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 $3,000 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. Building accessible data tools to support fisheries management (NWFSC Mentors: Chantel Wetzel and Jason Cope)
2. Study of dynamic ocean environments using image classification algorithms applied to remote-sensing data (NWFSC Mentor: Eli Holmes).
3. Environmental Drivers of Hake Productivity (NWFSC Mentor: Kiva Oken)

For more information on these projects contact the NWFSC mentors (Chantel Wetzel: chantel.wetzel@noaa.gov Jason Cope: Jason.cope@noaa.gov; Eli Holmes: eli.holmes@noaa.gov; Kiva Oken: kiva.oken@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, send the following information to Sarah Garner (sterrs@uw.edu) by 15 March 2022.

- Application Materials (in one pdf). Save as "LastnameFirstname_MML2022.pdf" (where Lastname and Firstname are your name)

- Recent Resumé
- Unofficial UWTranscript
- 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, 2022

DECISIONS
Award notifications will be made by April 15, 2022

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: Building accessible data tools to support fisheries management

Mentors: 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 enhance user accessibility to data and information by creating user-friendly software applications using the R package Shiny to help support management planning.

Project: The project is made of two components:

1. Stock Assessment Prioritization tool: There are more than 90 groundfish stocks that require management through annual catch limits, yet only a small fraction can be assessed through use of a population model during each 2-year assessment 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 tool would allow for better exploration of the factors under consideration and how those factors compare across species. The intern, working with the mentors, will build a Shiny tool 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 to understand if sufficient data exist to support a stock assessment. The data summaries include the numbers of lengths, ages, and collected ageing structures by species and year from commercial (PacFIN) and recreational (RecFIN) fisheries, and from surveys (e.g., Northwest Fisheries Science Center West Coast Groundfish Bottom Trawl and the Hook & Line 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 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: Study of dynamic ocean environments using image classification algorithms applied to remote-sensing data

Mentor: Eli Holmes

Background: Small pelagic fish, such as sardines and anchovies, are critical species in many fisheries ecosystems, especially ecosystems in the world's major upwelling zones. These small pelagic fish are characterized by large yearly fluctuations. These fluctuations are influenced by biological factors such as population dynamics, but they are also driven by ocean environmental variables. National Marine Fisheries Service scientists have been working for many years on using environmental variables, especially sea surface temperature, to predict recruitment and abundance of Pacific sardines and small pelagic fishes more generally. However, the informative environmental variables have typically been large scale (variables such as ocean climate indices, e.g. the Pacific Decadal Index, or regional average sea-surface temperature). The actual ocean environment is a complex spatial and temporal process that evolves in a seasonal and multi-year cycle and these broad-scale indices do not capture spatial patterns.

Goals: This project will explore a novel approaches for quantifying the ocean environment by using unsupervised learning algorithms to classify remote sensing images for key ocean environmental variables. The goal is to 1) gain new insights into seasonal and yearly spatio-temporal patterns of the ocean environment and 2) use these methods to explore changes in these patterns as the ocean has warmed.

We have two pilot projects that the intern can work on or the intern can come up with their own project with guidance. The existing pilot projects are: Project 1) Using image classification and clustering algorithms (e.g. K-means, hierarchical, anomaly detection) to study the regional spatial patterns in coastal sea surface temperature in Eastern Boundary Upwelling systems. The goal is to analyze whether the spatial patterns we see today are the similar, albeit perhaps shifted in time, to those ten to twenty years ago in our study region, or if the processes have changed such that they would have been seen as anomalous. Project 2) Using a spatio-temporal time-series analysis (e.g. wavelet analysis) to study changes to the seasonality, length, and timing of upwelling across the world's main coastal upwelling systems. This will use a data set of global upwelling intensity along the world's coastlines developed by a prior intern.

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 images. The intern will take part in a research project on novel uses of these approaches in fisheries.

Required background: The intern should have experience programming (R, Python or Matlab). The intern should be able to read about an algorithm and write code to implement it. The intern should be able to read in data files, convert to matrices, and apply functions to those matrices in their programming language of choice. We have preliminary code to apply the algorithms to images, but the intern will need programming experience to be successful in this project. The intern should also have an interest in machine learning. Prior experience (classes or self-study) will be helpful but not required.

Project 3: Environmental drivers of hake productivity

Mentor: Kiva Oken

Background: Population productivity of marine organisms is driven by three key processes: new recruitment to the population, growth, and mortality. Variability in these processes is thought to be highly dependent on oceanographic conditions experienced during key life stages, but only recently has oceanographic modeling become advanced enough that we are able to associate mechanistic oceanographic drivers with these key population processes.

This project will specifically focus on linking environmental drivers to productivity of Pacific Hake. Pacific Hake (also called Pacific Whiting) is the largest fishery by volume along the U.S. West Coast and third-largest in the U.S. overall. Both recruitment and growth are notoriously variable from year to year. This, combined with the relatively rich amount of data available on the population, make it an excellent candidate for exploring the influence of environmental drivers. Ultimately, results from this work can help managers and stakeholders better anticipate short-term changes in the population, and can inform predictions about how the stock will respond to anticipated ocean change in the future.

Questions: Possible questions to explore, depending on the interests of the intern, include

- How does weight or length at a given age depend on environmental drivers?
- How does including environmental drivers in population assessments impact our ability to forecast the population biomass in the near future (within ~3 years)?
- Do the same environmental drivers derived from old and new oceanographic models perform similarly in their predictive skill?

Approach: The intern will work with a team of Northwest Fisheries Science Center scientists who study and assess the Pacific Hake population. Time series of environmental drivers will come from a regional ocean modeling system (ROMS) developed for the California Current ecosystem. The work itself will be implemented in R, and will possibly involve use of the stock assessment software Stock Synthesis. Variable and model selection will be done using methods specifically geared towards measuring future out-of-sample forecasting skill, which can yield different results than more traditional model selection methods. Other skills the intern may develop include use of version control systems (git/github), dynamic report generation, and random effects/hierarchical modeling.