NOAA Fisheries Service – National Sea Grant College Program

Fellowships in Population Dynamics and Marine Resource Economics

2013 Fellows Meeting

Northeast Fisheries Science Center

Woods Hole, MA
April 30—May 1, 2013

Tuesday, April 30 Clark Conference Room

9:00—9:30 **Welcome and Introduction**

Russ Brown – Deputy Science and Research Director, Northeast Fisheries Science Center
Terry Smith — Fellowship Coordinator, NMFS and National Sea Grant Office
Jason Link — NMFS Senior Scientist for Ecosystem Management

9:30 –12:00 **Fellows' seminars** (see seminar schedule)

12:00—1:00 **Lunch**

1:30 –4:30 **Fellows' seminars** (see seminar schedule)

5:00—7:00 **Meet and Greet the Fellows** — hosted by Woods Hole Sea Grant (*Woods Hole Oceanographic Institution Exhibit Center)*

Wednesday, May 1 Woods Hole Laboratory

9:00 –12:00 **Meet the Scientists**

The fellows will break into sections—population dynamics and marine resource economics—and meet with NMFS scientists in those focus areas in informal group discussions at several locations

12:00 pm **Adjourn**

The Fellowships

In 1999, NOAA National Sea Grant Office and NOAA Fisheries established a Graduate Fellowship Program in two specialized areas: population dynamics and marine resource economics. Population dynamics is the study of fish populations as affected by fishing mortality, growth, recruitment and natural mortality. Ph.D. candidates interested in the population dynamics of living marine resources and the development and implementation of quantitative methods for assessing their status can receive up to three years of funding. Ph.D. students in marine resource economics, concentrating on the conservation and management of living marine resources, can receive two years of funding.

The four main goals of the NOAA Fisheries/Sea Grant Fellowship Program are:

- *To encourage qualified applicants to pursue careers in either population dynamics and stock assessment or in marine resource economics*
- *To increase available expertise related to these fields*
- *To foster closer relationships between academic scientist and NOAA Fisheries*
- *To provide real-world experience to graduate students and accelerate their career development.*

Fellowships in Population Dynamics and Marine Resource Economics

2013 Fellows Meeting

SEMINAR SCHEDULE
Tuesday, April 30
Clark Conference Room

Session I

9:30 – 9:50 **Holly Perryman** - Rosenstiel School of Marine and Atmospheric Science, University of Miami *hperryman@rsmas.miami.edu*

Analyzing historical catch to facilitate ecosystem-based fisheries management in the Gulf of Mexico

9:50 —10:10 **Lewis Barnett –** University of California, Davis *labarnett@ucdavis.edu*

Propagation of variability across trophic levels: sensitivity of ecological communities to climate and fishing

10:10— 10:30 **Cody Szuwalski** - University of Washington *c.s.szuwalski@gmail.com*

Snow crab in the eastern Bering Sea: overfished and looking for answers

Break

10:40— 11:00 **David Kling** - University of California, Davis *dmkling@ucdavis.edu*

Taming the lionfish

11:00—11:20 **Susan Piacenza** - Oregon State University *Susan.Hilber@oregonstate.edu*

Developing quantitative tools to evaluate recovery in green sea turtles

11:20—11:40 **Mark Fitchett** - Rosenstiel School of Marine and Atmospheric Science, University of Miami *mfitchett@rsmas.miami.edu*

Improving the development of age-length keys in data-poor fisheries: the eastern Pacific sailfish as a case study

11:40—12:00 **Elizabeth Councill** - Rosenstiel School of Marine and Atmospheric Science, University of Miami *emartin@rsmas.miami.edu*

Using Comparative Modeling in the Analysis of Ontogenic Migration on the Age and Size Distribution of Atlantic Tarpon, Megalops atlanticus, in the Gulf of Mexico and Caribbean

Fellowships in Population Dynamics and Marine Resource Economics

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Session II

1:30—1:50 **Meagan Dunphy-Daly** – Duke University *meagan.dunphy-daly@duke.edu*

An assessment of pelagic predator populations since the establishment of marine protected areas: does a spillover effect exist?

1:50—2:10 **Andrew Scheld** - University of Washington *ascheld@uw.edu*
Catch shares, overlapping regulatory regimes, and micro-market structure in New England groundfish

2:10—2:30 **Andrew Ropicki** - University of Florida *aropicki@ufl.edu*

Network analysis of the Gulf of Mexico red snapper IFQ program

2:30—2:50 **Kailin Kroetz** - University of California, Davis *kkroetz@ucdavis.edu*

Dynamic efficiency costs of non-efficiency objectives in tradable permit programs

Break

3:00—3:20 **Charles Perretti** – Scripps Institution of Oceanography *cperrett@ucsd.edu*

A nonparametric approach to fishery management

3:20—3:40 **Jeff Rutter** - University of Washington *jdrutter@uw.edu*

Change in mean population body size: growth or culling?

3:40—4:00 **Sam Truesdell** – University of Maine *samuel.truesdell@maine.edu*

Implications to fisheries stock assessment of assuming spatial heterogeneity in harvesting

4:00—4:20 **Benjamin Galuardi** – School of Marine Science and Technology, University of Massachusetts, Dartmouth *galuardi@eco.umass.edu*

A combined modeling approach for informing stock assessment with electronic tags

4:20—4:40 **Dan Goethel** – School of Marine Science and Technology, University of Massachusetts, Dartmouth *dgoethel@umassd.edu*

Application of a Tag-Integrated Stock Assessment Model to Three Interconnected Stocks of Yellowtail Flounder off of New England

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Population Dynamics Fellows—Abstracts

Analyzing Historical Catch to Facilitate Ecosystem-based Fisheries Management of the Gulf of Mexico

Holly Perryman
Marine Biology and Fisheries, University of Miami, Rosenstiel School of Marine and Atmospheric Science

The Gulf of Mexico provides a wide range of economically and ecologically important goods and services to the U.S., Mexico and Cuba which are threatened by natural and anthropogenic impacts. In particular, top predators play an important role in marine communities, and their populations are known to be declining. Time series describing catch from the U.S. portion of the Gulf of Mexico between 1980 and 2011 are being used to calculate catch-based indicators related to the depletion of top predators within the Gulf of Mexico. Preliminary analysis will include analyzing catch mean trophic level (MTL) and pelagic-to-demersal ratio (P:D) between recreational and commercial fisheries. Catch time series will be developed for the entire Gulf of Mexico for an ecosystem-level indicator analysis. These time series will be used to calibrate an ATLANTIS model for the Gulf of Mexico to inform ecosystem-based fisheries management.

Propagation of Variability Across Trophic Levels: Sensitivity of Ecological Communities to Climate and Fishing

Lewis A.K. Barnett[1]
Marissa L. Baskett[1]
Louis W. Botsford[2]
John Field[3]
[1] *Department of Environmental Science and Policy, University of California Davis*
[2] *Department of Wildlife, Fish, and Conservation Biology, University of California Davis*
[3] *National Marine Fisheries Service, Southwest Fisheries Science Center*

Climate change is likely to cause increased temporal variability in the size of populations, thereby presenting a challenge to a primary goal of management: consistently maintaining populations at abundances that protect ecosystem function. One key to achieving this goal lies in understanding how climate-driven changes to a population of one species affect the populations of other community members through trophic interactions within a food web. We develop a theoretical approach to determine how climate variability propagates through food webs and how the sensitivity of communities to environmental variability may change over time and differ among systems, depending on which trophic level is most directly affected by the abiotic driver. Furthermore, we aim to determine which management techniques would be most effective at reducing variance in community structure under a range of potential changes to timescales of environmental variability imposed by climate change, given which trophic levels are harvested.

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Population Dynamics Fellows—Abstracts

Snow Crab in the Eastern Bering Sea: Overfished and Looking for Answers

Cody Szuwalski
School of Aquatic and Fishery Sciences, University of Washington

The fishery for snow crab (*Chionoecetes opilio*) in the eastern Bering Sea was declared overfished in 1999. The subsequent rebuilding plan was declared a failure in 2009. Lower than average recruitment over the rebuilding period likely contributed to the failure, but mechanisms behind changes in recruitment dynamics are not clear. Snow crab recruitment appears to be related to the winter Pacific Decadal Oscillation, which shifted in 1989 may have changed the productivity of the stock. However, the fishery is also often spatially concentrated, so an allowable catch calculated for the entire stock may be harvested from a smaller proportion of the population, resulting in local fishing mortalities higher than intended. If the more heavily harvested portion of the stock is important in recruitment dynamics, disproportional harvesting may have influenced the productivity of the stock. I will discuss a spatial stock assessment and alternative management strategies to cope with both possibilities.

Developing Quantitative Tools to Evaluate Recovery in Green Sea Turtles, *Chelonia mydas*

Susan Piacenza
Department of Fisheries and Wildlife, Oregon State University

Green sea turtles, *Chelonia mydas,* have increased dramatically in the Hawaiian Islands and Florida. These populations provide an opportunity to identify changes in vital rates that are associated with population growth and recovery. There is a need to determine the best tools and practices for incorporating vital rate information into population models to assess population size and status. Long-term monitoring data from Hawaii and Florida will be used to evaluate the life history parameters. I will test a variety of population models, and use model selection to determine which models are appropriate for each population. Recovering populations are useful for model development because they often show shifts in age structure that are related to changes in vital rates, which can themselves be linked to management actions. Further, it is critical to carefully consider how future management actions might affect their continued recovery. To this end, I will apply the Management Strategy Evaluation (MSE) to evaluate recovery and provide prospective guidance to for which types of monitoring data are necessary to accurately assess population size.

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Population Dynamics Fellows-Abstracts

Improving the Development of Age-length Keys in Data-poor Fisheries: the Eastern Pacific Sailfish as a Case Study

Mark Fitchett
Rosenstiel School of Marine and Atmospheric Science
University of Miami

Age-length keys (ALKs) are distributions of age at length used to estimate catch-at-age from length-frequencies in total landings. ALKs are specific to recruitment and exploitation patterns; therefore construction of ALKs must be estimated within specific time frames and gear types. Catch-at-age information derived from ALKs with length frequencies in total landings is needed in cohort analyses for assessing status of species abundance and exploitation. Sailfish in the eastern tropical Pacific are heavily exploited as bycatch in longline and purse seine fisheries targeting tunas. Sailfish catch is incompletely reported and biological hard parts for ageing throughout the distribution of the species are not available. In addition, ageing sailfish from hard parts has proven difficult due to vascularization of the inner core in spine sections. In data-poor fisheries where reliable ALKs are absent, length-frequency data are "sliced" into ages by a growth function. Deterministic age-slicing does not take into account variability of size-at-age and tends to overestimate mortality rates and underestimate abundance. Stochastic age-slicing utilizes variance of size-at-age, but does not consider linkages in the growth trajectories that depend on intrinsic biological composition. This study presents a method in contrast to slicing procedures that follows groups of fish throughout time within size-at-age bins using variance and covariance of growth parameters. Knowledge on the variance of size at age under given exploitation patterns contributes to a better distribution of age frequencies within length bins. Therefore, a numerical solution to an ALK approximation may significantly contribute to better estimates of fishing mortality and abundance in data-poor fisheries.

Using Comparative Modeling in the Analysis of Ontogenic Migration on the Age and Size Distribution of Atlantic Tarpon, *Megalops atlanticus*, in the Gulf of Mexico and Caribbean

Elizabeth Councill
Marine Biology and Fisheries and Department of Mathematics
Rosenstiel School of Marine and Atmospheric Science
University of Miami

For many species of marine fish, the impact of spawning behavior among subpopulations on population-level age and size structure is not well understood. Many of the current models developed to date require a large volume of high-quality data to give reliable information about such structure. Unfortunately, this data is often either limited or lacks the robustness required. This project examines the applicability a new modeling procedure for understanding the mechanisms and qualitative impact of spawning behavior among subpopulations on the age and size structure of a harvested marine fish population. This procedure, when applied correctly, allows the investigator to test specific mechanisms and to determine which behavioral components impact the age and size structure of the population and in what manner. In this presentation, both an outline of the method as well as its application to the theorized ontogenic migration of Atlantic Tarpon, *Megalops atlanticus*, are presented. The results show that this method can be used meaningfully for certain populations but perhaps not for others. Furthermore, for populations for which the method best applies, the procedure outlined here is quite powerful for revealing how we should expect these populations to be structured based on their subpopulations' life-history behaviors and why. Methods for validation of such methods are also discussed.

Population Dynamics Fellows-Abstracts

An Assessment of Pelagic Predator Populations Since the Establishment of Marine Protected Areas: Does a Spillover Effect Exist?

Meagan Dunphy-Daly
Andy Read
Jeff Polovina
Duke University Marine Laboratory

Marine protected areas (MPAs) are frequently used to protect sensitive ecosystem components. MPAs have been hypothesized to enhance adjacent fishery catches via "spillover" from reserves. However, few studies have examined the effectiveness of MPAs for conserving or improving fisheries yields of pelagic apex predators (*e.g.*, tunas, billfishes, sharks). Our study will use NOAA's Observer Program longline data and federally mandated fishing logbooks to determine whether established MPAs are effectively protecting and enhancing pelagic apex predator populations. Specifically, we will quantify the spatial variation in catch, CPUE, and size data for pelagic apex predators as a function of distance from MPA boundaries and time since the establishment of MPAs and assess fisher behavior to examine whether fishers are experiencing spillover effects from MPAs. Preliminary analyses in the Pacific suggest that the CPUE of all tuna species combined has decreased over time, while fishing effort has increased. However, the CPUE of all tuna species combined appears to increase within 500 km of MPAs and then decrease with greater distance away from the MPAs. Fishing effort appears to decrease within 200 km of MPAs, suggesting that fishers may not be experiencing a spillover effect. This research will provide information about MPAs that is critical for NMFS research priorities by assessing changes in the populations of pelagic apex predators after MPA creation, understanding fisher response to MPA establishment, and identifying biological hotspots of pelagic apex predators.

A Nonparametric Approach to Fishery Management

Charles Perretti
Scripps Institution of Oceanography

Population projections play a key role in establishing sustainable harvest rates. However, accurate projections remain a major challenge. In response, there has been a trend towards highly parameterized models in hope of increasing model realism. Here we find that even the correct parametric model will fail to provide accurate projections when the underlying dynamics are complex (i.e. realistic). In contrast, we find a nonparametric approach provides accurate short-term projections in the face of realistic complexity and uncertainty. Our analysis utilizes a suite of models and 21 time series from laboratory experiments. Finally, we apply the nonparametric method to 650 time series from the Ransom Meyers Stock-Recruitment database and find strong evidence for non-random dynamics.

Population Dynamics Fellows—Abstracts

Change in Mean Population Body Size: Growth or Culling?

Jeff Rutter
Quantitative Ecology and Resource Management
University of Washington

In their freshwater and early ocean life stages salmonids experience rapid growth. Because smaller individuals tend to experience greater mortality than larger individuals (hereafter, "culling"), the change in the size-frequency distribution of a population measured over time is larger than the actual growth of individuals in the population. I describe a model which accounts for the simultaneous effects of growth and culling and explore the implications for estimation of growth using two samples of population body size.

I used data from the Columbia Basin Fish and Wildlife Program (CBFWP) passive integrated transponder (PIT) tagging of wild-reared Chinook to parameterize the model for out-migrating juvenile Chinook salmon from the Snake River. I compared the results of naïve growth measurement and a number of model-fitted growth measurements to each year, with particular attention to bias.

The mathematical framework used in this study is also the backbone of a theoretical ocean growth and mortality model.

Implications to Fisheries Stock Assessment of Assuming Spatial Heterogeneity in Harvesting

Sam Truesdell
School of Marine Sciences, University of Maine

A standard assumption throughout the history of fisheries assessment has been the "dynamic pool," meaning a population of fish is thoroughly mixed and lacks any particular spatial structure. Fisheries scientists have always known that this is a vast over-simplification, but limitations in model development and computing power have often precluded spatially explicit models that account for heterogeneous population distributions in space. A dynamic pool assumption is particularly inapt for sedentary species because at harvestable size their movement is negligible so these stocks are not mixed. This project pertains to the potential consequences to stock assessment of assuming homogeneity in fishing effort when harvesting in fact clusters around static, high biomass concentrations. An operating model based on the northeast scallop fishery is developed and used in conjunction with a stock assessment model to test whether biases are introduced into the assessment by inaccurately specifying the spatial distribution of fishing effort.

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Population Dynamics Fellows—Abstracts

A Combined Modeling Approach for Informing Stock Assessment with Electronic Tags

Benjamin Galuardi[1,3]
Steven X. Cadrin[1],Timothy J. Miller[2], Molly Lutcavage[3]
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[3]*Large Pelagics Research Center, University of Massachusetts, Amherst*

Accounting for movement and mixing of fish stocks has the potential to improve assessments but is difficult to estimate and is not typically incorporated into current assessment frameworks. Electronic tagging provides important information on behavior and ecology of many fish species, but the high cost, relatively low sample size and nature of returned data has limited their utility in fisheries assessments. Common geolocation methods for individuals (e.g., Kalman filters) may be structured as advection diffusion equations, making them useful for population level inferences. Movement parameters estimated from tagged fish may be used in simulations to determine seasonal residency in differing geographic regions. Spatiotemporal distributions can then be used in operational models to assess population trends under various management scenarios, allowing evaluation of spatially-explicit stock assessment models and consideration of alternative management approaches for mixed-stock fisheries. This framework will be applied to Atlantic bluefin tuna using age and time based subsets of a large pop-up satellite tag database. Incorporating movement into operational models represents a possible mechanism for consideration of electronic tag data in stock assessments.

Application of a Tag-Integrated Stock Assessment Model to Three Interconnected Stocks of Yellowtail Flounder off of New England

Daniel R. Goethel[1]
Christopher M. Legault[2] ,Steven X. Cadrin[1]
[1]*University of Massachusetts School for Marine Science and Technology,*
[2]*National Marine Fisheries Service, Northeast Fisheries Science Center*

Ignoring population structure and connectivity in stock assessment models can bias the estimates of spawning stock biomass and fishing mortality. Over the last decade, the unknown degree of connectivity between the three stocks of yellowtail flounder (*Limanda ferruginea*) off the New England coast has been identified as a source of uncertainty in the assessments of these stocks. To investigate movement of fish among stocks and provide an independent estimate of mortality, a large-scale tagging study was conducted between 2003 and 2006. Over 45,000 yellowtail flounder were tagged and released, with the number of tagged fish from each stock based on the proportional abundance of that stock to the total yellowtail abundance in the entire region. A total of 3,130 tagged yellowtail were recaptured and reported. We developed and applied a tag-integrated stock assessment that (a) modeled all three populations simultaneously; (b) allowed for connectivity; and (c) incorporated the tagging data directly into the overall objective function. To evaluate the hypothesis that movement between stock areas is a major source of uncertainty, we compared our tag-integrated model results with those from closed population statistical catch-at-age models for each of the three yellowtail flounder stocks. Comparison of results revealed that movement of fish between stocks is low, estimates of stock size and fishing mortality are similar to those from the conventional stock assessments, and the incorporation of movement does not resolve residual patterns.

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Resource Fellows—Abstracts

Taming the Lionfish

David M. Kling[1]
James N. Sanchirico[2]

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[2]*Department of Environmental Science and Policy, University of California, Davis*

The lionfish invasion is a growing threat to native marine life throughout the western Atlantic Ocean. Lionfish abundance is not readily observable, and monitoring the species is costly. In this paper, we develop a bioeconomic model of lionfish management under imperfect information. We consider the problem of a resource manager who seeks to minimize the present value of both invasion damage and management costs using two controls: lionfish removal effort and monitoring. We account for the manager's imperfect knowledge of lionfish abundance by posing the problem as a continuous-state partially observable Markov decision process (POMDP). Our results indicate that early monitoring helps the manager limit the impact of the invasion. The importance of monitoring increases with greater biological stochasticity. Our study also considers the problem of native species bycatch arising from lionfish removal. We identify scenarios where tolerating some native species bycatch is worthwhile in order to suppress lionfish numbers.

Catch Shares, Overlapping Regulatory Regimes, and Micro-Market Structure in New England Groundfish

Andrew Scheld
School of Aquatic and Fishery Sciences, University of Washington

In 2010, management of New England Multispecies groundfish transitioned from input restrictions on harvester effort to a rights-based management scheme. Provided the option of a large reduction in allowable Days-at-Sea (DAS) or cooperative catch share management, 432 active vessels, representing 98% of historical landings, chose the latter. This significant change in management, coupled with the regulation of several, separately managed, revenue important species, led to wide-ranging changes in harvest strategies and landings' timing. This response altered the ex-vessel market mix of species throughout the fishing year, impacting prices received as well as annual harvester revenues. Two counterfactual individual harvester landings' timing scenarios for twenty-five species were combined with independent fixed effects models of inverse dealer demand in estimating the revenue effects of catch shares. Aggregate gains of over $30,000,000 were found to result from advantageous timing changes given estimated ex-vessel price flexibilities.

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Resource Economics Fellows—Abstracts

Price Dispersion in the Gulf of Mexico Red Snapper Quota Lease Market

Andrew Ropicki
Food and Resource Economics Department, University of Florida

Individual Fishing Quota (IFQ) programs are a popular tool for fishery managers trying to stop overfishing, overcapitalization, and derby style fishing. Although IFQs, and other tradable rights programs, provide market-based management tools for fishery managers, the effectiveness of such programs requires that quota trading *markets* function effectively. Price dispersion in the quota lease market is analyzed using network analysis to examine trading in that market for the first five years (2007-2011) of the Gulf of Mexico Commercial Red Snapper IFQ Program.

Dynamic Efficiency Costs of Non-efficiency Objectives in Tradable Permit Programs

Kailin Kroetz
Department of Agricultural and Resource Economics, University of California, Davis

Individual transferable quotas (ITQs) can improve the economic and ecological conditions of fisheries. In ITQ programs, managers often restrict the trade and ownership of quota as a means to accommodate social, cultural, and other non-economic goals. But these restrictions come at a potential cost; that is, by limiting who can trade with whom and own quota, the goal of achieving the total catch at the lowest possible cost to society is unlikely to be attained. Whether the non-economic objectives of fishery management result in significant economic costs is an important and to-date unanswered question. We use data on the Alaskan halibut and sablefish fishery, one of the first fisheries in the United States to implement ITQs, to estimate the magnitude of the costs in the fishery. Specifically, we examine costs associated with limits on consolidation and the linkage of quota to the size of the vessel and geographic areas.

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