ABSTRACTS

2017 NMFS – Sea Grant Graduate Fellows Symposium

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Lisa Ailloud

College of William and Mary, Virginia Institute of Marine Science
Advisor: John Hoenig
NMFS Mentor: Matthew Lauretta
Population and Ecosystem Dynamics, 2015

Improving growth estimates for Western Atlantic bluefin tuna using an integrated modeling approach

Lisa Ailloud, Matthew Lauretta, Alex Hanke, Walter Golet, Robert Allman, Matthew Siskey, Dave Secor, and John Hoenig

Advances in modeling growth using tag-recapture data and progress in otolith ageing procedures allowed improved fitting of the Western Atlantic bluefin tuna growth curve. Growth parameters were derived from an integrated analysis of tag-recapture data and otolith age-length data using the "Aires-da-Silva-Maunder-Schaefer-Fuller with correlation" (AMSFc) framework, which models growth such that parameter estimates from each data source are directly comparable. The otolith data consisted of a sample of 4045 otoliths for which ages were estimated using tested and consistent protocols and conventions designed to avoid bias. Strict data quality control measures were applied to the tagging data for quality assurance and a subsample of 1118 records were retained for use in the analysis. Two forms of the Schnute growth model were considered: the Richards model and the von Bertalanffy model. The Richards curve appears to provide a better fit. Both curves follow a similar trajectory until age 16, after which they diverge considerably. The Richards model supports a lower mean asymptotic length (L_∞= 271.0 cm FL) than the model currently used in the stock assessment (L_∞= 314.9 cm FL).

Nathan M. Bacheler
NMFS Beaufort Lab

Variable detection rates of reef fish sampled with traps and underwater video by the Southeast Reef Fish Survey

Nathan M. Bacheler

The Southeast Reef Fish Survey is a collaborative monitoring program along the southeast United States Atlantic coast (SEUS) that uses traps with attached video cameras to develop indices of abundance for economically important reef fish species. Indices of abundance can be biased, however, if surveys fail to detect species that are truly present (i.e., incomplete detection). We used chevron traps paired with underwater videos in a binomial (presence-absence) generalized additive modelling framework to quantify how environmental conditions, habitat characteristics, and the number of individuals at each site (i.e. site abundance) influenced the detection probabilities of economically important reef fish species in the SEUS. After accounting for variable site abundance, trap detection probabilities declined 40% for red porgy *Pagrus pagrus*, 65% for gray triggerfish *Balistes capriscus*, and 75% for vermilion snapper *Rhomboplites aurorubens* as percent hard bottom increased from 0 to 100%. Increasing water temperature caused red porgy trap detection probability to decline modestly, while for gray triggerfish and vermilion snapper it increased substantially. Underwater video was more likely to detect black sea bass *Centropristis striata*, red porgy, and gray triggerfish when site abundance and water clarity were high and the video camera was facing downcurrent. Using multiple gears simultaneously, we quantified the ways in which predictor variables influenced the sampling process, and suggest that occupancy or *N*-mixture models are needed to account for incomplete detection when developing indices of abundance.

Anna Birkenbach
Duke University
Advisor: Martin Smith
NMFS Mentor: Min-Yang Lee
2016 Marine Resource Economics

Empirical structural analysis of value generation in the northeast multispecies sector program

Anna Birkenbach, Min-Yang Lee, and Martin D. Smith

Much of the emerging work to evaluate the impact of catch share programs relies on treatment effects models, which identify the causal net effects of the policy change but fail to identify the underlying mechanisms driving those changes and thus have limited relevance for proposed new (out-of-sample) policies. To shed new light on mechanisms, I develop and estimate a structural dynamic discrete choice model of individual vessel behavior in order to learn more about how catch shares influence micro-level decision-making on the water. These decisions include species targets, timing of catch, and fishery participation. This work seeks to improve our understanding of how catch shares—or other proposed policies—influence the overall efficiency of extraction patterns and value generated from the resource. To allow study of inter-species substitutions in pre- versus post-rationalization exploitation patterns and to maximize external validity, I implement this model using fine-scale commercial fishing data from before and after the start of the Northeast Multispecies Sector Program. The economic effects I seek to understand are particularly salient now, as the Magnuson-Stevens Fishery Conservation and Management Act faces reauthorization and Congress debates the role of quota programs as fishery management tools going forward.

Erin Bohaboy

University of South Alabama
Advisor: William F. Patterson III
NMFS Mentor: Shannon L. Cass-Calay
2016 Population and Ecosystem Dynamics

Harvest slots as a management tool to maximize marine recreational fishing opportunities and sustainability: Gulf of Mexico red snapper as a model species

Erin Bohaboy, William F. Patterson III, and Shannon L. Cass-Calay

The Gulf of Mexico (GOM) red snapper (Lutjanus campechanus) stock is estimated to be overfished despite years of stringent recreational fishing regulations including daily bag limits, minimum size requirements, and seasonal closures. An additional management tool, harvest slots (a minimum and a maximum size requirement for harvested fish), may be beneficial by decreasing the mean size of landed fish, thus allowing for a longer harvest season while increasing the proportion of large females in the stock. Harvest slots have not been employed in the GOM red snapper recreational fishery due to uncertainty in post-release mortality and the inability to account for discarding of larger fish (dome-shaped retention) within the red snapper Stock Synthesis assessment model. My research focuses on estimating post-release mortality in red snapper and applying these estimates in a range of harvest slot scenarios in Stock Synthesis version 3.3, a recently released beta update which includes dome-shaped retention. The results of this study will inform GOM red snapper fisheries managers on the likely efficacy of harvest slots to increase recreational fishing opportunities and speed stock rebuilding, but will also be pertinent to other regional and national recreational reef fish fisheries where managers seek to increase recreational fishing opportunities.

Andrew Carr-Harris
University of Rhode Island
Advisor: Hirotsugu Uchida
NMFS Mentor: Min-Yang Lee
Marine Resource Economics 2015

Evaluating angler willingness-to-pay for keeping and releasing fish: An application to Atlantic striped bass

Andrew Carr-Harris

Understanding the economic tradeoffs that recreational anglers make regarding the number and sizes of fish that can be legally kept and the value of those that must be released is important for management that prioritizes the preservation of trophy-sized fish. In the Atlantic striped bass recreational fishery, trophy-sized fish make up nearly all of the spawning stock and are heavily sought after by anglers. Recently, harvest regulations have become more restrictive, prompted in part by a steady decline in spawning stock biomass. As the most likely future path of the fishery is a liberalization of these restrictions, measuring the degree to which different policies impact angler welfare gives managers the ability to take into consideration the social impacts of proposed regulations. To that end, we implemented a survey during 2016 that was sent to recreational striped bass anglers living in coastal states from Maine to Virginia. The survey employed a choice experiment which we use to elicit anglers' willingness-to-pay (WTP) for changes in the number and sizes of kept and released fish. We incorporate historical catch data to generate empirical distributions of WTP, allowing our results to be conditioned on current fishery conditions and hypothetical regulatory scenarios.

Brandon Chasco
Oregon State University
Advisor: Selina Heppell
NMFS Mentor: James Thorson
Population and Ecosystem Dynamics, 2016

Accounting for uncertainty in sea turtle growth models: applications to in-water surveys of Loggerheads (Caretta caretta)

Brandon Chasco, Selina Heppell, Jim Thorson, Larisa Avens, and Joanne McNeill

Loggerhead (Caretta caretta) sea turtles in the western Atlantic are listed as threatened under the United States Endangered Species Act. Assessing the status of this threatened population should be based on the management goals, while also maximizing the potential of the available data. Age-structured models (ASM), such as those frequently used in commercial fisheries assessments, are a valuable tool for assessing the Loggerhead's status because they growth models map large amounts of easily collected length data to the much less available ageing data. Additionally, they integrate multiple sources data into a single modeling framework, and they partition different sources of mortality (e.g., natural verses fishing mortality) while tracking individual cohorts through time. Unlike many teleost fishes, the Loggerhead length and age data is based on skeletochronology or mark-recapture studies where the true age is usually unknown, and we seek to better understand the parameter bias and uncertainty when the true age is unknown. In addition to quantifying parameter bias, we also examine whether integrating data from both stranding and tagging surveys reduces parameter bias and uncertainty. We see this analysis as a valuable step toward assessing Loggerhead sea turtle population status and improving management.

J.K. Craig
NMFS Beaufort Lab

Linking watershed processes to coastal fisheries: Ecological and economic effects of nutrient enrichment on the Gulf of Mexico shrimp fishery

J.K. Craig

The northwestern Gulf of Mexico drains the largest watershed in the continental United States via the Mississippi-Atchafalaya river system. Three-fold increases in nutrient loads since the 1950s now result in one of the largest seasonal hypoxic (dissolved oxygen ≤ 2 mg l^{-1}) zones in the northern hemisphere. Hypoxia is most severe during the summer (Jul-Aug) when major fisheries in the region are at their peak, yet the consequences of nutrient pollution for coastal fisheries are largely unknown. We conducted retrospective analyses of long-term survey, landings, and shrimp price data, as well as process-oriented field and laboratory studies to quantify the ecological and economic effects of hypoxia on brown shrimp and the shrimp trawl fishery, historically the most valuable single-species fishery in the region. Brown shrimp avoid severely hypoxic areas but occur at high densities in waters with sublethal oxygen levels near the edge of the hypoxic zone. Likewise, shrimpers avoid regions of low bottom DO and re-distribute fishing effort to nearby oxygenated waters, presumably in response to changes in the spatial distribution of their target species. These spatially-mediated responses of the shrimp fleet to hypoxia alter catch rates but are difficult to detect in aggregate landings data. Analysis of seafood prices indicates that hypoxia alters the relative price of small and large shrimp, and this shift has economic consequences for the fishery. Our results indicate that spatial-dynamic feedbacks between the natural (shrimp) and human (shrimp fleet) system are critical to understanding how watershed processes influence downstream coastal fisheries.

Mary Donovan
University of Hawaii at Manoa
Advisor: Megan Donahue
NMFS Mentor: Ivor Williams
Population and Ecosystem Dynamics, 2015

Ecological indicators of coral reefs across multiple spatial scales in Hawai'i

Mary Donovan, Megan Donahue, and Ivor Williams

Central to implementing ecosystem approaches to management is providing scientific support for the development of indicators for assessment and monitoring of ecosystem state. When developing indicators it is important to understand the spatial and temporal scaling of the underlying ecological processes, as the most useful indicators will be relevant at multiple scales. This study is investigating ecosystem indicators for Hawaii's near shore marine ecosystems with the goal of identifying the appropriate spatial scale to measure each indicator. The analysis utilizes a synthesis of biological monitoring datasets that is matched with data on environmental and human drivers, and tests for any non-linear relationships or thresholds for each indicator and stressor combination. These relationships are modeled with a Bayesian hierarchical model that accounts for variation due to data coming from multiple sources, and explicitly models relationships at multiple nested spatial scales. The results therefore include both information on indicators for assessing the status of the ecosystem, and the spatial scale at which the information is applicable. The results are important for multiple ongoing management planning processes in Hawaii that operate on fundamentally different spatial scales, and therefore may not be able to rely on the same suite of indicators.

Nichiolas Ducharme-Barth
University of Florida
Advisor: Robert Ahrens
NMFS Mentor: Kyle Shertzer
Population and Ecosystem Dynamics, 2015

Evaluating the use of VMS data for creating relative abundance time series in the Gulf of Mexico vertical line fishery: A comparative approach

Nicholas Ducharme-Barth, Robert Ahrens, and Kyle Shertzer

The Gulf of Mexico reef fish complex is socioeconomically important and is exploited by a vertical line fishery capable of high resolution spatial targeting. Relative abundance time series derived from fisheries dependent catch-per-unit-of-effort (CPUE) represent an important input to the assessment of these stocks. Traditionally, these relative abundance indices are derived from standardized logbook data, aggregated at a coarse spatial scale, and are limited to generating predictions for observed spatiotemporal strata. Understanding how CPUE is spatially distributed, however, can help identify range contractions and avoid hyperstability which can mask stock declines in targeted reef fish species. Vessel monitoring systems (VMS) represent a tool that can provide complete, high-resolution distributions of CPUE used to create relative abundance indices. This project compares four methods for generating relative abundance time series derived from three data sets (observer data, VMS, and commercial logbook), each differing in spatiotemporal completeness and resolution, to evaluate the use of VMS derived relative abundances in assessments of targeted reef fish stocks. We propose that in fisheries where targeting occurs at very fine spatial scales, relative abundance indices derived from high-resolution, spatiotemporally complete data may more accurately reflect the underlying dynamics of the stock

Robert Dunn
San Diego State University and U.C. Davis
Advisors: Kevin Hovel and Marissa Baskett
NMFS Mentor: Stephan Munch
Population and Ecosystem Dynamics, 2016

Interactive effects of predator and prey harvest on ecological resilience of rocky reefs

Robert Dunn, Kevin Hovel, and Marissa Baskett

A major goal of ecosystem-based fisheries management is to prevent fishery-induced shifts in community states. This requires an understanding of ecological resilience: the ability of an ecosystem to return to the same state following a perturbation, which can strongly depend on species interactions across trophic levels. We use a structured model of a temperate rocky reef to explore how multi-trophic level fisheries impact ecological resilience. Increasing fishing mortality of prey (urchins) has a minor effect on equilibrium biomass of kelp, urchins, and spiny lobster predators, but increases resilience by reducing the range of predator harvest rates at which alternative stable states are possible. Size-structured predation on urchins acts as the feedback maintaining each state. Our results demonstrate that the resilience of ecosystems strongly depends on the interactive effects of predator and prey harvest in multi-trophic level fisheries, which are common in marine ecosystems but are unaccounted for by traditional management.

Cassie Finer
Oregon State University
Advisor: David J. Lewis
NMFS Mentor: Cameron Speir
Marine Resource Economics 2016

Dike removal and saltmarsh restoration for fish habitat: Estimating the effects on coastal land markets

Cassie Finer and David J. Lewis

Restoring degraded estuary and freshwater rearing habitat constitutes the "single overriding focus" for federal salmon recovery plans (NMFS 2016). Restoration plans, however, do not consider landowner costs beyond lost acreage (Ewald & Brophy 2012). While previous empirical hedonic work suggests coastline structure capitalizes into adjacent property values, a gap exists in estimating this relationship for West Coast land markets. Understanding the effect of marine conservation practices on interconnected land-based systems plays an essential role in efficient conservation policy. This research examines the question: how do dike removals aimed at restoring salmon habitat affect adjacent land markets? This research will provide foundational empirical evidence for the economic relationship between marine habitat restoration and human systems. In addition, parcel-level analysis allows for spatially explicit economic impact assessment. This provides valuable information conspicuously missing from current restoration policy.
References: Ewald M, Brophy L. 2012. Tidal Wetland Prioritization for the Tillamook Bay Estuary. Tillamook Estuaries Partnership, Garibaldi, Oregon. Good JW. 2000. 3.3 Summary and Current Status of Oregon's Estuarine Ecosystem. In Oregon State of the Environment Report. Salem, OR. NMFS. 2016. Final ESA Recovery Plan for Oregon Coast Coho Salmon (Oncorhynchus kisuth)

William Goldsmith

College of William and Mary, Virginia Institute of Marine Science
Advisor: John Graves
NMFS Mentor: Kristy Wallmo
Marine Resource Economics, 2015

It's cheaper to go to the fish market: what motivates Atlantic bluefin tuna anglers?

William Goldsmith and Andrew Scheld

The recreational fishery for Atlantic bluefin tuna (Thunnus thynnus) is popular among U.S. east coast anglers from Maine to North Carolina. Despite domestic management strategies, recreational landings have in some years exceeded the allowable catch due to changing fish availability, limited predictability of angler effort, and difficulties in monitoring catch. Understanding the drivers of angler behavior is critical for predicting how effort and harvest may vary as a function of changing fish availability, regulations, or costs. To investigate angler decision-making, preferences, and values, we surveyed private anglers who possess the permit necessary to target Atlantic bluefin tuna. The survey employed discrete choice experiments (DCEs) to determine how regulatory and non-regulatory trip-specific variables influence trip-taking behavior. A latent class ranked logit model was applied to DCE responses to investigate angler willingness-to-pay for various aspects of the fishing experience, and to examine preference heterogeneity across the angling population. The model identified two distinct segments of bluefin tuna anglers: one group that primarily derives value from harvesting fish; and a second group that obtains substantial benefits from non-consumptive elements of the fishing experience. Findings will be used to inform management that maximizes angler benefits while keeping landings within acceptable limits.

Quang Huynh
College of William and Mary, Virginia Institute of Marine Science
Advisor: John Hoenig
NMFS Mentors: John F. Walter, III and Jon Brodziak
Population and Ecosystem Dynamics, 2015

Comparative performance of the length-converted catch curve and Beverton-Holt equation for estimating mortality

Quang Huynh

The length-converted catch curve and the Beverton-Holt equation are two historically common procedures for estimating the instantaneous total mortality rate (Z) of exploited marine populations. Both use length data as a proxy for age. The length-converted catch curve regresses the logarithm of the catch-at-length on the relative ages at the midpoints of the length bins of a length frequency distribution, while the Beverton-Holt equation estimates total mortality as a function of the observed mean length in a sample. We compared the methods using Monte Carlo simulations across a range of total mortality rates, von Bertalanffy growth parameter K, and other life history characteristics. Neither the length-converted catch curve nor the Beverton-Holt equation was uniformly superior in terms of bias or root mean square error across simulations. If total mortality was low and von Bertalanffy K was high, the Beverton-Holt equation was preferred, although some large outliers were observed. In most other scenarios, the length-converted catch curve had a slight advantage. Generally, the differences in performance were small between the two methods when commonly-used decision rules were appropriately applied to truncate the data.

Peter Kuriyama
University of Washington
Advisor: Trevor Branch
NMFS Mentors: Alan Hicks and John Harms
Population and Ecosystem Dynamics, 2014

Sources of bias in hook-and-line survey indices

Peter Kuriyama, Allan Hicks, John Harms, Owen Hamel, and Trevor Branch

The Southern California hook-and-line survey has been conducted by the Northwest Fisheries Science Center since 2004 to monitor the untrawlable habitat of the Southern California Bight. Data from the survey have been used in stock assessments and supporting research for a number of shelf rockfish species, such as bocaccio (Sebastes pauicispinis) and vermilion rockfish (S. miniatus). However, an index of abundance estimated from hook-and-line data may be biased due to the fixed-site design of the survey and issues with hook saturation and hook competition. Here, I will present empirical results from the hook-and-line data and results of a simulation study exploring the biases associated with aspects of the survey. Bocaccio are the most sampled species in the survey, and sites with low catch rates of bocaccio have high catch rates of vermilion rockfish. Preliminary results from the simulations indicate that hook saturation causes estimates of abundance to be negatively biased at large population sizes. Additionally, hook competition leads to positively biased indices of abundance, and weighting catch rates by site leads to the least biased index of abundance. These results identify methods of incorporating hook-and-line data from untrawlable habitat into stock assessments and identify biases that are applicable to general hook-and-line survey methods.

Ben Marcek
Virginia Institute of Marine Science
Advisor: Mary Fabrizio
NMFS Mentors: Richard Brill and Kevin Craig
Population and Ecosystem Dynamics, 2014

Using an individual-based model with physiological constraints to investigate fish distribution in Chesapeake Bay

Ben Marcek, Mary C. Fabrizio, Robert Humston, and Jian Shen

Changes in water temperature and the severity and extent of hypoxic zones impact individual fish physiology and the distribution of fish populations. However, few studies have connected individual-level impacts of changing environmental conditions to population-level effects. Using physiological data describing the effects of temperature on the metabolic scope and hypoxia tolerance of Atlantic croaker and spot, we developed individual-based models (IBMs) to investigate the effect of environmental conditions on the distribution of these species in Chesapeake Bay. Monthly bottom temperature and dissolved oxygen concentrations coinciding with the time that Atlantic croaker and spot inhabit Chesapeake Bay were used to parameterize the environment from 1988 to 2014. Ten-thousand fish of each species were included in three movement submodels (random walk, kinesis, and restricted-area search). Outputs from the IBMs were used to examine environmental conditions in which simulated fish were found and the amount of time individuals spent in hypoxic areas. The model-based results were compared with monthly survey observations to assess the role of physiology in directing the movement and distribution of fish

Lisa McManus
Princeton University
Advisor: Simon Levin
NMFS Mentor: Rusty Brainard
Population and Ecosystem Dynamics, 2014

Resilience and regime shifts across the Coral Triangle

Lisa McManus, Vitor V. Vasconcelos, James R. Watson, Joan A. Kleypas, and Simon A. Levin

Understanding coral reef resilience in light of a changing climate is critical, especially since the most biologically diverse reefs, those of the Coral Triangle (CT), are also the most threatened. Connectivity through larval dispersal is a mechanism that can facilitate the recovery of coral populations after severe perturbations, and its overall role in ecosystem dynamics must be elucidated as reefs increasingly face stressors that lead to mass coral mortality. Here, using particle-tracking data as a proxy for trajectories of coral larvae, we attempt to link hydrodynamic patterns in the Indo-Pacific region to regime shifts in reef communities. To that end, we simulated a coral-algal competition model across a network of reef patches in the CT, all linked by annual reproduction and dispersal or coral larvae. We then classified reefs as coral- or algal-dominated (i.e. desirable vs. undesirable), and investigated how these states change through time as a function of sea surface temperature and connectivity patterns. We find that larval connectivity is a major determinant of reef community structure in the CT and may be able to partially mediate the effects of climate change in this region.

Matthew Nuttall
University of Miami
Advisor: Elizabeth Babcock
NMFS Mentor: John Walter III
Population and Ecosystem Dynamics, 2014

Role of Gulf menhaden in the structure and functioning of the northern Gulf of Mexico ecosystem

Matthew Nuttall and Elizabeth Babcock

Gulf menhaden provide forage for a number of Gulf of Mexico piscivores and likely sustain a number of ecosystem services. This stock also supports the second largest US fishery by weight, which may threaten these services. I evaluate the role of gulf menhaden in the structure and functioning of the northern Gulf of Mexico ecosystem using the Ecopath modeling framework. This objective is addressed within a sensitivity analysis to account for uncertainty in the strength of predator-prey interactions, which are highly dynamic. Diet matrix parameters are randomly drawn from distributions representing plausible values of predatory feeding habits. Statistics describing the trophic role of gulf menhaden (e.g., trophic level, mixed trophic impact, keystoneness) are then compared to indices of ecosystem structure and maturity (e.g., total system throughput, ascendency:capacity) to assess how fluctuations in menhaden consumption influence the northern Gulf of Mexico. Of particular interest will be identification of statistics highly sensitive to parameter uncertainty and any ecological thresholds that fishery managers may wish to avoid.

Cecilia O'Leary
School of Marine and Atmospheric Science, Stony Brook University
Advisor: Janet Nye
NMFS Mentor: Tim Miller
Population and Ecosystem Dynamics, 2015

Understanding retrospective Summer Flounder (Paralichthys dentatus) abundance patterns through incorporation of oceanographic dependent vital rates in Bayesian state-space models

Cecilia O'Leary, Janet Nye, and Tim Miller

Climate can impact fish population dynamics both through changes in productivity and shifts in distribution. These shifts have been observed for many fish species in the Northwest Atlantic, but few studies have been able to resolve the root cause. This paper aimed to uncover how past variations in population vital rates and fishing pressure account for observed shifts in abundances. Using summer flounder (Paralichthys dentatus) as the model species, the effect of climate on fish demographic rates was considered a potential driver of past abundance patterns. The influence of climate on abundance was explored through natural mortality and stock-recruitment relationships. Models tested were age-structured hierarchical state-space models using Bayesian estimation. Model selection indicated that a temperature-dependent natural mortality model that included age-specific responses to GSI produced the best hindcasts of summer flounder abundances out of the tested models. This work indicated that when considering temporal summer flounder abundances at a population level, oceanographic processes play a role in driving those abundances. This mechanistically-based population model demonstrated the role age-specific temperature responses play in observed changes in abundance and emphasized the complexities of environmental effects on populations beyond simple correlations. This approach can be used for other species' responses to climate.

Dan Ovando

UC Santa Barbara
Advisor: Steven Gaines
NMFS Mentor: Jason Cope
Population and Ecosystem Dynamics, 2016

Integrating economic information into data-limited stock assessment

Dan Ovando, Steven Gaines, and Jason Cope

Many fisheries around the world require management guidance but lack the robust data streams that underpin state-of-the art science driven fisheries management. To resolve this problem, a large and growing suite of "data-limited stock assessments" (DLAs) have emerged, designed to provide management advice using relatively minimal data (but generous assumptions). Interestingly though, nearly all of the quantitative DLAs established rely exclusively on fish-centric data, for example length frequency distributions, catch data, or CPUE trends. While these data are clearly critical to proper understanding of a fishery's status, they also ignore the potential light that the economic history of a fishery may shed on its current biological status. This project proposes to address this challenge, by developing a quantitative method for integrating economic information into the stock assessment process. Length-based DLAs provide a useful entry point for this process. Length-based approaches often rely on equilibrium assumptions in order to "account" for recruitment fluctuations. However, this assumption is rarely justified. Attempts to relax this assumption can be hampered by the difficulties in separating changes in recruitment from changes in fishing mortality. We propose to address this challenge by utilizing economic data to set informative priors on the rate of change of fishing mortality.

Zack Oyafuso
Unviersity of Hawaii at Manoa
Advisor: Erik Franklin
NMFS Mentor: Jon Brodziak
Population and Ecosystem Dynamics, 2016

Evaluating the effectiveness of systematic marine reserve planning for the Hawaiian deep-water snapper-grouper fishery

Zack Oyafuso

The “Hawaiian Deep Seven Bottomfishes” is a deep-water species complex of six eteline snappers and one endemic grouper and is the most commercially important insular fishery in the State of Hawaii. The goal of my fellowship project is to evaluate, via simulation testing, the effectiveness of restricted fishing areas (RFAs) for this fishery. In the first section, I fitted habitat-based species distribution models for each species in the complex using Boosted Regression Trees. In the second section, the species distribution maps created from the model output from the first section were inputted into spatial optimizations of RFAs using two methods: simulated annealing (i.e., Marxan) and integer linear programming. The optimized reserve placements were then compared to the current restricted fishing areas with respect to socioeconomic and conservation objectives. The objective of the last section was to evaluate the effectiveness of RFAs created using the spatial optimization techniques examined in the second section, similar to a management strategy evaluation (MSE). Of interest was the comparison of different configurations of reserves as a function of optimization method, size and number of reserves, and choice of cost. This last section can provide the foundation for formalized MSEs of insular Hawaiian fisheries.

Mikaela Provost
University of California, Davis
Advisor: Louis Botsford
NMFS Mentor: Michael O'Farrell
Population and Ecosystem Dynamics, 2016

Sensitivities of West Coast fish stocks to environmental variability and their use in management

Mikaela Provost and Louis W. Botsford

There are clear signs that the physical environment of fisheries may be changing with a changing climate, underscoring the importance of knowing how different harvested populations will respond to fluctuating environmental conditions. One question is, given the broad variation in life histories of harvested species, how should we expect these species to respond differently to the environment, and how would that response depend on the spectrum of the environment? Secondly, how can this information and the estimated variance of environmental impact on recruitment be used to inform management? I propose to employ stochastic age-structured models to describe the frequency-dependent sensitivity of 17 species fished along the US West Coast which will enable us to see how specific frequency components of the California ocean environment, such as ENSOs, for example, influence probabilities of extinction or surpassing overfishing limits.

Amy M. Schueller
NMFS Beaufort Lab

Atlantic menhanden and ecosystem management

Amy M. Schueller

Atlantic menhaden are a pelagic, forage fish species found along the Atlantic coast of the United States and are harvested as part of the largest volume commercial fishery on the Atlantic coast. Central to the management of Atlantic menhaden is the recognition that the species plays a key role in the food web. The Atlantic Menhaden Management Board has indicated that they would like to manage with ecosystem reference points (ERPs), and thus, the scientific committee has been charged with developing ERPs. To start, a facilitated meeting was held to identify management goals and objectives; participants included industry, environmental groups, recreational fishermen of predators, and scientists. Next, the scientific committee identified a suite of models to address the goals and objectives as identified by the stakeholders. Model development work is ongoing with the intention of reviewing a suite of options in 2019. The end goal is to have the scientific work peer reviewed and incorporated into management.

Kyle Shertzer
NMFS Beaufort Lab

Stock assessment methods and related research at the Beaufort Lab

Kyle Shertzer

This presentation has two primary components. The first is an overview of assessment methodology used at the Beaufort Lab, highlighting software developed here, such as BAM, ASPIC, and FishGraph. The second is a synopsis of our assessment-related research. My underlying goal is to provide an inside look into life as a NOAA stock assessment biologist, in case you might consider becoming one.

Katie Siegfried
NMFS Beaufort Lab

Data prioritization for stock assessments in the southeastern US: how much do better data actually improve assessment accuracy?

Katie Siegfried

“We need better data” is often the rally cry of stakeholders when asked for public comments about the status of a fishery stock. With all the different data types and costs, it is difficult to discern the importance of each data type for assessment purposes. We approached this problem using a simulation study. We created an amalgam species from eight assessed stocks in the southeastern US and simulated a “known” population and assessment from that amalgamation. We then incrementally improved the data, by either improving precision or sample size, for each data source, and groupings of data (e.g. all commercial data, all recreational data, or all survey data). We also considered the marginal cost of each of these improvements. Our results show that the age composition data have the most impact on the accuracy of our assessments. Composition data are a relatively inexpensive type of data as well. Within the age composition grouping, the survey age composition had the biggest impact on the assessment accuracy. Further studies will examine other model constructs and incorporate the reduction of bias and other data sources we were unable to test in this study, such as the type of reproductive data.

Mark Stratton

Virginia Institute of Marine Science
Advisor: Rob LaTour
NMFS Mentor: Rick Hart
Population and Ecosystem Dynamics, 2014

A shark species and its prey: Relative importance of predation, fishing, and environmental variability to abundance dynamics

Mark Stratton, Cassidy D Peterson, and Robert J Latour

Multiple processes influence the abundance dynamics of marine fish and shellfish populations, including density-dependence, fluctuations in the environment, trophodynamic interactions, and fishing. Because marine food webs can be complex and difficult to characterize, determining the relative importance of trophodynamics to a species' population dynamics is challenging. For species that occupy lower trophic positions, accurately explaining and predicting abundance dynamics requires accounting for top-down predation pressure. In this study we present results from a multispecies time-series model quantifying the impacts of the bonnethead shark (Sphyrna tiburo) on the abundance dynamics of five prey species within nearshore coastal Southeast U.S. Atlantic waters: lesser blue crab (Callinectes similis), two lady crabs (Ovalipes ocellatus and O. stephensoni), blotched swimming crab (Portunus spinimanus), and a mantis shrimp (Squilla empusa). Density-dependence and changes in bycatch mortality were important for explaining S. tiburo trends. Abundance dynamics for most prey species were negatively impacted by S. tiburo abundance, indicating that predation pressure has a measurable population effect on these prey. Additionally, environmental variability associated with the Pacific Decadal Oscillation index governed the abundance dynamics of multiple prey species. This study highlights advantages of simultaneously accounting for multiple exogenous factors, namely trophodynamic interactions, when modeling abundance trends of lower trophic level marine species.

Laura Urbisci
Bren School of Environmental Science & Management at UC Santa Barbara
Advisor: Hunter Lenihan
NMFS Mentor: Kevin Piner
Population and Ecosystem Dynamics, 2014

Examining the sustainability of cumulative MSY projections

Laura Urbisci, Matthew G. Burgess, Hunter S. Lenihan, and Steven D. Gaines

Recent studies have suggested that current fisheries catches are unsustainable at the ecosystem level, because the primary production that occurs in the ocean ecosystems is insufficient to support the current catch rates given how energy is transferred through the food web. While most fish stocks are assessed and managed using single-species models, these models only focus on the population of interest and do not account for the constraints of primary productivity and trophic energy transfer. Here, we show that the net primary production of the California Current large marine ecosystem is substantially insufficient to cumulatively support the maximum sustainable yields (MSY) that single-species stock assessment models projected to be attainable for each fish stock present in this ecosystem. We calculated that the California Current ecosystem would need to have a trophic transfer efficiency of about eight times greater than the most recently available published estimate in order for the available net primary production to be able to support the projected MSYs. This suggests that there may be significant positive biases in the single-species estimates of sustainable yields in California Current fish stocks. We propose that both fishing down and fishing through food webs is likely to cause such positive bias in single-species MSY projections, and we provide evidence that fishing through the food web has indeed been occurring in the California Current. Our results raise important questions about the accuracy of recent projections from single-species models.

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Comparative analysis of genetic and phenotypic risks of inbreeding across two different hatchery management scenarios in Chinook salmon

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Captive breeding programs may reduce the fitness of cultured organisms and negatively affect the wild populations they are intended to support. However, research efforts have focused on the impacts of domestication selection. Comparatively, the consequences of inbreeding have received little attention, partly because detecting inbred individuals traditionally relied on pedigrees. Genomic approaches now enable accurate estimation of inbreeding from molecular markers, and permit testing of management strategies that may reduce associated risks in captive populations. Here, we quantified multi-generational genetic and phenotypic impacts of inbreeding in two hatchery populations of Chinook salmon, and determined how contrasting management practices affected these impacts. The hatchery populations were derived from the same source but are now managed separately, one integrated with and one segregated from the wild population. Inbreeding coefficients were estimated across five generations using 465 fish and 9108 restriction-site associated markers. The effects of inbreeding on five fitness-related traits were then quantified using linear mixed-effects models. The findings of this comparative analysis will inform hatchery management and improve long-term risk assessments. The results will also be incorporated into a model to quantify the effects of inbreeding on population dynamics and to identify critical levels of inbreeding to avoid in captive breeding.

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Stock assessment and science in support of U.S. South Atlantic fisheries management

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The Southeast Fisheries Science Center is one of five science centers in NOAA Fisheries, providing science advice for the Gulf of Mexico, South Atlantic, and Caribbean Fisheries Management Councils. The Beaufort Laboratory is the primary source for management advice for the South Atlantic. The sustainable fisheries branch at Beaufort conducts most of the stock assessment and related analyses in support of the South Atlantic fish species. The stock assessments are completed as part of the council run process, SEDAR (SouthEast Data, Assessment and Review). The Beaufort Lab has strong history of stock assessments and research in support of South Atlantic fisheries management.