Summer Internship Opportunity: Work with a NOAA Scientist and Learn to Integrate Mathematics and Fisheries Science

The Northwest Fisheries Science Center (NWFSC) and the University of Washington request applications for students in the Mathematical Sciences for a summer internship at the NWFSC. Interns will spend summer (~16 June – 15 September) working on a research project that integrates mathematics with the science that informs fishery managers. A stipend of $5,500 will be provided from the Usha and S. Rao Varanasi SAFS Faculty Endowment for Student Support, the NWFSC and School of Aquatic and Fishery Sciences (SAFS). The successful applicant will also be provided with office space at the NWFSC or SAFS and a NWFSC mentor.

Although any projects related to sustainable management of west coast fish resources would be considered, the following projects are already available and NWFSC mentors identified:

1. Utilizing data visualization tools to better inform fisheries management (NWFSC Mentors: Chantel Wetzel and Jason Cope)
2. The effect of sex, age, body size, and growth on Southern Resident killer whale morphometric body condition indices used to evaluate health (NWFSC Mentors: Dawn Noren and Nick Tolimieri)
3. Study of coastal upwelling dynamics using image machine-learning algorithms applied to remote-sensing data (NWFSC Mentor: Eli Holmes).

For more information on these projects contact the NWFSC mentors (Chantel Wetzel: chantel.wetzel@noaa.gov; Jason Cope: jason.cope@noaa.gov; Dawn Noren: dawn.noren@noaa.gov; Nick Tolimieri: nick.tolimieri@noaa.gov; Eli Holmes: eli.holmes@noaa.gov).

The SAFS values the strengths and professional experience that students, faculty, and staff bring to our community. We are committed to providing an excellent education to all of our students, regardless of their race, gender, class, nationality, physical ability, religion, age, or sexual orientation. We are proud of the different roles that our students, staff, and faculty play in the community of the School and the College of the Environment. We also recognize that science is richer, and the SAFS community is more vibrant when a diverse group of people participate in research. We are especially interested in candidates who can contribute to our department's diversity through their life experiences, scholarship, and/or service to the institution. Women, people with culturally diverse backgrounds, people from communities historically excluded from STEM, first generation students, people with disabilities, and veterans are encouraged to apply and will receive equal opportunity.

HOW TO APPLY

To apply for this internship, upload all of the following information to this form (https://forms.gle/nyS4hQEHmeRNumrX8) by 15 March 2023.

• Application Materials (in one pdf). Save as "LastnameFirstname_MML2023.pdf" (where Lastname and Firstname are your name)

o Recent Resumé
o Unofficial UW Transcript
o Letter of Interest (maximum of four pages) – include the name of the project that most interests you and why; tell us about yourself and your research interests; explain how the internship will further your studies and career; include other information the selection committee should be aware of, such as what it means to you to have a commitment to diversity, equity, and inclusion.

DEADLINE FOR SUBMISSION
March 15, 2023

DECISIONS
Award notifications will be made by April 25, 2023

The University of Washington is an affirmative action and equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, gender expression, national origin, age, protected veteran or disabled status, or genetic information.

Project 1: Utilizing data visualization tools to better inform fisheries management

Mentors: Drs. Chantel Wetzel and Jason Cope

Background: Data and science products are essential for clear communication and support of fisheries management. The Pacific Fishery Management Council (PFMC) relies on science-support from the Northwest Fisheries Science Center, however improvements in accessibility to many of the products and sources of information that inform decision making are needed. This project aims to support fisheries management by enhancing user accessibility to data and information through utilizing data visualization tools to create user-friendly software applications with the R package Shiny.

Project: The project is made of two components:

1. Stock Assessment Prioritization tool: There are more than 90 groundfish stocks off the U.S. West Coast that require timely scientific assessment to inform management actions. However, the capacity to conduct science is limited requiring managers to prioritize a select number of species to evaluate each assessment and management cycle. Prioritizing and then choosing which stocks to assess is a major decision point in groundfish management. While the process, involving weighting multiple factors to determine prioritization of stocks, is fairly well established, the suite of analyses is currently available as an offline workbook where comparing results across species can be challenging. The development of a user-friendly communication tool to visualize and synthesize information by factors across species can facilitate decision making by fisheries managers, as well as provide all interested parties with easy access to the information. The intern, working with the mentors, will build a Shiny tool in the R programming language to turn the workbook into an interactive graphical user interface. This would include species selection and sorting and visual presentation of the prioritization factors.
2. Data availability tool: One aspect of the stock assessment prioritization is summarizing the available data for each species. The data summary is used in tandem with the assessment prioritization by decision makers in order understand if sufficient data exists to support a scientific assessment. The data summaries include the numbers of lengths, ages, and ageing structures (e.g., otoliths) available by species and year from commercial (PacFIN) and recreational (RecFIN) fisheries and from surveys (e.g., the NWFSC West Coast Groundfish Bottom Trawl Survey). Beyond summaries, this tool would also allow the option to produce processed abundance and biological data for additional analyses and use in stock assessments.

What the intern will gain from the project: We anticipate the intern will improve coding skills and become familiar with the information types outlined above and their uses in stock assessment models. The products created from this project will find immediate utility and could become a substantial contribution supporting West Coast groundfish fishery management planning and decision-making.

Project 2: The effect of sex, age, body size, and growth on Southern Resident killer whale morphometric body condition indices used to evaluate health

Mentors: Drs. Dawn Noren and Nick Tolimieri

This internship will provide the student an opportunity to use statistical methods in R to evaluate complex nonlinear relationships between two variables. The student will also gain an understanding of how various factors affect body condition index (BCI) measurements in free-ranging killer whales. This project will provide information to evaluate BCI measurements being used to assess health in the endangered Southern Resident killer whale distinct population.

Specifically, the intern will work on killer whale body condition data collected from twenty-one healthy trained killer whales (approximately 2.5-50 years old) at SeaWorld with a focus on evaluating how the different body condition indices (BCIs: 4 different girths/length and 3 different girths/eye girth) are influenced by natural variation in body shape. The main goals of the study are to determine how the 7 BCIs vary by sex, age, and length, and also change with growth over a one-year period. Most BCI values will likely change as animals grow, and some of the BCIs may change substantially over the one-year study period, especially for the youngest animals in the study. A recent paper (Stewart et al. 2021) demonstrated that one BCI measured in free-ranging killer whales varies by sex and changes with age. Similar to results presented in Stewart et al. (2021), relationships for the seven BCIs in the present study will likely be nonlinear. The student will also evaluate how the seven BCIs change for each individual over the one-year study period to determine how rapidly BCIs change over time. This will require statistical analyses to determine the most appropriate relationships, using methods such as those described in Stewart et al. (2021), while also taking into account that the data are repeated measures taken from individual killer whales.

The deliverables will be to determine the equations and/or shapes of relationships for each of the 7 BCIs by sex with age and by sex with length as well as identify which BCIs change significantly over the one-year study period for each individual killer whale using generalized additive models or other similar techniques. Previous experience using R for data analysis is desired, and some background in nonlinear regression and spline relationship fitting analyses would be beneficial. This internship can be hybrid or virtual, with most advisory meetings occurring virtually. As such, the student should have regular access to a computer during the internship.

This project provides valuable data to evaluate how growth affects killer whale aerial photogrammetry BCI measurements and killer whale necropsy BCI measurements to help the NOAA NMFS West Coast Region Office interpret annual BCI measurements of endangered Southern Resident killer whales, which are currently being used to identify animals of concern.

Reference: Stewart, J. D., Durban, J. W., Fearnbach, H., Barrett-Lennard, L. G., Casler, P. K., Ward, E. J., and Dapp, D. R. 2021. Survival of the fattest: linking body condition to prey availability and survivorship of killer whales. Ecosphere 12(8):e03660. 10.1002/ecs2.3660 https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.3660

Project 3: Study of coastal upwelling dynamics using image machine-learning algorithms applied to remote-sensing data

Mentor: Dr. Eli Holmes

Coastal upwelling is a key driver of productive fisheries. It is largely driven by coastal winds that produce wind stress perpendicular to the coast. This wind stress pulls surface water away from the coast and pulls deep, cold, nutrient rich water to the surface. Strong and consistent coastal upwelling happens in specific regions around the world and supports strong fisheries in these regions. An interesting and curious aspect of upwelling is that it is influenced by ocean-atmosphere teleconnections—correlations in ocean climate across long-distances. In plain language, it means that a pattern that arises in one part of the world's oceans will be seen later on the other side of the world in a very different part of the world. One of these teleconnections is between temperature anomalies in the North Atlantic Ocean and coastal upwelling off the coast of North Africa (the Canary Upwelling system) and off the southwest coast of India.

In this project, you will explore the use of machine learning or deep learning using sea-surface temperature images (maps) from the North Atlantic Ocean (NAO) to develop predictive models of coastal upwelling intensity. The goal is to explore whether NAO sea-surface temperature images along with neural networks provide a promising way to develop predictive models for upwelling intensity. For the internship, you do not need to know machine learning but you should have an interest in learning about it and doing a machine learning project. There are several popular Python libraries for implementing neural networks with image inputs, including TensorFlow, PyTorch, and Keras, and you'll choose one of these to learn and work with.

Although the topic is specified and you'll be given remote-sensing datasets to work with, you will develop your own project (with guidance) and if a machine-learning approach different than neural networks seems more promising, you can definitely switch.

What the intern will gain from the project:

This project will give the intern experience working with ocean remote-sensing data and applying image classification and machine learning algorithms to create predictive models (of upwelling intensity). The intern will take part in a research project on novel uses of these approaches in fisheries. The intern will get experience with popular Python packages for machine learning (e.g. TensorFlow, PyTorch or Keras). Prior interns have presented their summer projects at undergraduate symposiums.

Required background:

The intern will need programming experience in Python to be successful in this project. The intern should be able to read about an algorithm and write code to implement it. The intern should enjoy reading tutorials and then apply the ideas learned to a novel project on a different set of data (sea surface temperature images). The intern should have an interest in machine learning. Prior experience with machine-learning (classes or self-study) will be helpful but not required.