ANNUAL REPORT

July 1, 2020–June 30, 2021

Washington Cooperative Fish and Wildlife Research Unit

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Sarah Converse

MESSAGE FROM
The Unit Leader

As I write this, the University of Washington community is preparing to head back to campus after 18 months working from home. Throughout these months, the WACFWRU has continued on a productive path.

My own research lab is busy as ever, with 2 postdocs (Staci Amburgey and Lisanne Petracca), 3 PhD students (Hannah Sipe, Mark Sorel, and Amanda Warlick), and 4 MS students (Abby Bratt, Amelia DuVall, Brielle Thompson, and Liam Pendleton). We continue our collaborations outside the state, but we are increasingly focused in Washington, with ongoing work on gray wolves, Chinook salmon, Streaked Horned Larks, Pigeon Guillemots, and seaducks.

My three priorities as Unit Leader are ensuring our Sustainability, increasing our Connection, and serving our Community. After more than 4 years as Unit Leader, I feel good about the sustainability of our operations. Among other good news, we maintained a slightly higher level of student support this year than last, by facilitating 60 quarters of student funding at University of Washington (UW) and 18 semesters at Washington State University (WSU). For postdoctoral scientists, we facilitated 24 quarters at UW and 4 semesters at WSU.

In terms of the sustainability of our operations, the big news is that we have a new Assistant Unit Leader–Wildlife. Dr. Alex McInturff started his position in June, with an appointment in the School of Environmental and Forest Sciences. Alex was hired for his expertise in the social sciences, and he has projects already underway with Washington Department of Fish and Wildlife. We are thrilled to have him here and, after 7 years, be back to our full staffing level. I want to thank the members of the search committee: Jerry Nelson (co-chair), Sarah Bassing, Megan Feddern, Dave Fulton, Josh Halofsky, John Marzluff, Mark Scheuerell, Lisa Shipley, Chris Smith, Jim Unsworth, Ken Warheit, and Verna Blackhurst.

A key way we increase our connection is through our annual Graduate Student Symposium. After last year's online symposium, we realized the benefit of getting students in front of more agency staff and researchers across the state. We will be holding this year's symposium online (October 27) and we will continue to assess how to make the symposium most successful.

One thing we've done to serve the fish and wildlife community is the UW Fish and Wildlife Ecology Seminar Series. Thanks to Mark Scheuerell's and Laura Prugh's (SEFS) labs, who organized the 2020–2021 seminar. We are currently considering a change to the format of the seminar, to make it better for connecting people across the state. We will be announcing a new format in the coming year.

We had some changes in the Cooperator's Committee this year: we said goodbye to former member Jerry Nelson, who retired from his position as Chief Scientist–Wildlife at Washington Department of Fish and Wildlife. Jerry was a great partner and we were sad to see him go, but we were happy to welcome Donny Martorello as our newest member when he took the Chief Scientist position.

Sadly, we lost two former staff members this year. Glenn VanBlaricom, former Assistant Unit Leader–Wildlife, passed away in late 2020, while Dick Whitney, former Unit Leader, passed away in early 2021. Both Dick and Glenn were extraordinary scientists and mentors who left their mark on the Washington Coop Unit, and we are proud that they are part of our history. Please read *In Memoriam* on page 5.

—Sarah Converse, *Seattle, September 16, 2021*

Photo: UW College of the Environment

MESSAGE FROM
Assistant Unit Leader–Fisheries

This past year has been challenging, but I am fortunate to have wonderful colleagues, students, and cooperators with whom to work.

Mark Scheuerell

My lab group is expanding, and we welcomed Karl Veggerby as an MS student in SAFS this past spring. Karl is studying the foraging ecology of fish and crabs in commercial aquaculture habitats in an effort to understand the industry's impacts on other species within Puget Sound. Nicole Doran is joining us this month from Ohio, and as an MS student in SAFS, she will be collaborating with partners from USFWS, WDFW, King County, and the Snoqualmie Tribe to better understand the factors limiting the recovery of kokanee in Lake Sammamish. Andrea Hennings is coming to us from WDFW where she works in the groundfish assessment team. Andrea will continue her duties there while working towards her MS in SAFS and studying rockfishes in Puget Sound. Dara Farrell, a native of Trinidad and Tobago, will join us as a postdoc in November, and she will be working with our NOAA colleagues to revise some machine learning algorithms for identifying fish from underwater videos.

This past winter, I taught a brand new course called Introduction to Environmental Data Science (FISH 497) to 20 undergraduate and graduate students from three different units at UW. Teaching this course for the first time, and doing so remotely, was indeed challenging, but the students were patient and understanding. In the future, this course is set to become a core requirement for graduate students in SAFS who are pursuing the new Data Science option. I also became an affiliate scientist in UW's eScience Institute this past spring, and I look forward to working with other postdocs and scientists to further advance data science approaches to fisheries management.

I've spent a fair bit of time this past year assisting the USFWS with an updated species status assessment (SSA) for ESA-listed bull trout in OR, WA, ID, and MT. My role has been to estimate trends in abundance among 61 core areas within 8 recovery units. It turns out that about half of the core areas show increasing trends while the other half appear to be declining. This has been a great introduction to the SSA process, and I've enjoyed getting to know the scientists from various state and federal agencies who are assisting with data collection and writing the report.

We took possession of our new research boat this past July. I traveled to the North River Boats factory in Roseburg, OR to pick up the boat and was able to tour their factory, which runs entirely on solar power. While there, I also saw a new vessel that WDFW had ordered and was in mid-production. My students and I have had the boat out on several occasions to get acquainted with its systems and complete the necessary engine break-in protocol. This boat will be a fantastic research platform for us, and we are fortunate to have been granted the funds to pay for it.

I am very excited to have Alex join our Unit, and I look forward to collaborating with him on projects in the future. I have always appreciated the human dimension of natural resource management, and it will be wonderful to work alongside an expert and learn about the different approaches to understanding human perceptions of fish and wildlife issues in Washington.

—Mark Scheuerell, *Seattle, September 18, 2021*

Photo: UW College of the Environment

MESSAGE FROM
Assistant Unit Leader–Wildlife

Greetings! In June of this year, I began serving as the WACFWRU Assistant Unit Leader for Wildlife, and I am thrilled and honored to be a part of this team.

Alex McInturff

I can imagine no better situation in which to pursue transformative research, mentor students, and serve the needs of cooperators. I've already had the pleasure of learning a great deal from Mark and Sarah's experience and wisdom, and I look forward to continuing to learn from and work with the Unit's many collaborators going forward.

As the newest member of the Unit, I am energized by our core commitments to Sustainability, Connection, and Community. These commitments are at the heart of the research program I am pursuing, which links ecological questions about wildlife with their social dimensions and with questions of justice. While each of these commitments is meaningful on its own, I am particularly excited to develop connections between them in research and practice.

Even as the COVID-19 pandemic lingers, there is much to look forward to in the coming year. One of my top priorities is building a research community that produces results, fosters community, and welcomes a diversity of thought. To this end, I have begun recruiting both postdocs and graduate students who will start as soon as January of next year. I am also quickly getting familiar with our region, its governments and agencies, and its residents, both human and beyond. I still have an incredible amount to learn, but that is one of the many joys of being here.

While Washington may not be where I grew up, arriving here has been a kind of homecoming for me. My family lived and worked here for several generations, and I grew up around stories of the region's people, wildlife, and landscapes. In my past work in California, I often found myself looking north with envy, thinking about the rich possibilities of conducting and applying research. I can now express a sense of luck and gratitude for the opportunity to work in this role, and above all, an eagerness to contribute to our shared goals in the years to come.

—Alex McInturff, *Seattle, September 17, 2021*

Photos: top: Courtesy of Alex McInturff, iStock.com/Dennis Stogsdill

Photos, l to r: Courtesy of Abby Bratt, iStock.com/skibreck

Unit Award Recipients

Photo: Courtesy of Amanda Warlick

The Gilbert B. Pauley Award

Awarded annually for best student presentation at the Annual Student Symposium

2020 Winner—Amanda Warlick

School of Aquatic and Fishery Sciences, University of Washington; advised by Dr. Sarah Converse

For her presentation, *Examining the impacts of environmental variability on nest survival when nest age, state, and fate are unknown: gaining new insights for a Puget Sound indicator species.*

Photo: Courtesy of Abby Bratt

The John Pierce Outstanding Graduate Student Award

Awarded annually to the graduate student who best embodies the spirit and mission of the WACFWRU

2020 Winner—Abby Bratt

Quantitative Ecology and Resource Management Program, University of Washington; advised by Dr. Sarah Converse

In Memoriam

Photo: Courtesy of the Whitney family

Richard "Dick" Whitney

On 17 March 2021, Richard (Dick) Whitney, SAFS Emeritus Professor and former Unit Leader, passed away at his home. He was 93 years old. Dick was the first Leader of the Washington Unit, appointed when it was formed in 1967. Dick retired from the U.S. Fish and Wildlife Service (former home of the Cooperative Research Units program) in 1983/1984, though he remained on the UW faculty until 1993. Dick was well known for his impact on salmon ecology and management in the Pacific Northwest, and is perhaps best known for his role as advisor to the Honorable Judge George H. Boldt in the Indian Treaty Fishing Rights Decision. The School of Aquatic and Fishery Sciences published an in-depth memoriam at https://fish.uw.edu/2021/08/remembering-richard-dick-ralph-whitney/.

Photo: Courtesy of WACFWRU

Glenn VanBlaricom

Glenn VanBlaricom, former Assistant Unit Leader–Wildlife, passed away on 24 December 2020, at the age of 71. Glenn was the first person to hold his position, which was created when the Washington Unit became a joint Fish and Wildlife Unit. He joined the Unit and the University of Washington faculty in 1993, and retired in 2017. Glenn's research focus was marine mammal ecology and conservation, and he was especially well known for his work on sea otters. He was a prolific mentor, advising 17 PhD students and 26 MS students during his career. The School of Aquatic and Fisheries Science published a memoriam at https://fish.uw.edu/2021/08/remembering-glenn-richard-vanblaricom/.

Below, left: Dick Whitney; right: Glenn VanBlaricom

Courtesy of Whitney family, Josh London

ANNUAL
Student Symposium

The 2020 WACFWRU Annual Student Symposium was held virtually on October 28.
The full lineup of speakers included:

Photo: iStock.com/Vince Barnes

WASHINGTON COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

WACFWRU

Annual Student Symposium

Wednesday, October 28, 2020, 3:00–6:00 pm

depts.washington.edu/wacfwru/category/symposium/

3:00 pm	**Welcome** Sarah Converse & Mark Scheuerell, *Washington Cooperative Fish and Wildlife Research Unit*
3:10 pm	**Modeling fine sediment production and transport on unpaved forest roads** Amanda Manaster, *Dept of Civil & Environmental Engineering, University of Washington (UW)*
3:19 pm	**How long do fuels reduction treatments reduce wildfire risk in dry forests? Long term experimental results from the East Cascades of Washington** Don Radcliffe, *School of Environmental and Forest Sciences (SEFS), UW*
3:28 pm	**Paradise sought: the path to restoring Guam's vertebrates** Hannah Sipe, *SEFS, UW*
3:37 pm	**Using environmental DNA to improve beaver monitoring and assess their impacts on aquatic communities** Alexandra Kahler, *School of the Environment, Washington State University (WSU)*
3:46 pm	**Engineered biochar for phosphate adsorption from aqueous solution** Sohrab Mood, *Dept of Biological Systems Engineering, WSU*
3:55 pm	**Potential outcomes of using herbicides for butterfly conservation** Cassandra Doll, *Dept of Biology, WSU*
4:04 pm	**Pellets or pictures? Assessing the accuracy of non-invasive methods for snowshoe hare density estimation** Paul Jensen, *School of the Environment, WSU*
4:13 pm	**Developing an integrated life cycle model for Wenatchee River spring Chinook salmon** Mark Sorel, *School of Aquatic and Fishery Sciences (SAFS), UW*
4:22 pm	**BREAK**
4:31 pm	**Examining the impacts of environmental variability on nest survival when nest age, state, and fate are unknown: gaining new insights for a Puget Sound indicator species** Amanda Warlick, *SAFS, UW*
4:40 pm	**Quantifying food web interactions and limitations to reservoir fishes in the Upper Skagit River, WA** Rachelle (Shelley) Johnson, *SAFS, UW*
4:49 pm	**Invasive species management: picking the right model for the occasion** Brielle Kwarta, *Quantitative Ecology and Resource Management, UW*
4:58 pm	**Genetic techniques for differentiating between whitetail deer and mule deer at cougar and wolf kill sites** Lauren Satterfield, *SEFS, UW*
5:07 pm	**Seabird population modeling and threats assessment at Channel Islands National Park** Amelia DuVall, *SAFS, UW*
5:16 pm	**Estimating streaked horned lark fecundity in South Puget Sound** Abby Bratt, *Quantitative Ecology and Resource Management, UW*
5:25 pm	**Improving short-term recruitment forecasts for coho salmon using a spatiotemporal integrated population model** Lukas DeFilippo, *SAFS, UW*
5:34 pm	**Climate change and residential outdoor consumptive water use** Rojina Desar, *Dept of Civil & Environmental Engineering, WSU*
5:45 pm	**Awards presentation** Sarah Converse & Mark Scheuerell

Disability Accommodations: Contact the Disability Services Office at 206-543-6450 (voice), 206-543-6452 (TTY), 206-685-7264 (fax) or dso@uw.edu for accommodation requests.

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Photos, l to r: iStock.com/slowmotiongli, Staci Amburgey

Research Projects

During 2020–2021, the WACFWRU Cooperative Agreement facilitated $8,941,492 in project funding at UW, including $2,246,024 in new dollars, and $2,888,134 in project funds at WSU, including $40,728 in new dollars. The WACFWRU Unit staff and cooperating faculty at UW and WSU worked with 5 federal agencies in addition to our 3 state cooperating agencies. All funded projects led by WACFWRU staff are listed by funder, including project title and dates, with student and postdoctoral scientist support listed below the project title. For cooperating faculty, projects are listed by university and funder, including project title, principal investigator, department, and project dates, along with student and postdoctoral scientist support.

Sarah Converse, WACFWRU Unit Leader

Department of the Navy—Joint Region Marianas

- **Evaluating and mitigating the effects of brown treesnakes on Guam's birds**
  Staci Amburgey, *postdoctoral scientist*
  Hannah Sipe, *PhD student*

National Oceanic and Atmospheric Administration

- **Developing an integrated Bayesian population viability analysis model for cetaceans**
  Amanda Warlick, *PhD student*
- **Integrating data sources to characterize demographic responses of Columbia River salmon and steelhead to threats and management actions**
  Mark Sorel, *PhD student*
- **Public benefits of Cook Inlet Beluga Whale recovery actions: the integration of population viability analysis and species valuation models**
  Amanda Warlick, *PhD student*

National Park Service/U.S. Geological Survey

- **Long-term seabird monitoring data analysis to update Channel Islands National Park seabird inventory and monitoring program and inform management and conservation**
  Amelia DuVall, *MS student*

U.S. Fish and Wildlife Service

- **Evaluating sea duck detectability in the Puget Sound winter ambient monitoring program**
- **Monitoring Tufted Puffins in the United States**
  Co-investigator: Beth Gardner, *School of Environmental and Forest Sciences*


Photos l to r: iStock.com/FrankHildebrand, UW Tetiaroa Seabird Team

U.S. Geological Survey

- **Assessing the precision of estimates of population vital rates for polar bears in Alaska**
  Co-investigator: Eric Regehr, *Applied Physics Laboratory*
  Nathan Hostetter, *postdoctoral scientist*
- **Early detection and rapid response: choosing monitoring targets to promote management effectiveness**
  Brielle Thompson, *MS student (co-advised by Julian Olden, School of Aquatic and Fishery Sciences)*
- **Improving our tools for combating invasive species**
  Brielle Thompson, *MS student (co-advised by Julian Olden, School of Aquatic and Fishery Sciences*
- **Restoration tools for Oregon silverspot butterfly**
  Cassandra Doll, *MS student (advised by Cheryl Schultz, School of Biological Sciences, Washington State University)*

Washington Department of Fish and Wildlife

- **Assessing the fish community in the Chehalis River with occupancy models**
  Mark Sorel, *PhD student*
- **Constructing a modeling tool for wolf status review in Washington**
  Co-investigator: Beth Gardner, *School of Environmental and Forest Sciences*
  Lisanne Petracca, *postdoctoral scientist*

Other

- **Integrated abundance and movement models for marine mammals** (*supported by North Pacific Research Board*)
- **Integrated population model for Maine black bears** (*supported by Maine Department of Inland Fisheries and Wildlife*)
  Nathan Hostetter, *postdoctoral scientist and co-investigator*
- **Integrated population modeling for evaluating status and effects of management actions in Streaked Horned Larks** (*supported by Washington Cooperative Fish and Wildlife Research Unit*)
  Abby Bratt, *MS student*
- **Integrated population models that account for the effects of environmental variability on abundance and demographic rates for species with complex life histories** (*supported by National Science Foundation Graduate Research Fellowship*)
  Amanda Warlick, *PhD student*
- **Seabird ecology and conservation at Tetiaroa, French Polynesia (***supported by private donors to University of Washington***)**
  Co-investigators: Beth Gardner, *School of Environmental and Forest Sciences*, and
  Julia Parrish, *School of Aquatic and Fishery Sciences*

Mark Scheuerell, WACFWRU Assistant Unit Leader - Fisheries

National Oceanic and Atmospheric Administration

- **A simulation and case-study comparison of existing and spatio-temporal methods to apportion coastwide catch limits for subregional management**
  Kelly Mistry, *MS student*
- **Advancing sustainable shellfish aquaculture through machine learning and automated data collection on fish communities**
- **Five-year status review of yelloweye and bocaccio rockfish in Puget Sound**
  Markus Min, *MS student*
- **Habitat function of shellfish aquaculture ecosystems: developing new technology to understand species use of nearshore habitats**
  Karl Veggerby, *MS student*
- **Investigating how the dispersal of fry and distribution of redds interact to shape density-dependence and productive capacity in Skagit River**
  Nick Chambers, *MS student*

U.S. Fish and Wildlife Service

- **Evaluating the relative effects of top-down and bottom-up factors on declines in Lake Sammamish kokanee salmon**

Cooperating Faculty, University of Washington

National Oceanic and Atmospheric Administration

- **Rockfish remotely operated vehicle—MESA video review**
  PI: Peter Abe, *Seattle MESA*
  Omar Abdirahman, *undergraduate student*

U.S. Fish and Wildlife Service

- **Inferring habitat use and migratory behavior of bull trout in the White River using microchemistry**
  PI: Daniel Schindler, *School of Aquatic and Fishery Sciences*
- **Lateral and longitudinal occupancy of Chehalis floodplain habitats to guide restoration and conservation**
  PI: Julian Olden, *School of Aquatic and Fishery Sciences*

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Photos, l to r: iStock.com/naturediver, iStock.com/Strekoza2, UW Tetiaroa Seabird Team

Photo: iStock.com/LagunaticPhoto

PROJECT IN THE SPOTLIGHT

Five-year status review of yelloweye and bocaccio rockfish in Puget Sound

Principal Investigator:	Mark Scheuerell, *Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington*
Student Researcher:	Markus Min, *School of Aquatic and Fishery Sciences, University of Washington*
Project Funder:	NOAA Fisheries

The Endangered Species Act (ESA) requires periodic reviews of species that are listed as threatened or endangered to ensure that the listing is still accurate. Specifically, section 4(c)(2) of the ESA states that the Secretary shall: *Conduct, at least once every five years, a review of all species included in a list. Determine on the basis of such review whether any such species should be removed from such list, be changed in status from an endangered species to a threatened species or be changed in status from a threatened species to an endangered species.*

Yelloweye rockfish (*Sebastes ruberrimus*), canary rockfish (*Sebastes pinniger*), and bocaccio (*Sebastes paucispinis*) within the Salish Sea (Puget Sound, Georgia Basin) were listed under the ESA in 2010, and the next 5-year review is scheduled to be finished in late 2021. Our role was to assist NOAA Fisheries in updating the status of these listed species. This required us to review many disparate sources of information, which included gray literature reports going back to the 1970s and relatively recent data gathered from WDFW surveys using remotely operated vehicles. Reconstructing catch histories from commercial and recreational surveys proved particularly challenging because older records did not necessarily include angler effort or particular species names. All of the information we gathered was used in a stock assessment model designed specifically for data-poor species, and the results suggest that these fish are trending towards recovery, but the uncertainty in their status is still rather high.

U.S. Geological Survey

- **Adaptation of Infectious Haematopoietic Necrosis Virus to Pacific Northwest Chinook salmon and impacts on other salmonids**
  PI: Kerry Naish, *School of Aquatic and Fishery Sciences*
- **Crossing the divide: inundation drives hotspots of carbon flux**
  PI: David Butman, *School of Environmental and Forest Sciences*
  Fenix Garcia-Tigeros, *postdoctoral scientist*
- **Factors influencing productivity of native adfluvial salmonids in mainstem Skagit River reservoirs**
  PI: Julian Olden, *School of Aquatic and Fishery Sciences*
  Shelley Johnson, *MS student*
- **Ichthyophonus in Pacific herring**
  PI: Chelsea Wood, *School of Aquatic and Fishery Sciences*
- **Tracing the age of wetland and aquatic carbon emissions across northern latitudes**
  PI: David Butman, *School of Environmental and Forest Sciences*
- **Transgenerational impacts of endocrine disrupting chemicals on innate immunity**
  PI: Ram Savan, *Department of Immunology*

Washington Department of Ecology

- **Burke Museum Herbarium—national wetland condition assessment 2021**
  PI: David Giblin, *Burke Museum*
- **Testing diver-assisted and autonomous suction harvesting to control *Myriophyllum spicatum***
  PI: Julian Olden, *School of Aquatic and Fishery Sciences*
- **Washington Department of Ecology auto chemicals scoping and alternatives**
  PI: Edward Kolodziej, *School of Interdisciplinary Arts and Sciences, UW Tacoma*

Washington Department of Fish and Wildlife

- **Assessing and minimizing genetic risks of hatchery production of native species for aquaculture**
  PI: Kate Litle, *Washington Sea Grant*
- **Climate risk assessment final report**
  PI: Meade Krosby, *Climate Impacts Group*
- **COVID-19 impacts on natural resource perceptions**
  PIs: Peter Kahn/Josh Lawler, *School of Environmental and Forest Sciences*
  Audryana Nay, *MS student*
- **Ecology of non-native fish**
  PI: Julian Olden, *School of Aquatic and Fishery Sciences*
- **Improving preseason forecasts for U.S. coho salmon management units by accounting for spatially structured temporal variation in age-at-maturity**
  PI: Daniel Schindler, *School of Aquatic and Fishery Sciences*
  Lukas DeFilippo, *PhD student*

Photos: above: iStock.com/Gerald Corsi; l to r: iStock.com/Yelena Rodriguez Mena, brown54486

- **Investigating how the dispersal of fry and distribution of redds interact to shape density-dependence in Skagit River winter steelhead**
  PI: Daniel Schindler, *School of Aquatic and Fishery Sciences*
  Nick Chambers, *MS student*
- **Investigating the impacts of peak flows on the performance, design, and cost of water crossing structures in the Chehalis Basin to guide comprehensive fish passage restoration**
  PI: Erkan Istanbulluoglu, *Civil and Environmental Engineering*
  Zachary Johnson, *postdoctoral scientist*
- **Marine bird and mammal hot and cold spots in Washington's marine waters**
  PI: Beth Gardner, *School of Environmental and Forest Sciences*
  Jamie Brusa, *postdoctoral scientist*
- **Prioritizing sea level rise exposure and habitat sensitivity across Puget Sound**
  PI: Kate Litle, *Washington Sea Grant*
- **Protection and restoration of shoreline processes: training, integration of Green Shores for Homes, and Shore Friendly**
  PI: Kate Litle, *Washington Sea Grant*
- **Shoreline monitoring toolbox—protocol implementation and data management**
  PI: Kate Litle, *Washington Sea Grant*
  Simone Des Roches, *postdoctoral scientist*
- **Skagit River Chinook spawning phenology and multispecies salmonid distribution**
  PI: Thomas Quinn, *School of Aquatic and Fishery Sciences*
- **Ungulate-predator dynamics in northern Washington**
  PIs: Beth Gardner/Laura Prugh/Aaron Wirsing, *School of Environmental and Forest Sciences*
  Sarah Bassing, *PhD student*
  Taylor Ganz, *PhD student*
  Lauren Satterfield, *PhD student*
- **Washington Sea Grant Crab Team**
  PI: Kate Litle, *Washington Sea Grant*
- **Washington Sea Grant Crab Team: European green crab control and coastal capacity building**
  PI: Kate Litle, *Washington Sea Grant*
- **Washington Sea Grant green crab management**
  PI: Kate Litle, *Washington Sea Grant*

Washington Department of Natural Resources

- **A proposal to develop data products in support of the State's 20-year forest health strategic plan**
  PI: Luke Rogers, *School of Environmental and Forest Sciences*
- **Finalize Phase I and Phase II deliverables of the wetlands intrinsic potential tool**
  PI: Monika Moskal, *School of Environmental and Forest Sciences*

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Photos l to r: iStock.com/DaveAlan, Scott Pearson, iStock.com/ impr2003

Photo: Scott Pearson

PROJECT IN THE SPOTLIGHT

Marine bird and mammal hot and cold spots in Washington's marine waters

Principal Investigator:	Beth Gardner, *School of Environmental and Forest Sciences, University of Washington*
Postdoctoral Researcher:	Jamie Brusa, *School of Environmental and Forest Sciences, University of Washington*
Student Researcher:	Sierra Gillman, *School of Environmental and Forest Sciences, University of Washington*
Project Funder:	Puget Sound Partnership and Washington Department of Fish and Wildlife

Hotspot analysis is often a first step in understanding species distributional patterns and an important component in conservation planning. Hotspots are typically defined as areas with high concentrations of individuals or species; however, the term has expanded since its inception to include definitions of species richness, endemism, and taxonomic distinctiveness. Describing hotspots (and coldspots) in the Salish Sea and coastal Washington is particularly important for conservation planning, habitat protection, project location (e.g., alternative energy), and prioritizing areas for oil spill response. Our goals include developing dynamic hotspot maps for a suite of marine species and to better understand the environmental drivers of those locations.

We will use the latest developments in hierarchical distance models to build predicted density surfaces for marine birds and mammals in the U.S. portion of the Salish Sea and the Washington coast. We will examine how a suite of environmental covariates influence the distribution and abundance of marine birds and mammals of the Salish Sea (e.g., temperature, bathymetry, shoreline type, etc.). The model output will allow us to create a series of maps depicting predicted bird and mammal relative densities by season that will ultimately help us identify hotspots, coldspots and intermittent cold and hotspots of bird or mammal density.

We will compare bird and mammal trends in the Salish Sea in the spring and summer to those on the Washington coast using the same underlying models that are developed for the hotspot map. This coast-Salish Sea comparison allows us to identify the drivers that are unique to the Salish Sea versus large marine ecosystem drivers like the Pacific Decadal Oscillation or El Niño Southern Oscillation events. The strength of influence of the drivers on abundance and trends statistically, provides a quantitative ranking scheme for assessing the relative importance of ecosystem drivers on bird and mammal distribution.

- **Long-term monitoring and focus studies in shoreline biota in Puget Sound: 2019–20 data analysis and 2020–21 data collection**
  PI: Megan Dethier, *Friday Harbor Labs*
  Margaret Turner, *PhD student*
- **Riparian extensive vegetation monitoring, model transferability testing**
  PI: Monika Moskal, *School of Environmental and Forest Sciences*
- **Roads prescription scale effectiveness monitoring project**
  PI: Erkan Istanbulluoglu, *Department of Civil and Environmental Engineering*
  Amanda Manaster, *PhD student*
- **Supplement to support dynamically downscaled projections for fish passage planning and design**
  PI: Guillaume Mauger, *Climate Impacts Group*
- **UW-DNR restoration treatment need and monitoring**
  PIs: Jonathan Bakker/Brian Harvey, *School of Environmental and Forest Sciences*
  Don Radcliffe, *PhD student*

Cooperating Faculty, Washington State University

Washington Department of Ecology

- **2020 Columbia River supply–demand forecast**
  PI: Jennifer Adam, *Department of Civil and Environmental Engineering*
  Fabio Scarpare, *postdoctoral scientist*
  Collins Asante-Sasu, *PhD student*
  Matt Yourek, *PhD student*
  Rojina Desar, *MS student*
  Ry Weber, *MS student*
- **Beach Program in Snohomish County**
  PI: Jonathan Robinson, *Washington State University Extension*
- **Identification of safer alternatives to per- and polyfluorinated substances in plant fiber-based food packaging**
  PI: Donna Riordan, *Washington State Academy of Sciences*
- **Skagit Basin supply and demand analysis**
  PI: Jonathan Yoder, *School of Economic Sciences*
  James Fleharty, *undergraduate student*
- **Waste to fuels technology partnership**
  PI: Georgine Yorgey, *Center for Sustaining Agriculture & Natural Resources*

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Photos, l to r: UW Tetiaroa Seabird Team, iStock.com/JeffGoulden, iStock.com/pilipenkoD

Photo: iStock.com/Karen Hogan

PROJECT IN THE SPOTLIGHT

Snowshoe hare population ecology in lynx-occupied areas of Washington

Principal Investigator: Daniel Thornton, *School of the Environment, Washington State University*

Student Researcher: Paul Jensen, *School of the Environment, Washington State University*

Project Funder: Washington Department of Fish and Wildlife

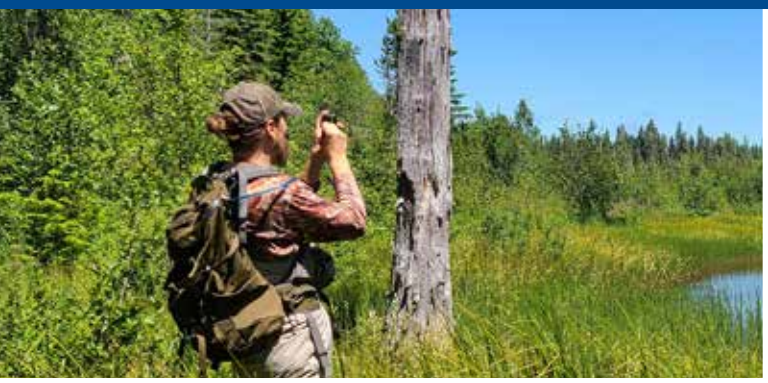
Snowshoe hares (*Lepus americanus*) are a keystone boreal forest species, influencing a wide variety of ecosystem properties across several trophic levels, including plant production and predator abundance. Southern populations of hare may be at particular risk of decline due to changing snowpack and fire regimes, with northward range shifts already being observed in some areas. In Washington, hare are a vital resource to the federally threatened and state-endangered Canada lynx, yet we lack data on snowshoe hare abundance at the proper scales with which to inform management and conservation. Our project had three inter-related objectives: 1) estimate hare density across a variety of sites within north-central Washington, 2) assess the ability of non-invasive camera traps and pellet indices to estimate hare density by comparing these methods with traditional spatial-mark recapture techniques, and 3) model hare density at a landscape scale by linking information on hare abundance with remotely sensed data on forest structure.

We assessed hare density across 13 sites in Loomis State Forest and Colville National Forest. Density was low, consistent with southern populations, and varied 10-fold across our sites. The random encounter model and random encounter and staying time model applied to camera data accurately estimated hare density across our sites. Pellet indices, as well as indices of camera detection rates, also strongly related to hare density (regression $R^2 > 0.90$ and 0.70, respectively). When linking hare density with remotely sensed imagery, we found that the primary determinants of hare density related to forest structure (tree height, vertical and horizontal cover). By utilizing LiDAR imagery, we were able to create a continuous surface of hare density across the Loomis State Forest that helped to explain variability in lynx detection rates. Results of our study provide a methodological platform for future large-scale modeling and monitoring efforts for this species.

Washington Department of Fish and Wildlife

- **Advancing northern leopard frog recovery in Washington through reintroduction and habitat management: Phase II**
  PI: Caren Goldberg, *School of the Environment*
- **Beaver relocation research project**
  PIs: Caren Goldberg, *School of the Environment,* and Jonah Piovia-Scott, *School of Biological Sciences*
  Jesse Burgher, *MS student*
  Alexandra Duke, *MS student*
- **Northern leopard frog population assessment and modeling, disease surveillance, and headstart optimization**
  PI: Caren Goldberg, *School of the Environment*
- **Snowshoe hare density**
  PI: Daniel Thornton, *School of the Environment*
  Paul Jensen, *MS student*

Photos: above, l to r: iStock.com/PaulReevesPhotography, iStock.com/photographybyJHWilliams, Abby Bratt; below,l to r: Jonah Piovia-Scott, Abby Bratt; bottom: Staci Amburgey



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