Abstracts

2023 NMFS-Sea Grant Graduate Fellowship Symposium

2023 NMFS-Sea Grant Fellowship Research Symposium
Location: Silver Spring, MD

Table of Contents

Oral Presentations

Poster Presentations

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Title: Improving Predictions of How Tuna Distributions Will Change in response to MHWs: A Joint Fishery-Species Distribution Model Approach
NMFS-Sea Grant Fellow Presenter: Nima Farchadi

Abstract: Marine heatwaves (MHWs) have been shown to shift the distributions of fishery resources in response to unfavorable conditions. Despite species distribution models (SDMs) being a powerful tool to understand species spatiotemporal patterns, their predictive performance has shown to behave poorly under novel environmental conditions and can be particularly challenging for migratory species that respond rapidly to changing environments. There has also been limited exploration of how fishing fleets will be impacted by MHWs and related species shifts. Here, we focus on predicting the spatiotemporal distribution of albacore tuna (Thunnus alalunga) and U.S. North Pacific albacore troll and pole-and-line fishery to improve understanding of how fish and fishers will respond to MHWs. Using fishery dependent and independent data from 2003 to 2016, we employ a novel joint fishery-species distribution model approach (JFSDM) that uses fishery dependent and independent data to simultaneously model the distribution of both. We compare the predictive performance of JFSDM to single-SDM modeling approaches that use semiparametric and machine learning frameworks. We then compare spatial predictions of the albacore and the troll and pole-and-line fishery to identify differences across model types. As fish populations and fishing fleets may respond to extreme climatic events like MHWs in divergent ways, accurately characterizing variations in species and fleet distributions is needed to support climate-readiness and resilience in U.S. fisheries.

Title: Epigenetic Age Estimation in Wild-Caught Fishes: Insights and Implications for Fisheries Management

NMFS-Sea Grant Fellow Presenter: Nick Weber

Abstract: Age data are essential for estimating life history parameters and are thus critical for fisheries assessment and management. Traditional aging techniques, however, can be costly and time intensive, of low precision, and are necessarily lethal when involving otoliths or vertebrae. Recent studies have demonstrated that DNA methylation levels at certain CpG sites (cytosines followed by guanines) exhibit strong correlations with chronological age, allowing for the development of DNA methylation-based, age-predictive models referred to as epigenetic clocks. Herein, preliminary results from epigenetic clocks developed for red snapper (Lutjanus campechanus), red grouper (Epinephelus morio), and a deepwater scorpionfish, blackbelly rosefish (Helicolenus dactylopterus) will be discussed. Topics covered will include assessments of accuracy and precision, the effect of tissue type (fin clip versus muscle tissue), and the influence of including biological information (e.g., length and sex) on epigenetic clock accuracy.

Title: Evaluating the potential of expanding Virginia's small-scale commercial fishery for blue catfish (*Ictalurus furcatus*)
NMFS-Sea Grant Fellow Presenter: Shelby White

Abstract: The commercialization of non-native, invasive species can provide additional fishing opportunities to commercial fishermen and support the diversification of fishing portfolios. In Virginia, there are ongoing efforts to expand the exploitation of the invasive blue catfish (Ictalurus furcatus), an invasive species of growing management concern. A survey instrument was used to assess the willingness of Virginia's small-scale commercial fishermen to participate in the blue catfish fishery. Surveys included hypothetical contingent behavior scenarios to evaluate the effect of ex-vessel price on the willingness to participate, an aspect that has anecdotally served as one of the primary barriers to entry. Results indicate that ex-vessel price plays a significant role in the decision to participate in the blue catfish fishery, along with other sociodemographic factors. Future research could investigate potential evaluation of barriers and bottlenecks within the seafood sales and processing sector to better understand the feasibility of expanding the commercial fishery for blue catfish and seek solutions that enhance market demand to encourage higher ex-vessel prices.

Title: Quantitative Characterization of Fine-Scale Distributional Changes for Spatially Managing Fisheries

NMFS-Sea Grant Fellow Presenter: Janelle Morano

Abstract: Species distributions are contracting, expanding, and shifting as they adapt to climate conditions, but these changes are not homogenous across a species' range. Quantitatively characterizing fine-scale changes within a patchy distribution is pertinent for effective management and marine spatial planning. Changes in distribution of forage fishes are less well known because they are not commonly targeted for management and less data are typically available. We used Atlantic menhaden, Brevoortia tyrannus, as a case-study to apply multi-scale spatio-temporal species distribution models to integrate multiple fishery-independent data sources and identify fine-scale spatial changes, seasonal patterns, and decadal trends in distribution along the US East Coast. Higher menhaden density consistently occurs near North Carolina, Chesapeake Bay, and New York Bight regions, but distribution patterns vary seasonally and among years. Quantifying and tracking patterns over time provides opportunities for informed spatial management, and further work could make use of climate indicators for forecasting changes in the ecosystem and inform spatial management.

Title: Evaluating the Performance of a Spatially Explicit Population Model for Striped Bass using Simulations

NMFS-Sea Grant Fellow Presenter: Samara Nehemiah

Abstract: Spatial population estimates are particularly beneficial to the Chesapeake Bay as this region faces unique challenges as a result of climate change, fishing pressure, and land use within the watershed. However, use of spatial models for fisheries management relies on the ability of these models to reliably estimate biological parameters. The objectives of this project are to test the performance of spatially-explicit population estimates for Striped Bass (Morone saxatilis) in the Chesapeake Bay and determine how assessment model performance changes with varying data availability and mis-specified population dynamics (i.e. time varying movement rates). Simulations will be built for estimating population abundance of Striped Bass with different movement rates and patterns of fishing mortality. Based on model performance, I will identify data needs for reliable population estimates of fish species. Finally, I will explore how parameter estimates within the Chesapeake Bay may be affected by climate induced changes to movement, recruitment, and other dynamics.

Title: Spatial management of marine disease in aquaculture
NMFS-Sea Grant Fellow Presenter: Thomas Anderson Jr.

Abstract: Marine pathogens are a key challenge for the global aquaculture industry. Not only can infections impact the productivity of farms and the value of finished products but they also tend to be transmissible through the water over long distances. Individual operators have the incentive to limit disease incidence on their own farms, these actions are costly and may not be enough to prevent the spread of pathogens to their neighbors. The resulting spatial-dynamic externality is costly and suggests a role for regulation. Using a unique dataset from Chile's salmon aquaculture industry, I evaluate the extent to which a spatially and temporally explicit management policy is effective at reducing endemic disease transmission.

Title: Who Gets the Fish? Labor Market Sorting and Efficiency in Regulating the Commons
NMFS-Sea Grant Fellow Presenter: Karl Aspelund

Abstract: Reacting to depleted fisheries, governments design regulations that reduce extraction from the commons through the exit of firms and workers. A motivation to ease disruptions in local communities—i.e. maintaining jobs—might make a government keep less productive firms in the commons while lowering the cost of transitions in local communities. The tension depends on the assortative matching of firms to workers and the existing frictions in the labor market. I investigate this tension in the Icelandic fisheries, where a comprehensive ITQ scheme was put in place and it is possible to link individual fishers both to their vessels' catch and characteristics and to comprehensive tax data that tracks their employment and earnings histories even outside of the fisheries. With this unique data, I can investigate the earnings and employment outcomes of fishers who sort into different firms and/or exit the fishery after the ITQ system is imposed, to understand the nature of the outside options available to fishers across a variety of demographic characteristics. I will outline how to assess productivity at the firm and worker level, relying in part on a Roy model of sorting, to show the degree to which the market-based scheme caused the most productive firms to exit and how that relates to the exit of the most productive workers. The correlation between the comparative advantage of workers and the productivity of firms will inform how counterfactual regulations targeting firms of different productivities would impact labor markets.

Poster Presentations

Title: Applying an integrated population model to understand marine processes affecting Western Alaskan Chum salmon productivity

NMFS-Sea Grant Fellow Presenter: Genoa Sullaway

Abstract: Western Alaska Chum salmon (Oncorhynchus keta), typically monitored using the spawning populations of the Arctic, Yukon, and Kuskokwim rivers (hereafter, AYK), have been declining in the Kuskokwim since 2019 and in 2021, both the Yukon and Kuskokwim River Chum salmon runs collapsed below 90% of the long-term average. This resulted in closed subsistence harvest fisheries which have a significant detriment to food security and cultural tradition for Wester AK Indigenous peoples who are facing a multi-species salmon decline. Early marine processes are often a bottle neck for salmon lifecycle and previous work has suggested that Chum abundances most likely influenced by areas where AYK fish share a common environment. Synchronous 2021 declines indicate this may still be the case. We are using an integrated population model to test the hypothesis that changes to the marine conditions and prey field in the first marine year has contributed to recent declines in AYK Chum salmon abundance.

Title: Development of a seasonal size-structured, tag-integrated, state-space stock assessment model with application to an estuarine fish stock
NMFS-Sea Grant Fellow Presenter: Johnna Brooks

Abstract: Size-structured stock assessment models possess the advantage that knowledge of fish length at time of tagging and recapture are far easier to obtain while having less measurement error compared to age of tagged fish. This is an important benefit when integrating a tagging sub-model into the stock assessment because it allows for the estimation of size-structured parameters such as fishing mortality and natural mortality. Natural mortality is an important parameter in a stock assessment because it is directly proportionate to the stock's productivity and can therefore heavily impact stock assessment outcomes and management decisions. For simplicity, natural mortality is often set at a fixed rate based on general life history. However, natural mortality often fluctuates with environmental factors, such as cold stun events, as seen in the spotted seatrout stock in North Carolina and Virginia. Therefore, I propose to (1) develop a seasonal size-structured, tag-integrated, state-space stock assessment model for the spotted seatrout stock in North Carolina and Virginia, and to (2) conduct a simulation-estimation experiment to evaluate model performance, evaluate ability to estimate parameters, and test different ways to incorporate process errors.

Title: Improving Predictions of How Tuna Distributions Will Change in response to MHWs: A Joint Fishery-Species Distribution Model Approach
NMFS-Sea Grant Fellow Presenter: Nima Farchadi

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Title: Incorporating age structure into pre- and post-season assessments of California's salmon fishery

NMFS-Sea Grant Fellow Presenter: Emily Chen

Abstract: While collecting and incorporating additional information in forecast models generally improves their accuracy, whether the effort is justified depends on the magnitude of change to decision making and fulfilling objectives. This challenge has come to the fore for California's primary stock of salmon, Sacramento River fall-run Chinook. Over-forecasts of escapement in recent years have called for revisiting the existing forecast model and incorporating additional age structure information but collecting additional data can be costly and may not change recommendations in a meaningful way. My research objectives are to compare the performance of alternative forecast models and evaluate the value of age structure information on decision making through a value of information analysis.

Title: Evaluating fish production on artificial reefs using mark-recapture and telemetry data
NMFS-Sea Grant Fellow Presenter: Katrina Munsterman

Abstract: My study aims to assess how incorporating empirical data on fish growth, movement, and mortality can affect fish production estimates on artificial reefs built in subtropical coastal ecosystems. Mark-recapture data in combination with visual surveys and acoustic telemetry data provided information on individual growth, immigration and emigration, and, as well as predation mortality. Next, we used simulations to estimate production of two fish species that make up a large proportion of the biomass on artificial reefs built in seagrass beds in the Caribbean. Simulations were parameterized with (1) empirical data on fish growth, movement and mortality from this study and (2) published data on functional relationships between fish size and growth, movement and mortality. We then calculated variability in production estimates to assess the importance of including population and individual-level empirical data in fish production models. Beyond improving measures of production, an additional goal of this study is to improve sampling methodologies to better assess the efficacy of artificial reefs for fisheries rehabilitation and management in nearshore habitats in Florida.

Title: Rpath Rules! Open-Source Food Web Modeling to Understand Resilience and Regime Shift in the Gulf of Maine – Before and During Rapid Warming
NMFS-Sea Grant Fellow Presenter: Sarah Weisberg

Abstract: In recent decades, the Gulf of Maine (GoM) has experienced dramatic warming, with major changes in species composition and abundance both expected and observed. Although there have been many shifts in abundance of specific species – steep declines in cod populations, the collapse of the northern shrimp fishery, increases in once-rare black sea bass, among others – it remains unclear whether the GoM has undergone a regime shift and entered a new stable state. I explore connections between resilience and possible states of the GoM food web by using Rpath to model the food web in 1980-85 (prior to contemporary warming) as well as over time. I rely on ecological network analysis to derive metrics of ecological resilience, and use uncertainty-based approaches to probabilistically describe the system's components and flows. While this work is focused on the GoM, my broader goal is to advance methods for understanding food web resilience and regime shifts to inform management decisions.

Title: Methods for improving catch stability: featuring phase-in provisions for large changes in catch limit recommendations

NMFS-Sea Grant Fellow Presenter: Kristin Privitera-Johnson

Abstract: The status of a stock can change when a new stock assessment includes new data, different values for pre-specified parameters, or different model assumptions. At present within the US, changes in annual catch limits given changes in assessments (and hence overfishing limits and acceptable biological catches) may be implemented immediately at the start of the next management period. However, two provisions added during recent revisions to the National Standard 1 guidelines may provide opportunities to specify catch limits to produce more stable harvests over time. The provisions allow Councils to develop flexible harvest control rules that a) phase-in changes to the acceptable biological catch over a time window, not to exceed three years, and b) include contingencies for carrying-over some of the unused portion of an annual catch limit (i.e., an underage) from one year to increase the acceptable biological catch for the next year. This project will use management strategy evaluation to investigate to what extent management strategies can minimize interannual variation in catch when new stock assessments result in a large increase or decrease in catch recommendations. Specifically, I will investigate the performance of harvest control rules that phase in new catch limits over time (see Wiedenmann and Holland [2020] for carryover!) and use constraints on catch limits or fishing mortality rate. The objective will be to explore the consequences of assessment model misspecification due to assumptions used for natural mortality, stock-recruit steepness, catch history, and selectivity form when a new assessment is conducted for long- and short-lived stocks.

Title: Predicting Recreational Angler Behavior in the Florida Keys using Agent-Based Modeling
NMFS-Sea Grant Fellow Presenter: Matthew Marrero

Abstract: In the Southeast United States, recreational fisheries consistently outpace the fishing effort of commercial fisheries. However, we know much less about recreational fisheries than their commercial counterparts. This agent-based model seeks to fill some of these knowledge gaps by giving spatially explicit predictions of recreational angler fishing locations along the Upper Florida Keys. This model is the first step to making spatially explicit ecosystem scale predictions of fishing impacts in the area. Additionally, this model is intended to be used as an exploratory tool for management decisions.

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