leslie Hammer, Professor, Director, Oregon Healthy Workforce Center, Associate Director of Applied Research, Oregon Institute of Occupational Health Sciences, Oregon Health & Science University. **Evaluation of the Oregon Overtime Pay Legislation (HB-4002) among Latine Agricultural Workers.** This project sought to evaluate the initial impact of the new Oregon Farmworker Overtime Law (OFOL) on farmworkers' work experiences (e.g., wage theft; work overload; stress; job insecurity) and well-being, including mental health. Oregon passed HB 4002 in 2022, which began its 5-year phase-in to provide overtime pay to agricultural workers starting in January 2023. Although much is known about the impacts of consistently working overtime and/or low pay on physical health, mental health, sleep, and mortality, little is known about the experiences of farmworkers and their families in reference to working overtime, and, to our knowledge, no work has considered the impact or effectiveness of state-level overtime legislation on farmworkers' work experiences, mental health and wellbeing.

Survey interview data were collected from 214 farmworkers between March and September 2024. The project contracted with 3 Oregon-based community organizations (CBOs) to complete the interviews: Centro Cultural in Hillsboro, PCUN in Woodburn, and Unete in Medford. They were able to bring together a community advisory board (CAB) early in the project to assist with survey development and study design.

Findings from this initial evaluation, serving as a baseline assessment of the phased-in law, demonstrate that less than half of respondents said they were familiar with the overtime law, indicating that much more education regarding the law is needed. Farmworkers learned about the law from a variety of sources (employers, CBOs, coworkers, and media). Attitudes towards the OFOL varied at this early stage of the implementation of the law, with farmworkers having conflicting feelings. In addition, we found that rates of depression and anxiety among farmworkers were elevated, particularly depression, when compared to previous National Agricultural Workers Survey (NAWS) data from a decade ago. Depression scores were positively related to having experienced wage theft, job insecurity, and financial stress. Regarding attitudes toward the OFOL, there was a negative relationship between believing employers would pay overtime and depression and anxiety.

The data for the current study provide initial information and baseline data for the evaluation of the OFOL. To our knowledge, no other study has gathered data from the perspective of the farmworkers who are directly impacted by such overtime laws, although currently eight states have passed legislation regarding overtime pay for agricultural workers. Research that does exist, however, has focused on the economic impact on growers and income. There is a general lack of knowledge about the law and the attitudes are very diverse and complicated. The rates of depressive symptoms among the sample are particularly concerning and highlights the need for services.

Using the findings from this initial stage, the project team has received a $322,358 award from the Robert Wood Johnson Foundation to continue this work in 2025-2026.

Julie Postma, Professor, Associate Dean for Research, College of Nursing, Washington State University. **Smoke hazards in the Agricultural Workplace; a bilingual survey for agricultural employers.** Agricultural workers in Washington State are geographically and occupationally at elevated risk for increased days of exposure to hazardous concentrations of fine particulate matter from wildfire smoke. The purpose of this study was to 1) Explore perceptions of air quality (AQ) monitoring, hazard communication, health impacts of smoke exposure, protective controls, and training needs among agricultural supervisors in alignment with the major elements of the wildfire smoke rule, and, 2) Compare survey responses by the language in which the survey was completed in order to identify training needs by group.

Bilingual personnel administered a survey in Spanish and English to agricultural supervisors and crew chiefs at two industry trainings in Washington State. A total of 116 surveys were collected with 61% completed in Spanish. Almost one fifth of respondents reported "hypertension/cardiovascular disease" (18%) as a condition that impacts their own health and 19% reported "asthma/respiratory disease." Eighty percent of respondents agreed that they have been exposed to wildfire smoke at work and 77% reported that they supervised workers who have been exposed to smoke. A significantly greater proportion of completers in Spanish (90%) reported being concerned with their own health and their workers' health in relation to smoke exposure than those completing in English (64%). Most (81%) respondents agreed that they can recognize signs/symptoms when a worker is not feeling well due to smoke exposure but only 63% reported having had training on managing workers with smoke-related symptoms. N95 masks were identified as readily available and the most realistic protective control to implement when wildfire smoke is present. There were significant differences by language group regarding what resources respondents identified as accurate for AQ monitoring at work. Most respondents (79%) had heard of the wildfire smoke rule.

Wildfire smoke is an occupational health threat for outdoors workers that is expected to increase. Supervisors who work in agricultural workplaces are required by law in WA, OR and CA to monitor AQ, manage workers' symptoms and implement protective controls at certain AQ thresholds. Study findings identify gaps in these areas and will support ongoing training of a critical subsector of the WA State agricultural workforce.

The project team presented their findings at the WA State Public Health Association meeting. They have drafted a manuscript for a peer reviewed journal to share their findings. The team has also submitted a proposal for grant funding to continue this work.

Peter Rabinowitz, MD, MPH, Professor, Environmental and Occupational Health Sciences; and Director, Center for One Health Research, University of Washington. **Knowledge and Practices of Health and Safety Managers in Washington Dairies.** Dairy workers face significant occupational hazards including animal related and other injury risks, and respiratory and infectious exposures. A particular risk is for zoonotic infections, which may be underreported in the workforce. Working in partnership with a number of dairies in Washington State, this project explored the relationship and communication between workers on the dairy responsible for herd health and those responsible for worker health to assess how information will flow between them in the event of a zoonotic disease outbreak. Key informant interviews with herd health workers explored knowledge and practices regarding infection prevention and control and communication between herd health workers and worker safety and health manager.

The project team conducted semi-structured, qualitative interviews with 3 herd health workers on 3 dairy farms (n=9) in Washington State exploring common infections on the farm, perceived risk of acquiring infection, and communication with

those responsible for worker health. Workers averaged 11.5 years working in the dairy industry working in herd health, maternity and calving, and the hospital. Respondents reported common illnesses on the farm in the herd include mastitis, pneumonia, pink eye, "milk fever," and twisted organs following birthing. Workers at each farm had mixed responses to whether those responsible for herd health and worker health were in communication, with some saying there was and others indicating there was no communication between the groups. Preferred method of training in order of preference included video, demonstration/hands on experience, in-person training and pamphlets.

The Center for One Health Research received a grant from Washington Health Labor and Industries to work in partnership with Northwest Dairy Association/Darigold and Washington State University's Veterinary Medicine Extension to develop practical set of guidelines for infection prevention and control for dairy workers, training materials to facilitate farms developing their own infection prevention and control plans tailored to their needs, and educational materials created for the dairy industry for employee health.

Outreach Mini-Grants

The Outreach Mini-Grant Program is a new funding opportunity intended to support stakeholder activities dedicated to promoting workplace health and safety among underserved populations. The Outreach Mini-Grant program has $15,000 available for small projects between $2,000 and $7,500 direct costs. Visit our website for more information: https://deohs.washington.edu/pnash/mini-grants

Emerging Issues Fund

This fund is dedicated to addressing new or timely safety issues and priorities raised by agricultural stakeholders in our region and developing new partnerships. The fund allocates up to $50,000 direct costs per year with awards as small as $2,000. Awards are available to active investigators within PNASH's Northwest network.

Marcy Harrington, Research Coordinator and PNASH Evaluation Lead, University of Washington. **Bilingual Pesticide Labels and Hazard Communications for Forestry Services.** This proposed small project will respond to a current request and reestablish PNASH with the forestry services industry, serving both English and Spanish-speaking reforestation pesticide handlers. The extent of pesticide exposure for handlers using handheld application equipment is not well documented for agriculture and, especially, forest services (reforestation). Forestry service workers do a variety of manual labor tasks: planting trees, pest control, cutting brush and small trees, and including vegetation management with herbicides. A PNASH Pilot Project and survey of 150 migrant Latino forest service workers in southern Oregon found that about half had used pesticides and 14% reported they "became sick or had a reaction to pesticides in the last 5 years." (Wilmsen et al. 2015). This small project conducted outreach to forestry services firms, state land management agencies, WPS regulators, and pesticide educators to identity: 1) the need for bilingual resources and education for this workforce, and 2) which specific products are most commonly used in Washington and Oregon. This was completed and by October 2023 translated labels were completed and available for integration into the PestiSeguro's App. The needs assessment and initial resources from this project showed a high demand for labels translation and training, resulting in a 1-year OROSHA funded project to provide further resources, and bilingual training (see Bilingual Pesticide Labels project described below).

New PNASH-Related Awards

PNASH researchers received outside funding for additional projects.

Michael Yost, PhD, MS, Professor, Department of Environmental and Occupational Health Sciences, University of Washington. **Bilingual Pesticide Labels for Reforestation Worker Safety (Oregon OSHA, 2024, $40,000 TC).** PNASH Center team members, Marcy Harrington, Pablo Palmández, and Mike Yost received a grant from Oregon OSHA. Forestry Services workers are traditionally underserved, yet Oregon OSHA and PNASH have stood out in their efforts to serve this hidden workforce. This one-year service project builds on past work and provides a new tool that meets Oregon pesticide safety trainer and supervisor needs. It will also serve as a model for bilingual label accessibility, a new requirement from the

Pesticide Registration Improvement Act (PRIA) of 2022, and identify future safety needs for the forestry services industry. The project provides new online and hardcopy resources in English & Spanish: labels handbook, translation glossary of terms, and trainers guide. These resources and bilingual trainings on these new resources are coming in Fall 2024. See https://deohs.washington.edu/pnash/bilingual-labels-forestry.

June T. Spector, MD, MPH, Research Associate Professor, Department of Environmental and Occupational Health Sciences, University of Washington. **A Mixed-Methods Evaluation of Heat-Related Illness Prevention Policy Implementation to Inform Practical Solutions for Farmworkers (NIOSH, 2024-2027, $750,261).** This intervention evaluation project will synthesize information from stakeholders, workers, supervisors, and administrative data to evaluate a new State occupational heat policy for agriculture using the consolidated framework for implementation research. The results and products from this project are expected to lead to more effective heat prevention policies and, ultimately, reduce the risk of adverse health effects of heat stress for agricultural workers.

Cores

Outreach during Fishermen's Appreciation Day in Newport, Oregon.

Evaluation and Planning Core

YEAR 2 of 5 (2022-2027)
Michael Yost, PhD, MS
Professor, Department of Environmental and Occupational Health Sciences, University of Washington

https://deohs.washington.edu/pnash/blog/new-federal-grant-improve-northwest-agricultural-safety-and-health

Background

The Planning and Evaluation (E&P) Core provides the infrastructure and support for the entire Center, conducts strategic planning, and assists in implementing and evaluating individual project and program objectives. We are in the second year of our 5-year cycle.
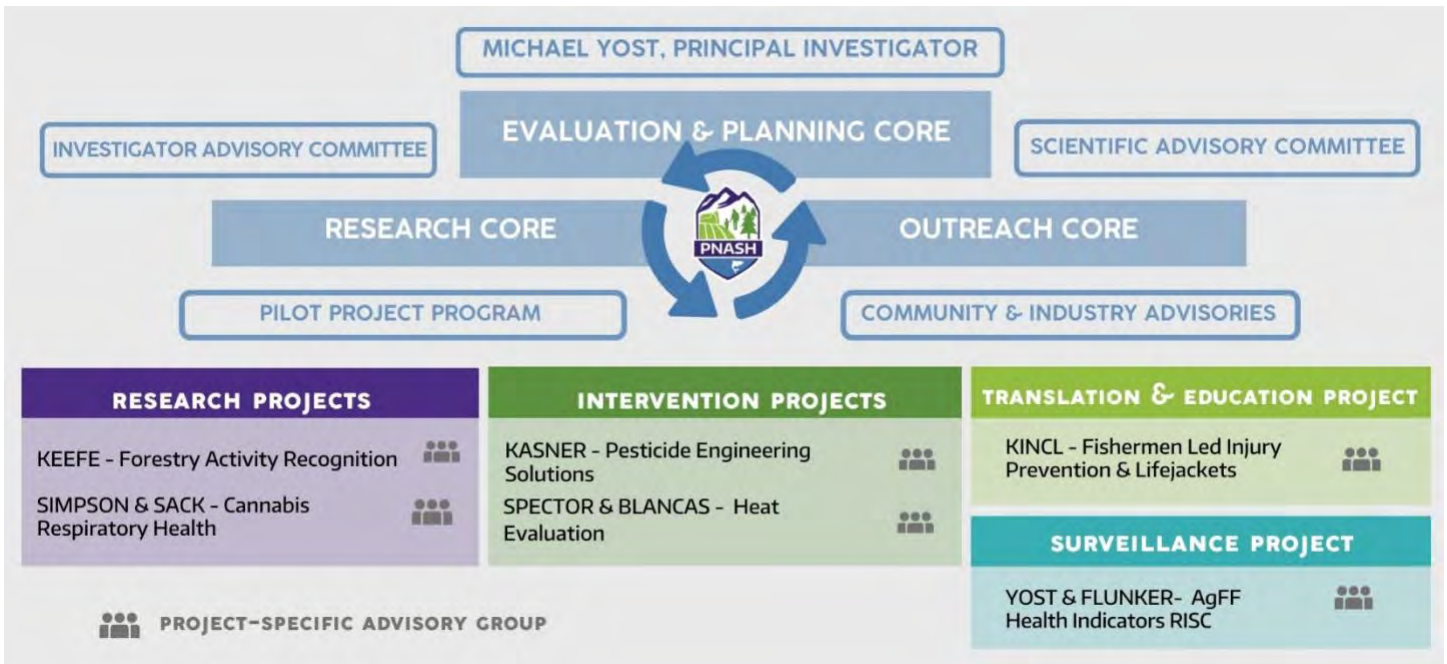

Figure 9: The E&P Core is responsible for PNASH Center leadership and management, strategic planning, evaluation, and administration of our small grants programs, like the Emerging Issues Fund and the Pilot Project Program.

Year 2 Progress

Leadership & Management

In December 2023, Judy Lysiak began her role as PNASH Program Coordinator, where she is part of the communications team, staffs the Pilot Project Program, and supports investigators and staff with various tasks. From July 2021 to December 2023, she began her employment at PNASH as an assistant program coordinator and a work study student. Judy graduated from the University of Washington Cum Laude, earning her Bachelor of Arts in Integrated Social Sciences in, Summer of 2022. Prior to that, she was the business administrator at a law office.

The E&P Core conducted a survey of our monthly Exchange meetings, an opportunity for faculty, staff, and students affiliated with PNASH to share updates and discuss emerging themes. The feedback from the survey has been incorporated into planning for the upcoming year's Exchange meetings so we can better serve our community and foster connections among attendees.

Strategic Planning
We recognize that collaboration in academia happens by creating space and platforms for our faculty and students to come together and foster new ideas. This past year, the PNASH Center participated in conferences that served as space for collaboration, presentation, and discussion.

In April 2024, the Scientific Advisory Committee met in person in Astoria, Oregon. The meeting focused on fishing and brought together researchers from Washington, Oregon, Alaska, NIOSH, and the Northeast Center for Occupational Health and Safety. Attendees also included representatives from community-based organizations and the US Coast Guard. During the meeting, the group discussed current projects and future directions for work in fishermen's health and safety.

For the first time, Safety, Health, and Workforce Development was highlighted as a distinct track at the Council of Forest Engineering's (COFE) Annual Meeting. Hosted by the University of Idaho's College of Natural Resources and the University of Idaho Experimental Forest May 21-24, 2024 in Moscow, Idaho, and co-sponsored by PNASH, the meeting included attendees from all over North America and Europe. This year's conference theme was The Future of Forest Operations. COFE blended traditional presentations with daily field excursions and demonstrations of new technologies. Dr. Robert Keefe, a NIOSH grant project Principal Investigator and the conference chair, spoke to the conference theme and goal to show the business drivers underlying current trends in our field and to think about how technological innovation can assist at the intersection of improved productivity, worker health and safety, and workforce development needs facing our industry.

PNASH was also involved in the International Society for Agricultural Safety and Health Annual Meeting on June 17-20, 2024, in Portland, Oregon. PNASH Manager Paulina Osinska served on the Planning Committee, and Michael Yost, PNASH Director, gave the keynote address, *Seeds of Change: The Promise and Challenges of Precision Agriculture*. New for this ISASH meeting was a two-day breakout session focused on forestry research. PNASH forestry presentations included Marcy Harrington on *Hidden Hands: Latino Immigrant Forestry Services Workers in the Pacific Northwest*, and John Garland on *Oregon Logging Accidents: Ten Years of Data, Fifty Years of Perspective*. Additional PNASH presentations included Leslie Hammer, Faviola Robles-Saenz, and Krista Brockwood on *Workplace Psychosocial Hazards and Mental Health of Latino Farmworkers,* Dennise Drury on *A Community-Engaged Approach to Prevent Sexual Harassment in Agriculture,* and Laurel Kincl on *Fishermen Led Injury Prevention Program (FLIPP): An Approach for Commercial Fishing Safety Research in the Pacific Northwest*. PNASH regional collaborators joined in ISASH for the first time.

Lastly, PNASH has collaborated with NIOSH to bring a forestry focus to NIOSH's blog, sharing results from several NIOSH-funded forestry safety projects. The first was shared in September 2024. PNASH-featured work will be included in the blogs:
- *Safety, Health, and Workforce Development at Council of Forest Engineering's (COFE) Annual Meeting* by Marcy Harrington and Rob Keefe (https://blogs.cdc.gov/niosh-science-blog/2024/09/03/forestry-cofe/)
- *Job Satisfaction Foundation to OSH in Forestry* by Marissa Baker (https://blogs.cdc.gov/niosh-science-blog/2024/09/18/forestry-logging-survey/)
- *Perspectives on Forest Operations Safety* by John Garland and Ray Berthiaume (https://blogs.cdc.gov/niosh-science-blog/2024/10/29/forest-operations/)
- *Qualitative Studies Showing Logging Worker Safety and Health Needs* by Marcy Harrington and Tara Haskins (forthcoming)
- *OSH Gaps for H2B Forestry Workers* by Carl Wilmsen and Marcy Harrington (forthcoming)

Emerging Issues Fund
Updates on the Emerging Issues Fund can be found in the PNASH Small Grants Programs section on page 17.

Evaluation Program
PNASH's evaluation program moves beyond traditional program monitoring, using a developmental approach to assist project teams in improving efficacy and outcomes. In meetings with project teams, we assessed impact opportunities, areas where there is an emerging need and a target audience for a health or safety intervention. In year 2, we have:

- Launched our Developmental Evaluation sessions with project leadership. These sessions aim to reassess project outcome goals and other re-directions needed. Our sessions use a strength-based approach and yet address current challenges. Sessions have been completed for FLIPP Lifejackets (Kincl) and RISC (Yost).
- Marcy Harrington has collaborated with the Northeast Center for Occupational Health and Safety in our multi-center evaluation of the FLIPP lifejackets (Kincl) and Lifejackets for Lobstermen (Sorensen) projects. Using contribution analysis, we have revised our logic model framework to match NIOSH's evaluation team's draft guidelines for centers. We are currently engaging across the teams as each center to refine the logic model and identify our shared (and unique) outcomes goals.

We developed new methods for capturing updates, activities, products, and publications from our investigators and staff. We developed a survey to collect outcomes and products from our small grants programs. Recipients of these grants will be asked to provide updates annually after their award so we can see what long-term impacts the funding has had. We also developed a comprehensive database for core project reporting, which includes updates on project aims and collects information on outreach efforts like key activities that have taken place and final products and publications that have been disseminated.

Next Steps

Collaboration with our advisories and stakeholders will continue throughout the cycle. The E&P Core will continue development evaluation planning for our Forestry (Keefe), Cannabis (Simpson), and Pesticide (Kasner) projects. We will also be leading regional planning efforts for the annual Association of University Programs for Occupational Health and Safety (AUPOHS) meeting in Washington, D.C. in February 2025. The Scientific Advisory Committee will be convening in person in Moscow, Idaho, in May 2025. This year's meeting will focus on forestry and dairy themes. Finally, the PNASH Center has volunteered to lead the Agriculture, Fishing, and Forestry (AgFF) campaigns for the NIOSH Ag Centers. The E&P Core will work with the Outreach Core to coordinate these campaigns, which include National Farm Safety and Health Week.

Partners and Collaborators

- PNASH Investigator Advisory Committee (IAC): https://deohs.washington.edu/pnash/directory/project-officers
- PNASH Scientific Advisory Committee (SAC): https://deohs.washington.edu/pnash/directory/advisors
- NIOSH Agriculture, Forestry, and Fishing (AgFF) Program: https://www.cdc.gov/niosh/programs/agff/default.html
- NIOSH Ag Centers: https://www.cdc.gov/niosh/oep/agctrhom.html
- NIOSH Ag Center Evaluators, Coordinator and Outreach (ECO) Group
- NIOSH's NORA: https://www.cdc.gov/nora/default.html
- Association of University Programs for Occupational Health and Safety (AUPOHS)

✗ Resources

- FY 2023 PNASH Year-end Report (washington.edu)

Event Highlights

PNASH Scientific Advisory Committee Meeting, April 22-23, 2024 in Astoria, OR

Marine and Environmental Research and Training Station

Pacific Seafood Processing Facility

International Society for Agricultural Safety and Health Annual Meeting, June 17-20, 2024, Portland, Oregon

ISASH Annual Meeting Group Photo

Dennise Drury presenting at ISASH

John Garland presenting at ISASH

Marcy Harrington presenting at ISASH

Laurel Kincl presenting at ISASH

Mike Yost presenting at ISASH

Outreach and Education Core

YEAR 2 of 5 (2022-2027)
Edward Kasner, PhD, MPH
Assistant Teaching Professor, Department of Environmental and Occupational Health
Sciences, University of Washington

 https://deohs.washington.edu/pnash/resources

Background

The Outreach Core is the Center's foundation for building relationships and sharing information with agricultural communities. Outreach Core responds to regional needs, develop safety solutions, and share PNASH research findings. In Year 2, the Outreach focused on our aims:

1. Identify and respond to needs in farming, fishing, and forestry communities.
2. Translate research findings into safety solutions and practical guidance.
   - Create accessible, effective, and culturally tailored communications to share research findings and resources.
3. Participate in regional and national efforts to improve the health, safety, and well-being of agricultural workers and their families.

Year 2 Progress

Outreach Core partners with regional stakeholders to develop, evaluate, and disseminate best practices, new technology, and health and safety resources built from our research.

Identifying Regional Needs

Outreach Core partners with agricultural communities and research teams to identify and address key health and safety needs. The Outreach Core leads the engagement in regional advisories with agricultural workers and employers, community organizations, universities, and agencies.

Forestry Safety Working Group

The Forestry Safety Working Group (FSWG) is a standing advisory group that meets quarterly to identify opportunities to collaborate and develop safety resources Northwest logging and forestry services. Marcy Harrington coordinates the group, and participants include UW School of Forestry, Associated Contract Loggers of Idaho, Associated Oregon Loggers, OSU School of Forestry, Washington State Dept. of Labor and Industries, Washington State Dept. of Natural Resources, Gahlsdorf Logging, and University of Idaho College of Forest and Rangeland Sciences. A needs assessment conducted with the FSWG during their in-person meeting at the Council of Forest Engineering (COFE) Conference found these were the top areas of interest:
- Adding information on worker's health and body movements into forestry and logging training.
- Tools to support workers mental health, trauma, and stress management after injuries.
- Supporting workforce development and recruitment programs.
- Working together to identify gaps in safety resources and develop them together.
- Preventing safety incidents that could have resulted in serious injury or fatality.

FLIPP Fishing Advisory Board

The FLIPP PFD Advisory Board was formed to provide guidance and feedback on the FLIPP Fishing project to promote the use of personal flotation devices (PFD) among commercial fishermen (P.I. Kincl, NIOSH 2022-2027). The meeting was organized by Laurel Kincl and Amelia Vaughn. Participants include Alaska Marine Safety Education Association, National Institute for Occupational Safety and Health, Northeast Center for Occupational Health and Safety, WA and OR Sea Grant, and Columbia River Inter-Tribal Fish Commission. During the meeting Sarah Fish provided a background, story, design elements, voice, tone, and methods being considered for the marketing campaign to be developed for the program to get feedback from the board. The board also shared feedback to inform FLIPP Fishing outreach activities:

- Giving PFDs to fishermen at the lowest possible price or free
- Working with manufactures to track PFD sales to see if outreach efforts boosted sales
- Recognizing the barrier for Tribes that are limited to only wearing US Coast Guard approved PFDs
- Promoting PFD use during other fishing safety trainings or events at ports in WA and OR
- Promoting PFD use among children and raising need for PFDs that fit women properly

Pesticide Application Safety Committee (PASCO)

This group is an inter-agency collaboration between the WA Depart. of Health, WA Depart. of Labor and Industries, WA Depart. of Agriculture, and other safety professionals to develop recommendations to reduce pesticide exposure. Edward Kasner serves on the Committee to share technical expertise. This year the committee conducted a review to identify gaps in training and compliance to support agricultural employers and workers. Findings include:

- Pesticide Exposure Prevention: Increase awareness of safe handling practices, PPE us, decontamination practices after exposure, and importance of following restricted-entry interval (REI) guidelines.
- Effective Communication: Provide guidance to enhance communication between farms during active spraying times and improve coordination with neighboring properties to prevent drift exposure.
- Record-Keeping & Compliance: Develop tools to support recording keeping for safety and application details.
- Health & PPE Safety: Increase awareness of pesticide exposure symptoms, reporting incidents promptly, and ensuring proper PPE maintenance and storage.

Oregon Ergonomics Needs Assessment for Farmworkers

In collaboration with the Northwest Center for Occupational Health and Safety, Dennise Drury and Maria Blancas conducted a needs assessment to identify ergonomic hazards faced by farmworkers. Columbia Valley Community Health (CVCH) requested a better understanding of the body strains and sprains affecting the farmworker community. To address this, the How Do You Move at Work poster was created to engage workers in discussions about common movements in warehouses and fields, alongside a body map for identifying pain points. Ten farmworkers, mostly from onion cultivation and packing, participated. Many reported performing repetitive movements like bending and twisting, leading to shoulder and back pain. Participants were provided with educational materials and referred to the health clinic for further support.

Developing Resources with Ag Communities

The Outreach Core in collaboration with agricultural stakeholders co-develop, disseminate, and evaluate resources, tools, and solutions for the agricultural community. Below are the resources developed this year.

Figure 10: The PNASH Co-development process is iterative: Identify needs, Draft message, Gather feedback from community, Develop the resource, Technical review, Dissemination with partners.

- **Fishermen Lead Injury Prevention Program**
  Created resources to share information about lifejackets and 7 posters to promote lifejacket use.
- **Climate Change and Community Impact HUB**
  Co-developed Best Practices Toolkit with step-by-step guidance on climate messaging and helped establish a Hootboard with wildfire smoke information, events, and resources in one place.
- **Bilingual Pesticide Labels for Reforestation Worker Safety**
  Developed a Handbook and Glossary of Terms in English & Spanish with pesticide label safety and environmental protection information, for forestry vegetation management of Oregon and Washington State products.
  🌐 https://deohs.washington.edu/pnash/bilingual-labels-forestry

Communicating with Agricultural Communities

PNASH made important updates to our website. We enhanced the Forestry Services and Logging Webpages by adding new resources from PNASH and external organizations. A new webpage was developed for the Bilingual Pesticide Labels for Reforestation Worker Safety project that shares the two new resources developed (see above) and upcoming forestry events. Updates were also made to the Child and Youth Farm Safety page. PNASH also published five blogs to highlight events and research activities: Following the research from data to impact with Nede Ovbiebo; Celebrating a Remarkable Man and Partner: Ricardo Ramon Garcia; Ag Injury News update: Tractor roll-overs and the need for ROPS; New Horizons for Forestry Services; Collaboration for innovation: Safety solutions for WA state dairy farms Communications.

🌐 https://deohs.washington.edu/pnash/blog

Engaging with Regional and National Stakeholders

The Outreach Core enhances PNASH's presence by participating in events, meetings, and conferences throughout the Pacific Northwest and nationally. This year, we expanded our outreach in Oregon and Idaho and joined community efforts to discuss the needs of rural communities experiencing wildfire smoke.

Partnerships and Advisories

Community and Climate Impact (CCI)

The CCI HUB is coordinated by Savannah D'Evelyn and Maria Blancas and seeks to bring together community leaders and stakeholders in north-central Washington to address wildfire issues in rural WA communities. It includes 25 participants from community organizations, local health districts and state agencies from Chelan, Okanogan, Grant and Douglas counties.

Ag Safety Day Planning Committee

This group organizes the largest health and safety training events in Washington by bringing together industry, agency, and academic partners to develop sessions responsive to current health and safety needs in farming. Committee members include WA Dept. of Labor and Industries, WA Dept. of Agriculture, WA Farm Bureau, WA Potato Commission, Yakima Valley OIC, and local growers.

Partnership for Agricultural Safety and Health

The Partnership for Ag Safety and Health was established to identify educational needs of agricultural workers and work together to develop resources. The meeting is facilitated by Dennise Drury and meets bi-weekly. Participants include El Proyecto Bienestar, Radio KDNA, WA Depart. Labor and Industries, and WA Department of Health.

El Proyecto Bienestar – Farmworker Advisory Group

This long-standing community-based partnership focuses on agricultural workers environmental and occupational health issues. Elizabeth Torres coordinates the advisory which includes: the Northwest Communities Education Center/Radio KDNA, UW Center for Child Environmental Health Risks Research, Heritage University, Yakima Valley Farm Workers Clinic, and members of the Yakima Valley agricultural community.

Agricultural Leadership Program

The PNASH Center was invited to be a partner in the Agricultural Leadership Program and outreach specialist Dennise Drury joined the training team. PNASH will be delivering training for the program and continuing to support evaluation of the program that builds on the work of Miguel Flores.

Western Treasure Valley Farmworker Resource Committee

This group is a collaboration between Idaho and Oregon bringing together community organizations that serve farmworkers. The Committee shares events and community programs for farmworkers as well as needs and challenges they experience. PNASH provided a presentation to share safety resources and attended the Community Forum: Know Your Rights Event to share heat illness, sexual harassment, and wildfire smoke resources.

Next Steps

The Outreach Core will continue to explore opportunities to expand our presence in Idaho and Oregon, building on those partnerships, attending events, and supporting their safety and health efforts. We will also continue to enhance our partnership with the WA Department of Health and WA State Dept. of Agriculture, and WA Dept. of Health. A theme that has come up is pesticide safety and working together to develop and disseminate best practices for improving safety training, as well as enhancing regional partnerships so states can share and learn from each other. We plan to identify more opportunities to enhance teen farm safety in the PNW. Beginning with WA, we will seek opportunities to collaborate with our partners' efforts, such as the WA Dept. of Labor and industries WISHA 10 Training that is preparing high school youth. PNASH will continue participating in the CCI HUB meetings to find ways to support wildfire smoke efforts. We will develop wildfire smoke resources for farmworkers, including animated videos, printed resources, and enhancements to our website. The Outreach Core will develop safety resources for forestry restoration workers and deliver safety training in WA and OR in collaboration with the Forestry Safety Working Group (FSWG) and industry partners. The Outreach Core will also create a safety resource for the cannabis industry to bring awareness to respiratory hazards related to cannabis processing, grinding, and the use of knockboxes. We will develop best practices and controls, along with recommendations for workers and employers, that can be used in conjunction with the Cannabis Safety module Diana Ceballos will be developing for the WA. Dept. Labor and Industries WISHA 10 Program. The FLIPP team will continue to attend events in OR and WA; build relationships with ports, WA and OR Sea Grant, and other fishing stakeholders; and survey workers about their PFD preferences and promote the use of PFDs. Finally, PNASH will be leading the US Ag Center Campaigns and bringing Spanish-language messages and resources to the various campaigns in collaboration with community partners.

✖ Resources

- Bilingual Pesticide Labels for Reforestation Workers
  https://deohs.washington.edu/pnash/bilingual-labels-forestry
- Fishing Safety https://deohs.washington.edu/pnash/fishing-safety
- Cannabis Worker Health and Safety https://deohs.washington.edu/pnash/cannabis-worker-health-and-safety
- Wildfire Smoke Safety https://deohs.washington.edu/pnash/wildfiresmoke
  - PNASH searchable Resource database https://deohs.washington.edu/pnash/resources

Regional Event Participation Highlights

Newport Fishermen's Appreciation
11/17/2023

Pacific Marine Expo
11/20-22/2023

WA Dairy Federation
12/4-6/2023

WA Ag Safety Days
1/31 and 2/28/2024

Western Forum for Migrant Health
2/22-24/2024

WA Sea Grant AMSEA Training
3/22-23/2024

WA Maritime Safety Day
3/26/2024

¡Basta! Farmworker Training
4/18/2024

Idaho Family Health Fair
6/1/2024

Council of Forestry Engineering
5/22-24/2024

ISASH Conference
6/17-20/2024

Suquamish Tribal EH Conference
7/17/2024

Supporting Students

The PNASH Center is fortunate to have talented and passionate students involved in our research every year. We want to express our gratitude to these students and recognize their academic achievements, inspiring stories, and professional accomplishments. PNASH coordinates with multiple training and pathway programs for student support and research funding to work with PNASH projects. Our student support includes meaningful student internships.

2024 Graduates

Nede Ovbiebo, BS and BA, Public Health - Global Health and Biochemistry, University of Washington
Ms. Ovbiebo's research, focused on pesticide spray tech, involved survey and analysis of attitudes surrounding emerging tech. This research will aid in the future adoption of new tech making agricultural work safer for tree-fruit farm workers, plus contributing to long term sustainability. She is the recipient of a Population Health Recognition Award as part of her participation in the 2024 Undergraduate Research Symposium.

Makenzie Melby, MS, Animal Science, Washington State University
Ms. Melby's research looks at cow and human behavior to see whether a cow being unhealthy makes them more or less safe to handle; in other words, if interactions with unhealthy cows are more likely to lead to injury to the handler. The goal is to use results to help inform workers about animal handling and to reduce injury rates on dairy farms. Her work is affiliated with the Partnership for Dairy Safety and Health.

Solaiman (Abeer) Doza, PhD, Environmental and Occupational Health, Oregon State University
Abeer's research draws from the RISC injury datasets to estimate injury risk and risk factors for commercial fishermen. Through this effort, he is building skills in data analysis and hazard assessment to help inform prevention efforts. His most recent research related to commercial fishing, is published in the Journal of Agromedicine.

Continuing Students

Catherine Jennifer, MS Student, Environmental Health Sciences, University of Washington
Ms. Jennifer is looking into the differences between pesticide use in California and in Washington state, comparing rural vs. urban usage. They will map out each county's pesticide use estimates data using 2 different methods, via GIS. The hope is that the comparison will help inform and educate the larger population about pesticide exposure in their area.

Grace Price, MS Student, Environmental and Occupational Hygiene, University of Washington
Ms. Price works with the Fishermen Led Injury Prevention Program. She is focused on safety outreach and education for commercial fishing populations, encouraging use of personal floatation devices (PFD). Ms. Price believes a community-driven culture of safety helps normalize PFD use onboard. The hope is to increase awareness and expand accessibility so fishers can have a PFD that they will choose to wear willingly and maintain over time.

Allen Chan, PhD Student, Public Health, Oregon State University
Mr. Chan's research focuses on improving health and safety in the commercial fishing industry by understanding the well-being needs and concerns of commercial fishermen and identifying solutions that may address them. Most recently, he helped with the banger bar study and contributed an article published in Science Direct, A fishermen-developed intervention reduced musculoskeletal load associated with commercial Dungeness crab harvesting.

Jorge Rivera-Gonzalez, PhD Student, Industrial Hygiene and One Health, University of Washington
Mr. Rivera-Gonzalez's current work is focused on assessing the gut and nasal microbial communities of the Healthy Dairy Worker cohort, composed of individuals in the Yakima Valley. Although the work is ongoing, he will soon explore occupational exposures within the dairy environment by comparing dairy workers to community members. He is most inspired by the urgency of providing results to the community members who participated in the studies.

Allison Clonch, PhD Candidate, Environmental and Occupational Hygiene, University of Washington
Ms. Clonch's research centers on the health and safety of vulnerable and underrepresented worker populations. One key area of her research is to assess the exposure of temporary foreign agricultural workers to heat and wildfire smoke. Another area of her research is to evaluate the relationship between gender-based violence and harassment on mental health outcomes among U.S. mariners.

PNASH Students

Nede Ovbiebo
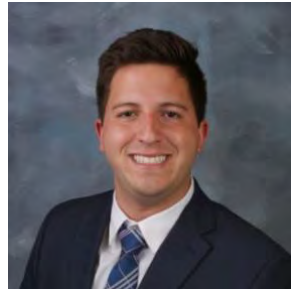

Makenzie Melby

Solaiman (Abeer) Doza

Catherine Jennifer

Grace Price

Allen Chan

Jorge Rivera-Gonzalez

Allison Clonch

PNASH in the News

Bird flu cases in people tick up: Dozens reported across 6 states.
> October 22, 2024 | NBCNews.com. | Featured: Peter Rabinowitz, MD, MPH

Farm safety advocates talk physical, mental health.
> September 20, 2024 | Capital Press | Featured: Edward Kasner, PhD, MPH

Job Satisfaction in the Logging Industry
> September 18, 2024 | CDC – NIOSH Science Blog | Featured: Marissa Baker, PhD, MS, Lily Monsey, Jennifer Lincoln, PhD CSP, Kitty Hendricks, MA

Protecting crop workers under the sun and smoke.
> September 12, 2024 | Washington Smoke Blog | Featured: Coralynn Sack, MD, MPH and John Flunker, PhD, MPH

COFE: The Future of Forest Operations – What does safety have to do with forest engineering? Everything.
> September 3, 2024 | CDC – NIOSH Science Blog | Featured: Marcy Harrington, MPA, Robert Keefe, PhD, Jennifer Lincoln, PhD CSP, Kitty Hendricks, MA

UW rises to sixth in global rankings for environmental and occupational health safety.
> July 1, 2024 | The DEOHS blog | Featured: Michael Yost, PhD, MS

Fruit industry groups focused on preventing sexual harassment.
> May 8, 2024 | Good Fruit Grower | Featured: Jody Early, PhD, MS, MCHESÒ, CHC

New tools track worker-safe weather data.
> May 6, 2024 | Good Fruit Grower | Featured: Edward Kasner, PhD, MPH

What to know about the risks of the bird flu outbreak.
> April 4, 2024 | NPR | Featured: Peter Rabinowitz, MD, MPH

Protecting workers from extreme heat through an energy-efficient workplace cooling transformation.
> April 3, 2024 | Federation of American Scientists | Featured: June T. Spector, MD, MPH

How workplaces exposures influence dairy workers' health.
> March 24, 2024 | Health and Safety Matters | Jorge Rivera-Gonzalez, PhD Candidate

Risk of wildfire smoke in long-term care facilities is worse than you'd think.
> January 22, 2024 | CBS News | Featured: Savannah D'Evelyn, PhD

Prescribed burning reduces wildfire smoke impacts.
> January 17, 2024 | Health and Safety Matters | Featured: June Spector, MD, MPH

Awake at the Wheel: How Fatigue Impacts Log Truck Driver Safety.
> December 20, 2023 | TimberWest | Featured: Allison Clonch, PhD Student, MPH, MCP

West Plains Water Coalition holding educational meetings on PFAS in water sources.
> December 6, 2023 | KREM | Featured: Catherine Karr, MD, PhD

Navigating the waves of stress: Empowering mental well-being in commercial fishermen.
> November 10, 2023 | National Fisherman | Featured: Marissa Baker, PhD, MS

Cultivators address new health and safety issues for plants and workers.
October 17, 2023 | Cannabis Science and Technology | Featured: Coralynn Sack, MD, MPH

Wildfires can impact your mental health.
September 6, 2023 | Northwest Public Broadcasting | Featured: Savannah D'Evelyn, PhD

What WA's New Wildfire Smoke Rules Might Mean for Outdoor Workers.
August 2, 2023 | Crosscut | Featured: Christopher Zuidema, PhD, CIH

Washington Legal Pot Farms Get Back to Work after Pesticide Concerns Halted Operations.
July 15, 2023 | APNews | Featured: Christopher Simpson, PhD, MSc

The heat is on: How to protect health in extreme heat.
July 13, 2023 | HSM Blog | PNASH Featured: Elena Austin, June T. Spector, Michael G. Yost

Oregon State University program aims to reduce injury and boost safety in commercial fisheries.
May 17, 2023 | Oregon Public Broadcast (OPB) | Featured: Laurel Kincl, PhD, CSP

Ready for Wildfire Season? Here's How Bad This Year's Season Could Be across the West.
May 14, 2023 | KomoNews | Featured: Savannah D'Evelyn, PhD

Alaska Native Salmon Set Gillnetters in Norton Sound Brave Fierce Conditions.
May 2023, Vol. 79, No. 05, pgs. 34-35 | Fishermen's News | Featured: Sarah Fish

Fishermen-developed 'banger bar' reduces injury risk, OSU study finds.
April 25, 2023 | KTVL10 CBS | Featured: Jay Kim, PhD, MS, and Laurel Kincl, PhD, CSP

Study: Farmworking Parents Need More Resources to Cope with Wildfire Seasons.
March 31, 2023 | Northwest Public Broadcasting | Featured: Savannah D'Evelyn, PhD

Farmworkers Don't Always Notice Their Own Mental Health Struggles.
February 22, 2023 | Northwest Public Broadcasting, Edward R. Murrow College of Communication at Washington State University | Featured: Elena Austin, DSc, MS

Commercially Fishing for Crab: Bang or Not? And How Best to Bang?
February 2023, Vol. 79, No. 02, pgs. 22-23 | Fishermen's News | Featured: Jay Kim, PhD, MS, Laurel Kincl, PhD, CSP, Allen Chan, OSU PhD Student, and Amelia Vaughan, MLIS

Fishing as a Contact Sport.
February 2023 | Fishermen's News | Featured: AMSEA and RISC

Slips, Trips & Falls: Don't Fall for It.
December 2022 | Fishermen's News | Featured: Amelia Vaughan, MLIS

Black Saliva, Sore Throat, Shortness of Breath: How Dangerous Is Wildfire Season for US Farmworkers?
October 10, 2022 | USA Today | Featured: Elena Austin, DSc, MS

PNASH-Related Research Publications (2022-2023)

CANNABIS

Sack C, Simpson C, Pacheco K. *The Emerging Spectrum of Respiratory Diseases in the U.S. Cannabis Industry.* Semin Respir Crit Care Med. 2023 Jun;44(3):405-414. DOI: 10.1055/s-0043-1766116. Epub 2023 Apr 4. PMID: 37015286; PMCID: PMC10449032.

DAIRY

Carmona J, deMarcken M, Trinh P, Frisbie L, Ramirez V, Palmandez P, Vedal S, Sack C, and Rabinowitz P. *A Cross Sectional Study of Respiratory and Allergy Status in Dairy Workers. Journal* of Agromedicine, 2023 Jul;28(3):545-552. doi: 10.1080/1059924X.2023.2171522. Epub 2023 Feb 6. PMID: 36704933; PMCID: PMC10421462.

FISHING

Doza S, Bovbjerg V, Case S, Vaughan A, Kincl L. *Utilizing Haddon matrix to assess nonfatal commercial fishing injury factors in Oregon and Washington.* Inj Epidemiol. 2023 Mar 24;10(1):18. DOI: 10.1186/s40621-023-00428-7. PMID: 36964638; PMCID: PMC10037792.

Kincl L, Doza S, Nahorniak J, Case S, Vaughan A, Bovbjerg V. *Commercial Fishing Fatalities and Injuries Described by Linked Vessel Incidents.* J Agromedicine. 2023 Oct;28(4):881-889. DOI: 10.1080/1059924X.2023.2229827. Epub 2023 Jun 30. PMID: 37387508; PMCID: PMC10543625.

FORESTRY

Clonch A, Harrington M, Spector J, Monsey LM, Baker MG. *Exploring determinants of log truck accidents resulting in injury or fatality in the Northwest United States between 2015-2019 using Motor Carrier Management Information System data.* International Journal of Forest Engineering, Published online: 15 Mar 2023. DOI: 10.1080/14942119.2023.2186026. Epub 2023 Mar 15. PMID: 38213500; PMCID: PMC10783025.

Kim, J.H. and Chung, W. (2023) *Forestry professionals' perspectives on exoskeletons (wearable assistive technology) to improve worker safety and health.* International Journal of Forest Engineering, 35(1), 11–20. DOI: 10.1080/14942119.2023.2256104.

Zimbelman EG, Keefe RF. *Lost in the woods: Forest vegetation, and not topography, most affects the connectivity of mesh radio networks for public safety.* PLoS One. 2022 Dec 7;17(12):e0278645. doi: 10.1371/journal.pone.0278645. PMID: 36477301; PMCID: PMC9728932.

HEAT-RELATED ILLNESS

Flunker, J. C., Spector, J. T., Blancas, M., Briggs, N. L., Flores, M., Whitaker, C. R., Schoonover, T., and Cardoso, T. (2024). *Farmworker-Relevant Heat Exposure in Different Crop and Shade Conditions.* Journal of Agromedicine. 2024 Oct;29(4):547-560. DOI: 10.1080/1059924X.2024.2365647. Epub 2024 Jun 14. PMID: 38874305; PMCID: PMC11410529. (available 2025-10-01)

Spector JT, Sampson L, Flunker JC, Adams D, Bonauto DK. *Occupational heat-related illness in Washington State: A descriptive study of day of illness and prior day ambient temperatures among cases and clusters, 2006-2021.* Am J Ind Med. 2023 Aug;66(8):623-636. DOI: 10.1002/ajim.23506. Epub 2023 Jun 8. PMID: 37291066; PMCID: PMC10330917.

OTHER FARMING

Thamsuwan O, Galvin K, Palmandez P, Johnson PW. *Commonly Used Subjective Effort Scales May Not Predict Directly Measured Physical Workloads and Fatigue in Hispanic Farmworkers.* Int J Environ Res Public Health. 2023 Feb 5;20(4):2809. DOI: 10.3390/ijerph20042809. PMID: 36833506; PMCID: PMC9957310.

PESTICIDE EXPOSURE

Hyland C, Hernandez A, Gaudreau É, Larose J, Bienvenu JF, Meierotto L, Som Castellano RL, Curl CL. *Examination of urinary pesticide concentrations, protective behaviors, and risk perceptions among Latino and Latina farmworkers in Southwestern Idaho.* Int J Hyg Environ Health. 2024 Jan;255:114275. doi: 10.1016/j.ijheh.2023.114275. Epub 2023 Oct 20. PMID: 37866282.

Hyland C, Meierotto L, Som Castellano RL, Curl CL. *Mixed-Methods Assessment of Farmworkers' Perceptions of Workplace Compliance with Worker Protection Standards and Implications for Risk Perceptions and Protective Behaviors.* J Agromedicine. 2024 Jul;29(3):355-371. doi: 10.1080/1059924X.2024.2307483. Epub 2024 Jan 29. PMID: 38284770.

Hyland C, Ruiz I, Meierotto L, Som Castellano R, Curl C. *Forging Community Partnerships to Examine Pesticide Exposure and Risk Perceptions among Latinx Farmworkers.* Poster Preparation Abstract, PISEE Conference, 2022 Sep 21; 2022(1). Article accepted for publication.

SMOKE & AIR QUALITY

Parker, M.M. *Wildfire Smoke Exposure in the Agricultural Workplace: Exploring Worker and Employer Perspectives on Occupational Safety and Health.* 2024 Doctoral Dissertation, College of Nursing, Washington State University, Pullman, Washington. See Abstract. Research Exchange Services.

Schollaert C, Austin E, Seto E, Spector J, Waller S, Kasner E. *Wildfire Smoke Monitoring for Agricultural Safety and Health in Rural Washington.* J Agromedicine. 2023 Jul;28(3):595-608. DOI: 10.1080/1059924X.2023.2213232