NOAA Scientific Publications Report

March 15, 2016

Highlighted Articles

Discovery of a new spawning ground reveals diverse migration strategies in Atlantic bluefin tuna (*Thunnus thynnus*)
Proceedings of the National Academy of Science (9.674)

A framework for inferring biological communities from environmental DNA
Ecological Applications (4.093)

Observing system simulation experiments to assess the potential impact of new observing systems on hurricane forecasting
Marine Technology Society Journal (0.678)

Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico
Scientific Reports (5.578)

Food limitation of sea lion pups and the decline of forage off central and southern California
Royal Society Open Science (N/A)

Thirty-two essential questions for understanding the social-ecological system of forage fish: the case of Pacific herring
Ecosystem Health & Sustainability (2.451)

Novel solutions to conservation data gaps from historical ecology
Ocean and Coastal Management (1.748)

Re-visiting projections of PCBs in lower Hudson River fish using model emulation
Science of the Total Environment (3.163)

Contaminants of emerging concern in a large temperate estuary
Environmental Pollution (4.143)

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Speciation in the benthic dinoflagellate genus *Coolia* (Dinophyceae)
Harmful Algae (3.34)

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Fluorescent Receptor Binding Assay for Detecting Ciguatoxins in Fish
PLOS ONE (3.23)

NMFS Publications

Comparison of growth models for sequential hermaphrodites by considering multi-phasic growth
Fisheries Research (1.90)

Development of the Pacific groundfish trawl IFQ market
Marine Resource Economics (2.071)

Swimming depth of FAD-associated and unassociated dolphinfish (*Coryphaena hippurus*)
Fishery Bulletin (1.783)

Evaluating the benefits and risks of species transformation provisions in multi-species IFQ fisheries with joint production
ICES Journal of Marine Science (2.377)

Reducing green sea turtle bycatch in small-scale fisheries using illuminated gillnets: The cost of reducing sea turtle bycatch
Marine Ecology Progress Series (2.62)

Domestic and imports sources of supply to the U.S. shrimp market and anti-dumping duties
Journal of Economic Studies

Redrawing the map: mtDNA provides new insights into the distribution and diversity of short-finned pilot whales in the Pacific Ocean
Marine Mammal Science (1.936)

Improving stock assessments through data prioritization
Canadian Journal of Fisheries and Aquatic Sciences (2.287)

A life-table model estimation of the Parr capacity of a late-nineteenth century Puget Sound Steelhead population
Canadian Journal of Fisheries and Aquatic Sciences (2.287)

Factors affecting summer distributions of Bering Sea forage fish species: assessing competing hypotheses

Deep Sea Research Part II: Topical Studies in Oceanography (2.190)

Spatial distribution of algicidal and growth-inhibiting bacteria associated with seagrass and macroalgae beds in Puget Sound
Harmful Algae (3.34)

Shallow tidal freshwater habitats of the Columbia River: Spatial and temporal variability of fish communities and density, size, and genetic stock composition of juvenile Chinook Salmon
Transactions of the American Fisheries Society (1.314)

Effect of population abundance and climate on the growth of 2 populations of chum salmon (*Oncorhynchus keta*) in the eastern North Pacific Ocean
Fishery Bulletin (1.738)

Trends and factors influencing the length, compensatory growth, and size-selective mortality of juvenile Bristol Bay, Alaska, sockeye salmon (*Oncorhynchus nerka*) at sea
Marine and Coastal Fisheries (1.810)

Otolith biochronologies reveal latitudinal differences in growth of Bering Sea yellowfin sole *Limanda aspera*
Polar Biology (2.071)

Spatial dynamic optimization of groundwater use with ecological standards for instream flow
Water Economics and Policy (0.698)

Integrating expert perceptions into food web conservation and management
Conservation Letters (7.241)

Human-induced life-history changes in marine ectotherms: trends and management implications
Fish and Fisheries (8.258)

Best practice in Ecopath with Ecosim food-web models for ecosystem-based management
Ecological Modeling (2.321)

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Relating mandates in the United States for managing the ocean to ecosystem goods and services demonstrates broad but varied coverage
Frontiers in Marine Science

Developing an effective model for predicting spatially and temporally continuous stream temperatures from remotely sensed land surface temperatures
Water (1.428)

Conceptualization of social-ecological systems of the California Current: an examination of interdisciplinary science supporting ecosystem-based management
Coastal Management (1.748)

Comparing density and length of Pacific groundfishes using two visual survey vehicles: a manned submersible and remotely operated vehicle
Fishery Bulletin (1.783)

Are spatial and temporal patterns in Lynn Canal overwintering Pacific herring related to top predator activity?
Canadian Journal of Fisheries and Aquatic Sciences (2.276)

Temporal shifts in seabird populations and spatial coherence with prey in the southeastern Bering Sea
Marine Ecology Progress Series (2.64)

The blurred line between form and process: a comparison of stream channel classification frameworks
PLOS ONE (3.23)

Statistical power to detect change in a mangrove shoreline fish community adjacent to a nuclear power plant
Environmental Monitoring and Assessment (1.44)

Coccidial infection of the Adrenal Glands of Leatherback Sea Turtles (*Dermochelys coriacea*)
Journal of Wildlife Diseases (1.355)

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Validation of ultrasound as a noninvasive tool to measure subcutaneous fat depth in leatherback sea turtles (*Dermochelys coriacea*)
Journal of Zoo and Wildlife Medicine (0.42)

Genetic stock composition of marine bycatch reveals disproportional impacts on depleted river herring genetic stocks
Canadian Journal of Fisheries and Aquatic Sciences (2.28)

A comparison between late summer 2012 and 2013 water masses, macronutrients, and phytoplankton standing crops in the northern Bering and Chukchi Seas
Deep Sea Research II (2.76)

Assessing spatial covariance among time series of abundance
Ecology and Evolution (2.320)

Harvest-induced evolution and effective population size
Evolutionary Applications (3.896)

Saffron cod (*Eliginus gracilis*) in North Pacific archaeology
Alaska Journal of Anthropology

Simulating environmental effects on brown shrimp production in the northern Gulf of Mexico
Ecological Modelling (2.321)

Movements and distribution of juvenile common thresher sharks (*Alopias vulpinus*) in Pacific coast waters of the United States and Mexico
Marine Ecology Progress Series (2.619)

OAR Publication

The pink and white terraces of Lake Rotomahana—What was their fate after the 1886 Tarawera eruption?
Journal of Volcanology and Geothermal Research (2.543)

Reconstruction of the geology and structure of Lake Rotomahana and its hydrothermal systems from high-resolution multibeam mapping and seismic surveys
Journal of Volcanology and Geothermal Research (2.543)

Cross Line Office Publications

Dependence of subsurface chlorophyll on seasonal water masses in the Chukchi Sea
Journal of Geophysical Research (3.174)

Human-induced life-history changes in marine ectotherms: trends and management implications
Fish and Fisheries (8.258)

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS

Benthic habitat mapping and assessment in the Wilmington-East wind energy call area
Technical Report to Bureau of Ocean Energy Management and NCCOS

Protected species and longline mussel aquaculture interactions
NOAA/NOS Technical Memorandum

NMFS

Evaluating methods for setting catch limits for gag grouper: data-rich versus data-limited
Proceedings of the Data-Limited Fisheries Symposium

OAR

Climate Program Office FY15 Annual Report
CPO Website

Climate in Context: science and society partnering for adaptation
Book Publication

HIGHLIGHTED ARTICLES

Discovery of a new spawning ground reveals diverse migration strategies in Atlantic bluefin tuna (Thunnus thynnus)
Proceedings of the National Academy of Science (9.674)
D.E. Richardson (NMFS/NEFSC), K.E. Marancik, **J.R. Guyon (NMFS/AKFSC),** M.E. Lutcavage, **B. Galuardi (NMFS/GARFO),** C H. Lam, **H. J. Walsh (NMFS/NEFSC), S. Wildes (NMFS/AKFSC), D.A. Yates (NMFS/AKFSC), J.A. Hare (NMFS/NEFSC)**

- A new western Atlantic spawning ground is described for Atlantic bluefin tuna. The delineation of spawning grounds is central to bluefin tuna management.
- Results indicate that age-at-maturity for western Atlantic bluefin tuna might be overestimated. Age-at-maturity is a critical input to the stock assessments. Lowering the age-at-maturity in an assessment often leads to higher estimates of sustainable fishing mortality rates.
- A new spawning ground means that the population structure of Atlantic bluefin tuna will have to be re-evaluated.

Atlantic bluefin tuna are a symbol of both the conflict between preservationist and utilitarian views of top ocean predators, and the struggle to reach international consensus on the management of migratory species. Currently, Atlantic bluefin tuna are managed as an early-maturing eastern stock, which spawns in the Mediterranean Sea, and a late-maturing western stock, which spawns in the Gulf of Mexico. However, electronic tagging studies show that many bluefin tuna, assumed to be of a mature size, do not visit either spawning ground during the spawning season. Whether these fish are spawning in an alternate location, skip-spawning, or not spawning until an older age affects how vulnerable this species is to anthropogenic stressors including exploitation. We use larval collections to demonstrate a bluefin tuna spawning ground in the Slope Sea, between the Gulf Stream and northeast United States continental shelf. We contend that western Atlantic bluefin tuna have a differential spawning migration, with larger individuals spawning in the Gulf of Mexico, and smaller individuals spawning in the Slope Sea. The current life-history model, which assumes only Gulf of Mexico spawning, overestimates age-at-maturity for the western stock. Furthermore, individual tuna occupy both the Slope Sea and Mediterranean Sea in separate years, contrary to the prevailing view that individuals exhibit complete spawning-site fidelity. Overall, this complexity of spawning migrations questions whether there is complete independence in the dynamics of eastern and western Atlantic bluefin tuna and leads to lower estimates of the vulnerability of this species to exploitation and other anthropogenic stressors.

Published: 7 March 2016
Available Online: http://www.pnas.org/content/early/2016/03/04/1525636113

A framework for inferring biological communities from environmental DNA

Ecological Applications (4.093)

A. O. Shelton, J. L. O'Donnell, **J. F. Samhouri**, N. Lowell, **G. D. Williams**, R. Kelly **(NMFS/NWFSC)**

- Illustrates how environmental DNA and traditional fisheries survey methods are compatible and complementary for surveying marine species.

Environmental DNA (eDNA)—genetic material recovered from an environmental medium such as soil, water, or feces—reflects the membership of the ecological community present in the sampled environment. As such, eDNA is a potentially rich source of data for basic ecology, conservation, and management, because it offers the prospect of quantitatively reconstructing whole ecological communities from easily-obtained samples. However, like all sampling methods, eDNA sequencing is subject to methodological limitations that can generate biased descriptions of ecological communities. Here, we demonstrate parallels between eDNA sampling and traditional sampling techniques, and use these parallels to offer a statistical structure for framing the challenges faced by eDNA and illuminating the gaps in our current knowledge that are needed to glean the greatest insights from eDNA data. Although the current state of knowledge on some of these steps precludes a full estimate of biomass for each taxon in a sampled eDNA community, we use an original dataset to estimate the relative abundances of taxon-specific template DNA prior to PCR, given the abundance of DNA sequences recovered post-PCR-and-sequencing, a critical step in the chain of eDNA inference. While we focus on the use of eDNA samples to determine the relative abundance of taxa within a community, our approach applies directly to single-taxon applications, as well as those that focus on estimating occurrence rather than abundance. By grounding inferences about eDNA community composition in a rigorous statistical framework, and by making these inferences explicit, we hope to improve the quantitative potential for the emerging field of community-level eDNA analysis.

Accepted: 28 January 2016

Observing system simulation experiments to assess the potential impact of new observing systems on hurricane forecasting

Marine Technology Society Journal (0.678)

R. Atlas, L. Bucci, B. Annane, R. Hoffman, S. Murillo (OAR/AOML)

- Cross-agency collaboration for improved weather analysis and prediction
- Early applications of global Observing System Simulation Experiments to track hurricane forecasting

Observing System Simulation Experiments (OSSEs) are an important tool for evaluating the potential impact of new or proposed observing systems, as well as for evaluating trade-offs in observing system design, and in developing and assessing improved methodology for assimilating new observations. Extensive OSSEs have been conducted at the National Aeronautical and Space

Administration (NASA) Goddard Space Flight Center (GSFC) and the National Oceanic and Atmospheric Administration (NOAA) Atlantic Oceanographic and Meteorological Laboratory (AOML) over the last three decades. These OSSEs determined correctly the quantitative potential for several proposed satellite observing systems to improve weather analysis and prediction prior to their launch; evaluated trade-offs in orbits, coverage, and accuracy for space-based wind lidars; and were used in the development of the methodology that led to the first beneficial impacts of satellite surface winds on numerical weather prediction. This paper summarizes early applications of global OSSEs to hurricane track forecasting and new experiments using both global and regional models. These latter experiments are aimed at assessing potential impact on hurricane track and intensity prediction over the oceans and at landfall.
Published: 1 November 2015
Available online:
http://www.ingentaconnect.com/content/mts/mtsj/2015/00000049/00000006/art00012

Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico
Scientific Reports (5.578)
J. J. Roberts, B. D. Best, L. Mannoccia, E. Fujiokaa, P. N. Halpin, **D. Palka (NMFS/NEFSC)**, **L. P. Garrison (NMFS/SEFSC)**, **K. D. Mullin (NMFS/SEFSC)**, **T. V. N. Cole (NMFS/NEFSC)**, **C. B. Khan (NMFS/NEFSC)**, W. A. McLellan, D. A. Pabst, G. G. Lockhart

- This paper presents density maps for 26 cetacean species and 3 multi-species guilds in the U.S. Atlantic and Gulf of Mexico by integrating survey data with habitat-based density models.
- The authors generate monthly mean density maps for 11 well-known species in the Atlantic and year-round mean density maps for lesser known species and in the Gulf of Mexico.
- The maps are freely available online and can be used to calculate levels of marine mammal takes.

Cetaceans are protected worldwide but vulnerable to incidental harm from an expanding array of human activities at sea. Managing potential hazards to these highly-mobile populations increasingly requires a detailed understanding of their seasonal distributions and habitats. Pursuant to the urgent need for this knowledge for the U.S. Atlantic and Gulf of Mexico, we integrated 23 years of aerial and shipboard cetacean surveys, linked them to environmental covariates obtained from remote sensing and ocean models, and built habitat-based density models for 26 species and 3 multi-species guilds using distance sampling methodology. In the

Atlantic, for 11 well-known species, model predictions resembled seasonal movement patterns previously suggested in the literature. For these we produced monthly mean density maps. For lesser-known taxa, and in the Gulf of Mexico, where seasonal movements were less well described, we produced year-round mean density maps. The results revealed high regional differences in small delphinoid densities, confirmed the importance of the continental slope to large delphinoids and of canyons and seamounts to beaked and sperm whales, and quantified seasonal shifts in the densities of migratory baleen whales. The density maps, freely available online, are the first for these regions to be published in the peer-reviewed literature.

Accepted: 17 February 2016
Available online: http://www.nature.com/articles/srep22615

Food limitation of sea lion pups and the decline of forage off central and southern California

Royal Society Open Science (N/A)

S. McClatchie, J. Field, A. R. Thompson, T. Gerrodette, M. Lowry, P. C. Fiedler, W. Watson, K. M. Nieto, R. D. Vetter (NMFS/SWFSC)

- The causes of sea lion pup weight loss are not from episodic stresses associated with El Niño but a longer term trend of declining forage quality in the waters around the California Channel Island rookeries.
- The authors show that trends in sea lion pup weights over the last decade can be predicted using the forage variables from fishery-independent surveys.
- In the near term, the authors expect repeated years with emaciated sea lion pups, which could have long-term consequences on California sea lion population numbers if the period of low quality forage continues.

California sea lions increased from approximately 50,000 to 340,000 animals in the last 40 years, and their pups are starving and stranding on beaches in southern California, raising questions about the adequacy of their food supply. We investigated whether the declining sea lion pup weight at San Miguel rookery was associated with changes in abundance and quality of sardine, anchovy, rockfish and market squid forage. In the last decade off central California, where breeding female sea lions from San Miguel rookery feed, sardine and anchovy greatly decreased in biomass, while market squid and rockfish abundance increased. Pup weights fell as forage food quality declined associated with changes in the relative abundances of forage species. A model explained 67% of the variance in pup weights using forage from central and southern California and 81% of the variance in pup weights using forage from the female sea lion foraging range. A shift from high to poor quality forage for breeding females results in food limitation of the

pups, ultimately flooding animal rescue centers with starving sea lion pups. Our study is unusual in using a long-term, fishery-independent data set to directly address an important consequence of forage decline on the productivity of a large marine predator. Whether forage declines are environmentally driven, a combination of environmental drivers and fishing removals, or are due to density-dependent interactions between forage and sea lions is uncertain. However, declining forage abundance and quality was coherent over a large area (32.5-38°N) for a decade, suggesting that trends in forage are environmentally driven.
Accepted: 2 February 2

Thirty-two essential questions for understanding the social-ecological system of forage fish: the case of Pacific herring
Ecosystem Health & Sustainability (2.451)
P. S. Levin, T. B. Francis, N. G. Taylor **(NMFS/NWFSC)**

- This work brought stakeholders in the Pacific herring social-ecological system in the Northeast Pacific together to collaboratively chart a path towards minimizing conflict while managing Pacific herring sustainably
- The questioned identified present researchers and resource managers the opportunity to fill critical knowledge gaps relevant across a diverse set of stakeholders
- The process used may be transferable to sustainable, collaborative management of other commercially and ecologically important forage fish

Forage fishes are ecologically and economically important low trophic level species, and in recent years interest in their biology and management has intensified. Pacific herring are emblematic of the management issues facing forage species—they are central components of the Northeast Pacific pelagic food web and support important commercial fisheries. In addition their importance to indigenous peoples have made them cultural keystone species. We employed a participatory process to promote collaborative priority-setting for this critical forage species. Working with managers, the fisheries industry, indigenous peoples, and scientists, we co-constructed a conceptual model of the Pacific herring social-ecological system (SES) in the Northeast Pacific. We then identified a set of questions, that if answered, would significantly increase our ability to sustainably manage the herring SES. Our objective was to generate a road map for scientists who wish to conduct useful forage fish research, for resource managers who wish to develop new research efforts that could fill critical gaps, and for public agencies and private foundations seeking to prioritize funding on forage fish issues in the Pacific. Herring are an archetypal forage fish; however, much more so than other forage fishes, they are at the foundation of cultural and

social systems in the Northeastern Pacific. With this socio-cultural centrality comes complexity for fisheries management. Our participatory process highlighted the value of conceptualizing the full social-ecological system, overcame disciplinary differences in scientific approaches, research philosophy and language, and charted a path forward for future research and management for forage species.
Accepted: 18 February 2016

Novel solutions to conservation data gaps from historical ecology
Ocean and Coastal Management (1.748)
R. H. Thurstan, L. McClenachan, L. B. Crowder, L. Drew, J. N. Kittinger, **P. S. Levin**, C. M. Roberts, J. M. Pandolfi **(NMFS/NWFSC)**

- Discusses the use of unconventional sources used to fill knowledge gaps in historical marine ecology.

Ecological data sets rarely extend back more than a few decades, limiting our understanding of environmental change and its drivers. Marine historical ecology has played a critical role in filling these data gaps by illuminating the magnitude and rate of ongoing changes in marine ecosystems. Yet despite a growing body of knowledge, historical insights are rarely explicitly incorporated in mainstream conservation and management efforts. Failing to consider historical change can have major implications for conservation, such as the ratcheting down of expectations of ecosystem quality over time, leading to less ambitious targets for recovery or restoration. We discuss several unconventional sources used by historical ecologists to fill data gaps – including menus, newspaper articles, cookbooks, museum collections, artwork, benthic sediment cores – and novel techniques for their analysis. We specify opportunities for the integration of historical data into conservation and management, and highlight the important role that these data can play in filling conservation data gaps and motivating conservation actions. As historical marine ecology research continues to grow as a multidisciplinary enterprise, great opportunities remain to foster direct linkages to conservation and improve the outlook for marine ecosystems.
Accepted: 18 February 2016

Re-Visiting projections of PCBs in Lower Hudson River fish using model emulation
Science of the Total Environment (3.163)
J. Field, J. Kern, **L. Rosman (NOS/ORR)**

- The emulated model predicted that the time to reach fish tissue risk-based thresholds in the lower Hudson will take decades longer than EPA's original mechanistic model projections.
- Additional removal would be needed to achieve EPA's original goals.
- Fish advisories on Hudson River fish will last for decades longer than originally expected.
- Therefore, the NRDA and injury to fish will continue to occur and damages that we will seek to recover from General Electric (the polluter) will be higher.

Remedial decision making at large contaminated sediment sites with bioaccumulative contaminants often relies on complex mechanistic models to forecast future concentrations and compare remedial alternatives. Remedial decision-making for the Hudson River PCBs Superfund Site involved predictions of future levels of PCBs in Upper Hudson River (UHR) and Lower Hudson River (LHR) fish. This study applied model emulation to evaluate the impact of updated sediment concentrations on the original mechanistic model projections of time to reach risk-based target thresholds in fish in the LHR under Monitored Natural Attenuation (MNA) and the selected dredging remedy. The model emulation approach used a combination of nonlinear and linear regression models to estimate UHR water PCBs as a function of UHR sediment PCBs and to estimate fish concentrations in the LHR as a function of UHR water PCBs, respectively. Model emulation captured temporal changes in sediment, water, and fish PCBs predicted by the mechanistic model over the emulation period. The emulated model, using updated sediment concentrations and a revised estimate of recovery rate, matched the trend in annual monitoring data for white perch in the LHR between 1997 and 2014. Our best predictions based on the emulated model indicate that the projected time to reach fish tissue risk-based thresholds in the LHR will take decades longer than the original mechanistic model projections.
Expected publication date: 10 March 2016

Contaminants of emerging concern in a large temperate estuary
Environmental Pollution (4.143)
J. P. Meador (NMFS/NWFSC), A. Yeh, G. Young, E. P. Gallagher

- This paper discusses contaminants of emerging concern that have been detected at relatively high concentrations in effluent, estuarine waters, and fish collected in Puget Sound.
- These chemicals were detected at concentrations that may result in adverse effects in fish and other biota.

- Substantial and continuous loading of these CECs to local Puget Sound estuaries may impact recovery efforts for species at risk.

This study was designed to assess the occurrence and concentrations of a broad range of contaminants of emerging concern (CECs) from three local estuaries within
a large estuarine ecosystem. In addition to effluent from two wastewater treatment plants (WWTP), we sampled water and whole-body juvenile Chinook salmon (Oncorhynchus tshawytscha) and Pacific staghorn sculpin (Leptocottus armatus) in estuaries receiving effluent. We analyzed these matrices for 150 compounds, which included pharmaceuticals, personal care products (PPCPs), and several industrial compounds. Collectively, we detected 81 analytes in effluent, 25 analytes in estuary water, and 42 analytes in fish tissue. A number of compounds, including sertraline, triclosan, estrone, fluoxetine, metformin, and nonylphenol were detected in water and tissue at concentrations that may cause adverse effects in fish. Interestingly, 29 CEC analytes were detected in effluent and fish tissue, but not in estuarine waters, indicating a high potential for bioaccumulation for these compounds. Although concentrations of most detected analytes were present at relatively low concentrations, our analysis revealed that overall CEC inputs to each estuary amount to several kilograms of these compounds per day. This study is unique because we report on CEC concentrations in estuarine waters and whole-body fish, which are both uncommon in the literature. A noteworthy finding was the preferential bioaccumulation of CECs in free-ranging juvenile Chinook salmon relative to staghorn sculpin, a benthic species with relatively high site fidelity.

Accepted: 29 January 2016
Expected publication date: 22 February 2016
Available online:
http://www.sciencedirect.com/science/article/pii/S0269749116300884

ADDITIONAL ARTICLES

NOS Publications

Speciation in the benthic dinoflagellate genus Coolia (Dinophyceae)
Harmful Algae (3.34)
C.P. Leaw, T.H. Tan, H.C. Lim, S.T. Teng, H.L. Yong, K.F. Smith, L. Rhodes, M. Wolf, **W.C. Holland**, **M.W. Vandersea**, **R.W. Litaker**, **P.A. Tester**, H. Gu, G. Usup, P.T. Lim **(NOS/NCCOS)**

- The authors assess the evolutionary history of harmful dinoflagellate genus *Coolia* Meunier.

- The results of phylogenetic genetic analysis confirm *C. malyensis* as a distinct species and support the hypothesis that vicariant events led to the allopatric differentiation of *C. malayensis* and *C. monotis*.

In this study, inter- and intraspecific genetic diversity within the marine harmful dinoflagellate genus *Coolia* Meunier was evaluated using isolates obtained from the tropics to subtropics in both Pacific and Atlantic Ocean basins. The aim was to assess the phylogeographic history of the genus and to clarify the validity of established species including C. malayensis. Phylogenetic analysis of the D1-D2 LSU rDNA sequences identified six major lineages (L1–L6) corresponding to the morphospecies *C. malayensis* (L1), *C. monotis* (L2), *C. santacrace* (L3), *C. palymerensis* (L4), *C. tropicalis* (L5), and *C. canariensis* (L6). A median joining network (MJN) of *C. malayensis* ITS2 rDNA sequences revealed a total of 16 haplotypes; however, no spatial genetic differentiation among populations was observed. These MJN results in conjunction with CBC analysis, rDNA phylogenies and geographical distribution analyses confirm *C. malayensis* as a distinct species which is globally distributed in the tropical to warm-temperate regions. A molecular clock analysis using ITS2 rDNA revealed the evolutionary history of *Coolia* dated back to the Mesozoic, and supports the hypothesis that historical vicariant events in the early Cenozoic drove the allopatric differentiation of *C. malayensis* and *C. monotis*.
Expected Publication Date: Spring 2016

Fluorescent receptor binding assay for detecting ciguatoxins in fish
PLOS ONE (3.23)
D. R. Hardison, **W. C. Holland**, J. R. McCall, A. J. Bourdelais, D. G. Baden, T. Darius, M.Chinain, **P. A. Tester**, D. Shea, H. A. F. Quintana, **J. Morris Jr.,** and **R. W. Litaker (NOS/NCCOS)**

- The fluorescent receptor binding assay developed in the study allows rapid) screening of ciguatoxin levels in fish, at a much lower cost than standard methods, and without generating radioactive waste.
- The assay utilizes commonly available equipment and is ideal for incorporation into monitoring programs designed to insure seafood safety and food security in poorer tropical island nations.
- The method is currently being used to screen the ciguatoxin concentration in invasive lionfish in the Caribbean. These fish are causing extensive damage to reefs and policy decisions regarding whether fishing can be used to control their population will depend on the levels of ciguatoxin they accumulate.

Globally, CTXs are the largest cause of non-bacterial seafood poisoning associated with fish consumption. Currently the most widely used methods to test for CTX in seafood is through the use of a radio-ligand based receptor binding assay (RBA(R)) using tritiated PbTx-3 ([3H]-PbTx-3) as the ligand and the mouse bioassay. Recently, a fluorescence based receptor binding assay (RBA(F)) allowing rapid screening of fish samples for ciguatoxins (CTXs) was developed. The fluorescence based assay utilizes the competition between CTXs and brevetoxins (PbTxs), both of which bind voltage gated sodium channel receptors at site 5. Specifically, ciguatoxins extracted from fish tissues competed with fluorescent BODIPY®-labeled PbTx-2 for the sodium channel binding sites present in standardized synaptosome preparations. Binding of the BODIPY®-PbTx-2 was inversely proportional to the sample CTX concentration, with lower limit of detection of 0.075 ppb and a linear response from 0.1 to 1.0 ppb P-CTX-3C equivalents. Caribbean ciguatoxin (C-CTX-1) detection was confirmed using LC-MS and C-CTX-1 standards. A total of six different fish species (N=61) were screened using the RBA(F) assay. Corresponding samples analyzed using the neuroblastoma-2a cytotoxicity (N2a) assay showed that the N2a and RBA(F) assays correlated well (R2=0.71), particularly given the low levels of CTX present in positive fish. Analysis of the data also showed that the resulting N2a P-CTX-3C equivalents were consistently lower than the RBA(F) cytotoxixity expressed as % binding equivalents, indicating that a given amount of toxin bound to the site 5 receptors translates into corresponding higher cytotoxicity. Consequently, the RBA(F) assay, which takes less than two hours to perform, provides a conservative estimate relative to the widely used N2a assay requiring 2.5 days to complete. Other RBA(F) advantages include the long-term (>5 years) stability of the BODIPY®- PbTx-2 and lower sample variability than equivalent assays employing tritiated PbTx-3 as the CTX site 5 competitor. The assay is cost effective, allows high sample throughput and is ideal for routine CTX monitoring programs. The laboratory transition from radiolabeled to fluorescent RBA should be straightforward given that the equipment used to perform the assay is commonly found in most laboratories without special restrictions.
Expected publication date: Spring 2016

NMFS Publications

Comparison of growth models for sequential hermaphrodites by considering multi-phasic growth
Fisheries Research (1.90)
B. G. Matthias, R. N. M. Ahrens, M. S. Allen, **L. A. Lombardi-Carlson, G. R. Fitzhugh (NMFS/SEFSC)**

- Where sufficient data was available, a multi-phasic growth function (tri-phasic Lester model) was better at representing growth, maturity and sex transition patterns in gag, a protogynous hermaphrodic grouper, compared to simpler models.
- Based upon a yield analysis, the management implications of a more biologically realistic growth model for gag are more conservative. That is, the estimate for F_{MSY} is lower than obtained using the more common Von Bertalanfy growth function.

The von Bertalanffy (VB) growth function has been extensively used since 1938 to describe fish growth. However, for fish with complex life history (e.g. hermaphroditism) it may not be the best predictor of changes in length-at-age. We sought to determine if growth curves accounting for maturity and sex change were more appropriate than the VB model at capturing the growth and maturation patterns of Gag *Mycteroperca microlepis*, a protogynous hermaphrodite. To account for changes in growth at maturity, we used the Lester et al. (2004) growth model (bi-phasic Lester) and a modified Lester et al. (2004) model to account for an additional growth phase at sex change (tri-phasic Lester). We also compared management reference points from each model using an equilibrium yield per recruit (YPR) framework to assess biases associated with the growth models. The tri-phasic Lester growth model described growth and maturity patterns better than the bi-phasic Lester or VB, indicating separate growth phases associated with maturation and sex change. Estimates of F_{MSY} from the YPR analysis showed conservative estimates when using the tri-phasic Lester model (0.18) compared to the VB model (0.34). Fishing mortality rates resulting in 35% of unfished total and male-specific spawning stock biomasses (SSB) were similar for all models, but female-specific estimates were lower using the bi-phasic Lester. Our results support arguments that a single growth curve is insufficient to capture the lifetime growth of fish particularly when growth parameters are linked to natural mortality. However, the VB and the tri-phasic Lester predicted mean length-at-age were similar for all ages. This suggests the VB equation should be adequate when information on reproductive data is not available, but at a risk to management recommendations.

Published: 20 February 2016
Available online: http://authors.elsevier.com/a/1SaPGbiU1ZoJz

Development of the Pacific groundfish trawl IFQ market
Marine Resource Economics (2.071)
Authors: D. S. Holland (NMFS/NWFSC)

- The study examines the development over time of quota markets in markets in multispecies individual fishing quota (IFQ) systems
- The results illustrate the negative effects on fisheries of slow developing quota markets
- The author provides recommendations for program design that can improve market efficiency

In multispecies individual fishing quota (IFQ) systems, in-season transferability of quota plays an important role since fishermen often need to acquire quota to balance incidental catch for which they hold insufficient quota. The optimal utilization of quotas is thus dependent in part on development of an efficient quota market, but markets in multispecies IFQ fisheries develop slowly and may fail to perform efficiently even after several years. In 2011 an IFQ system was implemented for the Pacific Groundfish trawl fishery in the US. After four years, the quota pounds (QP) market does not appear to be yielding efficient prices for many species or distributing quota efficiently. I explore the structure of the QP market and how it is performing and discuss the impediments to market efficiency. Drawing from theory and experience in other multispecies IFQ systems, I discuss other quota distribution and catch balancing mechanisms that can supplement and perhaps improve inefficient markets and enable higher quota utilization rates.
Accepted: 2 February 2016

Swimming depth of FAD-associated and unassociated dolphinfish (Coryphaena hippurus)
Fishery Bulletin (1.783)
N. M. Whitney, M. Taquet, **R. W. Brill**, C. Girard, G. D. Schwieterman, L. Dagorn, and K. N. Holland **(NMFS/NEFSC)**

- The authors studied the vertical movement patterns of dolphinfish associated and unassociated with floating objects such as debris or fish aggregation devices (FADs).
- FAD-associated dolphinfish generally stay within the upper 10 m of the water column and tend to make deeper excursions during the day rather than at night; in contrast, unassociated dolphinfish utilize the upper 75-100 m of the water column during the day and descend to 160 m during the night.
- Dolphin fish descend only to depths where water temperatures is no more than 3ºC cooler than the surface mixed layer, regardless of time of day.
- Using vertical behavior as a proxy to determine whether a dolphinfish is FAD-associated or not opens the possibility for large scale research investigating the role of floating objects in the ecology of this species.

Dolphinfish (*Coryphaena hippurus*) are large pelagic predators that are important targets of recreational, artisanal, and commercial fisheries, and are frequently associated with floating objects such as debris or fish aggregation devices (FADs). In order to elucidate vertical movement patterns and differences between FAD-associated and unassociated fish, we tagged eight dolphinfish with pressure-sensitive ultrasonic transmitters and actively tracked individuals continuously for up to 40 h. This allowed us to make direct observations of when fish were FAD-associated and unassociated. Four additional fish were equipped with coded transmitters and passively monitored for several days by FAD-attached receivers. When not associated with FADs, dolphinfish utilized the upper 75-100 m of the water column during the day, and during the night made descents up to 160 m. In contrast, when associated with floating objects, fish generally stayed within the upper 10 m of the water column and tended to make deeper excursions during the day rather than at night. Water temperature data from expendable bathythermographs deployed during active tracks showed they only descended to depths where water temperatures were no more than 3ºC cooler than the surface mixed layer, regardless of time of day. Using vertical behavior as a proxy to determine whether a dolphinfish is associated or not with a floating object opens the possibility for new large scale research aimed at investigating the role of floating objects in the ecology of this species, and at assessing the impacts of FADs on their ecology.
Accepted: 2 February 2016

Evaluating the benefits and risks of species transformation provisions in multi-species IFQ fisheries with joint production
ICES Journal of Marine Science (2.377)
P. Woods, **D. S. Holland**, and A. E. Punt **(NMFS/NWFSC)**

- The authors use a bioeconomic model to examine how species transformation provisions, a fisheries management system that allow fishers to convert quota of one species to that of another species, affect sustainability and profitability in a multi-species fishery.
- The authors demonstrate some risk and little benefit of species transformations systems.

Species transformation provisions used in fisheries management systems allow fishers to convert quota of one species to that of another species at prescribed conversion rates. These provisions, alongside other catch-quota balancing mechanisms, are meant to aid fishers in matching available quota to actual catch so that incentives to discard are reduced. Here we use a bioeconomic model to examine how species transformation provisions affect sustainability and

profitability of a multi-species fishery, given that fishers have a short-term view to maximize their profit within each fishing year. We base parameterization of the model loosely on management of the Icelandic demersal fishery, which currently employs one of the broadest implementations of species transformations. To represent fisher behavior in each year, effort is allocated among two or three métiers, such that total profit for that year is maximized. Each métier represents a combination of three species catchability rates that define which species are targeted by each métier and how independent a species' catch rate is from that of other species. Assumptions regarding how constrained the fishery is to fish several species simultaneously, versus target species individually, is paramount to understanding more generally how any fishing regulations, such as species transformations. Can be expected to change fishing patterns. This constraint depends not only on how correlated species catchabilities are within a métier, but also on relative species abundances and what alternate métiers are available. The potential for increased or decreased profit due to species transformations was also analyzed, as well as the potential for profit to be increased through an increased responsiveness of fishing to economic conditions when there is uncertainty or error in setting the total allowable catches or species conversion rates.
Accepted: 9 February 2016

Reducing green sea turtle bycatch in small-scale fisheries using illuminated gillnets: The cost of reducing sea turtle bycatch
Marine Ecology Progress Series (2.62)
N. Ortiz, **J. Wang**, J. Alfaro-Shigueto, S. Pingo, A. Jimenez, T. Suarez, Y. Swimmer, F. Carvalho, and B. J. Godley **(NMFS/PIFSC)**

- Managing the bycatch of sea turtles in gillnets is needed to promote the long-term stability of both sea turtle populations and local fisheries.
- Gillnet fisheries exist throughout the oceans and have been implicated in high bycatch rates of sea turtles.
- The authors examined the effectiveness of illuminating nets with light-emitting diodes (LEDs), placed on floatlines in order to reduce the sea turtle bycatch in a small-scale bottom-set gillnet fishery, and found that they reduced bycatch by 63.9%.

Gillnet fisheries exist throughout the oceans and have been implicated in high bycatch rates of sea turtles. In this study, we examined the effectiveness of illuminating nets with light-emitting diodes (LEDs), placed on floatlines in order to reduce the sea turtle bycatch in a small-scale bottom-set gillnet fishery. In Sechura Bay, Northern Peru, 114 pairs of control and experimental nets were deployed. The predicted mean Catch Per Unit of Effort (CPUE) of target species, standardized for

environmental variables using generalized additive model analysis, was similar for both control and experimental nets. In contrast, the predicted mean CPUE of green sea turtles (Chelonia mydas) was reduced by 63.9% in experimental nets. One hundred twenty-five green sea turtles were caught in control nets while 62 were caught in experimental nets illuminated by LEDs. This statistically significant ($p<0.05$) reduction in sea turtle bycatch suggests that net illumination could be an effective conservation tool. Challenges to implementing the use of LEDs include equipment costs, increased net handling times, and limited awareness among fishermen regarding the effectiveness of this technology. Cost estimates for preventing a single sea turtle catch range from $32 to $196 USD with a tendency to decrease over time, while the costs to outfit the fishery in Sechura Bay range from $19.3K to $33.4K USD. Understanding these cost challenges emphasizes the need for institutional support from National ministries and international non-governmental organizations in order to more broadly implement net illumination as a sea turtle bycatch reduction strategy.
Accepted: 24 February 2016

Domestic and imports sources of supply to the U.S. shrimp market and anti-dumping duties
Journal of Economic Studies
A. Marvasti and **D. Carter (NMFS/SEFSC)**

- 93% of shrimp consumption in the US is from imports (with the majority being farmed)
- While domestic shrimp production and output has remained fairly stable, there has been consolidation in the fishery, meaning that the output per vessel is going up.
- The US has levied anti--dumping duties on imported shrimp, but these duties have been ineffective in reducing the importation of foreign shrimp.
- Imports continue to flow into the US unabated, regardless of the duties imposed.

This study provides an economic analysis of the domestic sources of supply and imports to the U.S. shrimp market. We estimate a simultaneous equations model with equations for domestic supplies from the Gulf of Mexico, imports, and prices. Estimated long--run elasticities suggest that the domestic shrimp supply appears to be explained by seasons, diesel fuel price, hurricane activity and shrimp price. We find evidence of a downward-sloping supply curve for the domestic harvesters that is likely to be temporary. Furthermore, anti-dumping duties have been ineffectual in curtailing imports produced by exploitation of natural shrimp biomass in developing countries and by technological advancements in aquaculture

production. We also find evidence of a low exchange rate pass through. Finally, while domestic and import prices are not co-integrated, there is a two--way causality between them. This study provides a thorough investigation of the supply side of an important component of the U.S. seafood market displaying the complexity of domestic producers' reaction to falling prices, and ineffectual protectionism.
Accepted: 24 February 2016

Redrawing the map: mtDNA provides new insights into the distribution and diversity of short-finned pilot whales in the Pacific Ocean
Marine Mammal Science (1.936)
V. A. M. Cise, P. A. Morin, R. W. Baird, **A. R. Lang, K. M. Robertson, S. J. Chivers, R. L. Brownell,** and **K. K. Martien (NMFS/SWFSC)**

- The authors identify the distribution and genetic differentiation of two types of short-finned pilot whale in the Pacific Ocean.
- Based on genetics, there are two types of short-finned pilot whale distributed throughout the Pacific, which may be sub-species.

Correlations between morphological and genetic data provide evidence to delineate species or evolutionarily significant units, which then become the units to conserve in management plans. Here, we examine the distribution and genetic differentiation of two morphotypes of short-finned pilot whale (*Globicephala macrorhynchus*) in the Pacific Ocean. Mitochondrial control region sequences from 333 samples were combined with 152 previously published sequences to describe genetic variability globally and population structure in the Pacific. Although genetic variability is low, we found strong differentiation at both broad and local levels across the Pacific. Based on genetics, two types are distributed throughout the Pacific, one predominantly in the eastern Pacific and the other in the western and central Pacific. In the eastern Pacific Ocean, no correlation was found between distribution and sea surface temperature. The two types have broad latitudinal ranges, suggesting their distributions are likely driven by more complex factors, such as prey distribution, rather than sea surface temperature.
Accepted: 19 February 2016

Improving stock assessments through data prioritization
Canadian Journal of Fisheries and Aquatic Sciences (2.287)
K. I. Siegfried, E.H. Williams, K. W. Shertzer, L. Coggins **(NMFS/SEFSC)**

- This research provides a framework for fishery scientists to determine which of the data they are lacking would most influence the accuracy of the stock assessments in their region.

- For the U.S. South Atlantic, improving age data most improved the accuracy of the assessments.

The need for "better data" is a common response of stakeholders and managers when confronted with the uncertainty of advice resulting from quantitative stock assessments. Most contemporary stock assessments are based on integrated analysis of multiple data types each with their associated cost to collect. Because data collection resources are inevitably limited, it is important to quantify the relative value of increased sampling for alternative data types in terms of improving stock assessments. We approached this problem using a simulation study of a hypothetical, amalgam species developed from eight separate stock assessments conducted in the southeastern U.S. Atlantic waters. We simulated a population and a stock assessment from the amalgam species, and then individually improved alternative data types (indices, age compositions, landings and discards), by either increasing precision or sample size. We also simulated the effects of increased sampling for alternative groupings of data that might be collected in concert (e.g., commercial, all recreational, or survey). We also considered the marginal cost of each of these improvements. Our results show that age composition data have the largest effect on the accuracy of assessments, with commercial age compositions being the most influential. This is due in part to the relative paucity of age composition data for many U.S. Southeast stocks, so that modest increases in collection efforts have relatively high benefits for age-based assessment models currently in use for the region. Our simulation study provides a general investigative framework for quantitatively evaluating the benefits of improved data collection in terms of the precision of stock assessments.
Accepted: 18 January 2016

A life-table model estimation of the Parr capacity of a late-nineteenth century Puget Sound Steelhead population
Canadian Journal of Fisheries and Aquatic Sciences (2.287)
N. Gayeski, **G. R. Pess, T. J. Beechie (NMFS/NWFSC)**

- Historic reconstruction can help identify historic baseline conditions for steelhead populations in Puget sound

An age-structured life-cycle model for Stillaguamish River steelhead was employed to estimate the number of age-one steelhead parr that could have produced the estimated adult return of 69 000 in 1895. We then divided the estimated parr numbers by the estimated area of steelhead rearing habitat in the Stillaguamish River basin in 1895 and under current conditions to estimate density of rearing steelhead then and now. Scaled to total wetted area of mainstem habitat, our historic estimates range from 0.08 parr·m-2 to 0.19 parr·m-2. Values for

smaller tributary habitats range from 0.24 parr·m-2 to 0.7 parr/m2. These values are significantly greater than current densities in the Stillaguamish (mainstem: 0.04 parr·m-2, tributaries: 0.07 parr·m-2), but well within the range of recent estimates of steelhead parr rearing densities in high quality habitats. Our results indicate that modest improvement in the capacity of mainstem and tributary rearing habitat in Puget Sound rivers will yield large recovery benefits if realized in a large proportion of the area of river basins currently accessible to steelhead.
Accepted: 15 February 2016

Factors affecting summer distributions of Bering Sea forage fish species: assessing competing hypotheses
Deep Sea Research Part II: Topical Studies in Oceanography (2.190)
S. L. Parker-Stetter (NMFS/NWFSC), S. Urmy, J. K. Horne, **L. B. Eisner (NMFS/AKFSC), E. V. Farley, Jr (NMFS/AKFSC)**

- Many hypotheses have been advanced to explain the distribution of forage fish species in the Bering Sea and this study comprehensives tests those hypotheses.
- Both local (e.g. bottom depth, temperature, salinity) and annual (e.g. June winds, monthly sea surface temperature) were important factors in models describing the presence and/or densities of forage fish.
- Although forage fish are often treated as a single group, model results suggest that the factors influencing presence and/or density varied between species.

Hypotheses on the factors affecting forage fish species distributions are often proposed but rarely evaluated using a comprehensive suite of variables. Using 24 predictor variables, we compared competing hypotheses and calculated average models for the distributions of capelin, age-0 Pacific cod, and age-0 pollock in the eastern Bering Sea from 2006-2010. Distribution was described using a two stage modeling approach: probability of occurrence ("presence") and density when fish were present. Both local (varying by location and year) and annual (uniform in space but varying by year) variables were evaluated, the latter accounting for the possibility that distributions were random but that overall presence or densities changed with annual conditions. One regional variable, distance to the location of preflexion larvae earlier in the year, was evaluated for age-0 pollock. Capelin distributions were best predicted by local variables such as bottom depth, temperature, and salinity. Annual climate (May sea surface temperature (SST), sea ice extent anomaly) and wind (June wind speed) variables were often important for age-0 Pacific cod in addition to local variables (temperature and depth). Surface, midwater, and water column age-0 pollock distributions were best described by a

combination of local (depth, temperature, salinity, zooplankton) and annual (May SST, sea ice anomaly, June wind speed) variables. Our results corroborated some of those in previous distribution studies, but suggested that presence and density may be influenced by different factors. Even though there were common environmental factors that influenced all species' distributions, it is not possible to generalize conditions for forage fish as a group.
Accepted 11 January 2016

Spatial distribution of algicidal and growth-inhibiting bacteria associated with seagrass and macroalgae beds in Puget Sound
Harmful Algae (3.34)

- This study demonstrates the ability of seaweed and seagrass to harbor bacteria that can help control harmful algal blooms

The spatial distribution of algicidal bacteria and growth-inhibiting bacteria associated with seagrass and macroalgae were investigated during the summer of 2012 and 2013 throughout Puget Sound, WA, USA. In 2012, algicidal bacteria against the fish-killing raphidophyte Heterosigma akashiwo were isolated from the outer organic layer of biofilm on the common eelgrass, Zostera marina, in north Padilla Bay (2.77 x 106 CFU g-1 wt) and growth-inhibiting bacteria against the neurotoxin-producing dinoflagellate Alexandrium tamarense species complex were detected within the eelgrass canopy at Dumas Bay and North Bay at densities of ~108 CFU g-1 wt. From 1.8 x 101 – 4.1 x 103 CFU mL-1 of algicidal and growth-inhibiting bacteria against both A. tamarense and H. akashiwo were also detected in seawater adjacent to seven different eelgrass beds. In 2013, the investigation was extended to include algicidal and growth-inhibiting bacteria associated with several seagrass and dominant macroalgae species in north Puget Sound. Algicidal bacteria against H. akashiwo were found on Z. marina and U. lactuca with the highest densities of 1.1 x 108 and 1.4 x 108 CFU g-1 wt, respectively, at Shallow Bay, Sucia Island, in the northern San Juan Archipelago region of Puget Sound. Growth-inhibiting bacteria against three different harmful species, H. akashiwo, A. tamarense and Karenia mikimotoi, were also detected on Z. marina, Z. japonica and U. lactuca. Cyst densities of Heterosigma and Alexandrium in the sediment were also investigated at five different eelgrass beds and in Westcott Bay (north of San Juan Island), a location where eelgrass disappeared in 2002. No cysts of Heterosigma and Alexandrium were found at any eelgrass beds, however H. akashiwo cysts were detected in Westcott Bay at 3400 cells g-1 wet sediment. These findings provide new insights on the ecology of algicidal and growth-inhibiting bacteria, and suggest that seagrass and macroalgae beds serve as a habitat for bacteria that help to mitigate harmful algal blooms in coastal waters.

This work highlights the importance of protection and restoration of native seagrass and macroalgae in nearshore environments, in particular those regions where shellfish restoration initiatives are in place to satisfy a growing demand for seafood, to provide cleaner water via nutrient removal, and to assist with species recovery.

Accepted: 25 January 2016

Shallow tidal freshwater habitats of the Columbia River: Spatial and temporal variability of fish communities and density, size, and genetic stock composition of juvenile Chinook Salmon

Transactions of the American Fisheries Society (1.314)

N. K. Sather, G. E. Johnson, **D. J. Teel**, A. J. Storch, J. R. Skalski, V. I. Cullinan
(NMFS/NWFSC)

- To obtain comprehensive information about juvenile salmon characteristics in the lower Columbia River and estuary (LCRE), sampling should be conducted year-round in multiple habitat types because the complexity of early life history necessitates a broad spatial and temporal view.
- Our findings suggest that habitat restoration for juvenile salmon in the LCRE should restore a diverse suite of habitats that in turn support a diversity of life-history traits expressed by juvenile salmon during seaward migration.

We investigated spatial and temporal variability of the fish community and density, size, and genetic stock composition of juvenile Chinook Salmon *Oncorhynchus tshawytscha* in shallow tidal freshwater habitats of the Columbia River. The impetus for the study was to address data gaps related to juvenile Chinook Salmon in this portion of the Columbia River to inform habitat restoration efforts. We examined fish communities, attributes of juvenile salmon life-history characteristics, and relationships to habitat conditions using beach seine data from two tidal freshwater areas, the Sandy River delta (rkm 188–202) and the "Lower River Reach" (rkm 110–141), over a 63-month period (2007−2012). We found few differences in the fish community across the two study areas. Fish community patterns were largely attributable to seasonal changes as opposed to spatial gradients and habitat types. Juvenile Chinook Salmon, the most common salmon species in our catches, were the only salmon species encountered during all seasons. Densities of Chinook Salmon differed among three distinct habitat strata (main channel, off-channel, and wetland), but fork lengths (FLs) and genetic stock composition did not. Across all habitat strata, environmental covariates (mean percent tree cover, dissolved oxygen, and mean percent emergent vegetation) were positively associated with juvenile salmon density. While comparisons of

environmental metrics and salmon density helped to establish a quantitative relationship between biotic and abiotic conditions, we found juvenile salmon to occupy a range of habitats. These findings support a strategy of restoring a diversity of shallow tidal freshwater habitats to support recovery of threatened and endangered salmon populations in the Columbia River basin.
Accepted: 1 February 2016

Effect of population abundance and climate on the growth of 2 populations of chum salmon (Oncorhynchus keta) *in the eastern North Pacific Ocean*
Fishery Bulletin (1.738)
E. M. Yasumiishi, K. R. Criddle, J. H. Helle, N. Hillgruber, F. J. Mueter
(NMFS/AKFSC)

- Declines in the size at maturity of chum salmon from 1972 to mid-1990s was related to reduction in growth as immatures in offshore waters.
- Reduction in fall wind (an index for a fall bloom of phytoplankton) were associated with increased fall growth that may be important in determining over wintering survival of chum salmon during their first year at sea.

Seasonal and annual marine growth of chum salmon (*Oncorhynchus keta*) from Fish Creek, Alaska, during 1972–2004 and from Quilcene River, Washington, during 1973–2004 were examined in relation to abundances of chum salmon and pink salmon (*O. gorbuscha*) and climate indices from that period. Pink salmon abundance indices were included in the analysis because of evidence for density-dependent effects on chum salmon growth and survival. In linear regression models, growth was negatively related to abundance of chum salmon or to the combined abundance of pink and chum salmon during the middle juvenile (July–Sept), 1st immature, 2nd immature, and maturing stages for the Fish Creek chum salmon and the 1st immature, 2nd immature, and maturing stages for Quilcene River chum salmon, indicating possible density‑dependent effects on growth. Mid-juvenile and maturing growth models for the Fish Creek chum salmon and the maturing growth model for Quilcene River chum salmon performed well in model validation, when model predictions were tested against 20% of the data that were not used for model specification, and provided insight into the effects of climate and abundance on growth of chum salmon from 1972 to 2004.
Accepted: 5 February 2016

Trends and factors influencing the length, compensatory growth, and size-selective mortality of juvenile Bristol Bay, Alaska, sockeye salmon (Oncorhynchus nerka) *at sea*
Marine and Coastal Fisheries (1.810)

NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 15, 2016

E. Yasumiishi, E. Farley (NMFS/AKFSC), G. T. Ruggerone, B. A. Agler, and L. I. Wilson

- This paper supplements the understanding of the marine ecology of Bristol Bay sockeye salmon.
- Based on the findings in this study and other studies, increases in SSTs in the Bering Sea are expected to result in an increase in the length of juvenile sockeye salmon, increase in the frequency of compensatory growth, increase in size--selective mortality, and increase in overall survival to a point where the energy status of juvenile sockeye salmon reduces overwintering survival.
- This paper argues that length and compensatory growth are expected to increase up to a point where metabolic demands due to a higher SST would decrease growth.

Bristol Bay, Alaska, sockeye salmon (*Oncorhynchus nerka*) productivity increased during the mid-1970s. This increase in productivity was believed to be partially due to an increase in early marine growth associated with the 1976-77 cool to warm shift in summer sea surface temperature (SST). Body size of juvenile salmon during the first year at sea is believed to regulate their ability to survive overwinter. Back--calculated smolt length, first year ocean growth, and total juvenile length of sockeye salmon from five Bristol Bay river systems (Egegik, Kvichak, Naknek, Ugashik, and Wood) and for two smolt ages were used to examine trends and factors influencing total juvenile length, compensatory growth, and size--selective mortality in the first year in the ocean from 1962 to 2007. Juvenile length increased in relation to summer sea temperature warming, the 1977--2001 warm regime, 2002--2007 warmer regime, smolt length, and compensatory growth. Compensatory growth, an inverse relationship between first year ocean growth and smolt size, increased over time, increased after the 1976-77 climate regime shift, was more common in age--1.0 juveniles than age--2.0 juveniles, and was important in determining the length of juvenile sockeye salmon from Wood River (the shorter fish among rivers and smolt ages). The coefficient of variation in length did not change with SST suggesting size-selective mortality prior to the end of the first growth year at sea for all 10 fish groups (river & smolt age). Predictor variables significant in the models varied among river system and smolt age. Results of this study demonstrated that the frequency of compensatory growth and total length of juvenile sockeye salmon during the first year at sea increased with summer SST (7.5--10.5 °C range) in the eastern Bering Sea, a possible mechanism for increased productivity of Bristol Bay sockeye salmon associated with warmer sea temperatures.

Accepted: 23 February 2016

NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 15, 2016

Otolith biochronologies reveal latitudinal differences in growth of Bering Sea yellowfin sole Limanda aspera

Polar Biology (2.071)

M.E. Matta, **T. Helser,** B. Black **(NMFS/AKFSC)**

- In general, yellowfin sole otolith growth responds positively to temperature throughout the Bering Sea.
- However, somewhat unexpectedly, growth in the southern Bering is more strongly related to climate than in the north.
- Impacts of climate may not be felt uniformly across the species' range due to mitigating factors such as competition and prey availability.

Annual growth patterns in the hard parts of marine organisms are often related to factors in the physical environment; investigators are increasingly borrowing methods from the field of dendrochronology (tree-ring science) to explore these relationships. When applied to otoliths of yellowfin sole Limanda aspera, an abundant and commercially important flatfish, this approach has demonstrated a strong positive correlation between otolith growth and bottom temperature in the southeastern Bering Sea. In the present study, we assess whether the biochronology-growth relationship extends to yellowfin sole collected at higher latitudes. Two new northern Bering Sea biochronologies, one from the Bering Strait region and one near St. Matthew Island, were developed and compared with the southeastern Bering Sea biochronology using mixed effects modeling. Despite large distances (up to 600 km), a high degree of synchrony was observed among all three chronologies. However, subtle differences in growth among the three regions were revealed upon closer examination. The relative amplitude of otolith growth differed among the three chronologies, with stronger negative anomalies in the south and stronger positive anomalies in the north. Differences in average length at age were also detected, with fish growing slower to greater lengths at higher latitudes. Lastly, the Bering Strait biochronology had the weakest and most localized relationships with climate variables, suggesting effects of climate may not be felt uniformly across the regions examined. Biochronologies may thus provide a useful tool in evaluating potential biological responses to projected climate change across a species' range.

Accepted: 26 February 2016

Spatial dynamic optimization of groundwater use with ecological standards for instream flow

Water Economics and Policy (0.698)

C. Speir, J. Han, N. Brozovic **(NMFS/SWFSC)**

- The paper shows that there are economic benefits from tailoring pumping regulations to account for the spatial arrangement of wells near a stream.
- The results provide some guidance in designing effective streamflow management to protect fish habitat in systems where groundwater and surface water are interconnected.

We examine how variations in the spatial distribution and timing of groundwater management actions, as well as the physical characteristics of a stream aquifer system, affect regulators' ability to meet instream goals in a stream-aquifer system. We propose an optimization model that distributes restrictions on groundwater pumping among a set of irrigators in a way that minimizes costs, subject to meeting instream flow requirements. Our model is distinguished by two features: 1) instream flow requirements must be met daily and 2) we incorporate a hydrologic model of stream-aquifer interaction that allows the time lags of the stream depletion impact that vary across space. Our results show that there is a tradeoff between the daily magnitude and duration of the stream-depletion effect: more distant wells have a smaller, but longer-lived, impact on streamflow. We find that there exist important cases where in drought years where wells located closer to the stream should be allocated more water than wells farther from the stream, despite having a smaller overall effect on stream depletion. Our results show the importance of considering the lag between the time at which pumping occurs and the time at which stream depletion related to that pumping occurs.
Accepted: February 24, 2016

Integrating expert perceptions into food web conservation and management
Conservation Letters (7.241)
A. C. Stier, **J. F. Samhouri**, S. Gray, R. G. Martone, M. Mach, B. S. Halpern, C. Kappel, C. Scarborough, **P. S. Levin (NMFS/NWFSC)**
Decision makers rely on expert knowledge to guide environmental management and policy decisions, but expert knowledge of a system can vary significantly, which can lead to conflicts between stakeholders.

- This studies results show that different experts' knowledge and perceptions of the Pacific herring ecosystem will lead to a divergence in management outcomes
- By measuring how different experts anticipate ecosystems will respond to future perturbation or management action, experts can explicitly work toward consensus and building knowledge capital.

Decision makers often rely on expert knowledge to guide management and policy decisions, especially in complex, dynamic, and data-poor social-ecological systems. However, the knowledge held by experts can vary- often significantly- by

background, training, and experience. When differences exist they can lead to conflict due to variable perspectives on how the system works and is expected to respond to management actions. Understanding when expert perceptions vary and how these different perceptions might contribute to environmental conflict is therefore critical to building knowledge and developing shared understanding of sustainability solutions. Here we demonstrate variability in expert perceptions of food webs centered on Pacific herring—a valuable ecological, economic, and cultural resource. We use simulations to demonstrate how each expert's perceived food web exhibits divergent perceptions about the future state of the ecosystem under future management scenarios impacting herring. Expert's food web responses varied markedly when we simulated an increase in herring. Our findings demonstrate that expert knowledge is not as discrete or homogenous as typical expert categories suggest. Given the high variation we observed in predicted ecosystem impacts of herring, our results suggest that variation in experts' perceptions of the ecosystem may contribute to future conflict over herring management decisions. Our study also provides a preemptive approach for managers to predict and reduce conflict as a partial function of structural disagreement and uncertainty. We suggest that by measuring how different experts anticipate ecosystems will respond to future perturbation or management action, experts can explicitly work toward consensus and building knowledge capital.
Accepted: 8 February 2016

Human-induced life--history changes in marine ectotherms: trends and management implications
Fish and Fisheries (8.258)
A. Audzijonyte, E. A. Fulton, M. Haddon, F. Helidoniotis, A. J. Hobday, J. Morrongiello, J. Upston, **R. S. Waples (NMFS/NWFSC)**

- This paper finds that fishing and climate change will alter life history traits of marine fish
- It argues that stock assessments should take these changes into consideration
- It predicts that ecosystem models that assume life history traits are constant will produce misleading results

Evidence is accumulating that many marine ectotherms are undergoing rapid changes in their life--history characteristics. These changes have been variously attributed to fisheries--induced evolution, inhibited adult growth rate due to oxygen limitation at higher temperatures, and plastic responses to density dependence or changes in ocean productivity. Here we review the diverse underlying mechanisms by which plastic and evolutionary responses to climate change and fisheries are likely to produce similar life--history trends in harvested marine ectotherms,

leading to faster life--histories with earlier maturation and smaller adult size--at--age. While mechanistically understanding these growth and maturation changes may be difficult, it is clear that changing life--histories will lead to modified population dynamics, productivity and natural mortality of the affected species. We discuss how observed and expected life--history changes could affect the assumptions and uncertainty of single and multi-species models currently used in marine ecosystem management, highlighting that models which allow for dynamic life--history traits often report significantly different results on stock biomasses. Given that both climate and harvest induced life--history changes are likely to intensify and possibly amplify each other, there is an urgent need to adequately assess the implications of faster life-histories for marine ecosystem management. This is especially true for data poor stocks, where growth and maturation are not regularly assessed. Targeted monitoring can be used to inform responsive management, but for improved sustainability outcomes, a precautionary approach to management that is robust to life-history trends is advised.
Accepted: 3 February 2016

Best practice in Ecopath with Ecosim food-web models for ecosystem-based management
Ecological Modeling (2.321)
J. J. Heymans, M. Coll, **J. S. Link**, S. Mackinson, J. Steenbeek, C. Walters, V. Christensen **(NMFS/OAA)**

- Ecopath with Ecosim (EwE) models are easy to construct and have been for the past 30 years, but due to ease of use have been misapplied.
- We caution that using EwE models without best practices and an understanding of associated uncertainties may not result in desired outcomes of management decisions.

Ecopath with Ecosim (EwE) models are easier to construct and use compared to most other ecosystem modelling techniques and are therefore more widely used by more scientists and managers. This, however, creates a problem with quality assurance; to address this we provide an overview of best practices for creating Ecopath models. We describe the diagnostics that can be used to check for thermodynamic and ecological principles, and highlight principles that should be used for balancing a model. We then highlight the pitfalls when comparing Ecopath models using Ecological Network Analysis indices. For dynamic simulations in Ecosim we show the state of the art in calibrating the model by fitting it to time series using a formal fitting procedure and statistical goodness of fit. Finally, we show how Monte Carlo simulations can be used to address uncertainty in input parameters, and we discuss the use of models in a management

context, specifically using the concept of 'key runs' for ecosystem-based management. This novel list of best practices for EwE models will enable ecosystem managers to evaluate the goodness of fit of the given EwE model to the ecosystem management question.
Published: 29 January 2016
Available online:
http://www.sciencedirect.com/science/article/pii/S030438001500575X

Relating mandates in the United States for managing the ocean to ecosystem goods and services demonstrates broad but varied coverage
Frontiers in Marine Science
C. M. Foran, **J. S. Link (NMFS/OAA)**, **W. S. Patrick (NMFS/OSF)**, L. Sharpe

- This paper presents a complete catalog of the legislative, executive and international mandates related to NOAA, as well as the subset of these relevant to NOAA-Fisheries.
- The ecosystem goods and services addressed by each NOAA mandate are assessed, as well as the overlap between the major mandates.
- The collective coverage across the suite of ecosystem goods and services is shown in comparison to the portfolio of mandates; differences in these profiles indicate a continued need for ecosystem--based management.

There are numerous ecosystem goods and services (EGS) provided by the ocean. There are also multiple mandates to address this suite of EGS. What facets of the ocean EGS does this portfolio of mandates collectively address? How are these mandates interrelated? Are there gaps in their coverage of EGS? Are there areas of reinforcement? To elucidate this set of issues, we characterize the portfolio of mandates that a leading governmental ocean agency, the National Oceanographic and Atmospheric Administration (NOAA), and the subset of those that one of its Line Offices, the National Marine Fisheries Service (NOAA--Fisheries), is responsible for implementing. We link these mandates to a suite of EGS, evaluating the relative degree that each mandate addresses each EGS. The weighted overlap across mandates with respect to EGS was also estimated. Of the nearly 100 NOAA mandates, and the subset of 50 NOAA--Fisheries mandates, there was broad coverage of ocean EGS. Food production, habitat provision, genetic resources, recreation, tourism, historical and heritage value, and knowledge and science value were the EGS that had the highest degree of coverage. All EGS had at least some mandate coverage, although some had a limited number of mandates associated with them. There was some reinforcement across mandates, particularly for the top EGS, suggesting that the multiple facets of these EGS are

being reasonably well addressed. The large number of mandates and the importance of EGS they address suggest that some form of coordination is warranted, particularly via adoption of an ecosystem-based approach to management.
Published: 18 February 2016
Available online:
http://journal.frontiersin.org/article/10.3389/fmars.2016.00005/full?utm_source=Email_to_authors_&utm_medium=Email&utm_content=T1_11.5e1_author&utm_campaign=Email_publication&field=&journalName=Frontiers_in_Marine_Science&id=174209

Developing an effective model for predicting spatially and temporally continuous stream temperatures from remotely sensed land surface temperatures
Water (1.428)
K. M. McNyset, C. J. Volk, **C. E. Jordan (NMFS/NWFSC)**

- The authors develop a model to predict stream temperatures on site-specific to basin-wide scales from remotely-sensed land surface temperature data.
- The model is able to predict stream temperatures continuously in space and time with limited temperature logger information and extensive remote sensing data.

Although water temperature is important to stream biota, it's difficult to collect in a spatially and temporally continuous fashion. We used remotely-sensed Land Surface Temperature [LST] data to estimate mean daily stream temperature for every confluence-to-confluence reach in the John Day River, OR, USA for a ten year period. Models were built at 3 spatial scales: site-specific, subwatershed, and basin-wide. Model quality was assessed using jackknife and cross-validation. Model metrics for linear regressions of the predicted vs. observed data across all sites and years: site-specific r2 = 0.95, RMSE = 1.25 °C; subwatershed r2 = 0.88, RMSE = 2.02 °C; basin-wide r2 = 0.87, RMSE = 2.12 °C. Similar analyses were conducted using 2012 8-day composite LST and 8-day mean stream temperature in 5 watersheds in the interior Columbia River basin. Mean model metrics across all basins: r2 = 0.91, RMSE = 1.29 °C. Sensitivity analyses indicated accurate basin-wide models can be parameterized using data from as few as 4 temperature logger sites. This approach generates robust estimates of stream temperature through time for broad spatial regions for which there is only spatially and temporally patchy observational data, and may be useful for managers and researchers interested in stream biota.
Accepted: 23 November 2015
Available online: http://www.mdpi.com/2073-4441/7/12/6660

NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 15, 2016

Conceptualization of social-ecological systems of the California Current: an examination of interdisciplinary science supporting ecosystem-based management
Coastal Management (1.748)
P.S. Levin, S.J. Breslow, C.J. Harvey, K.C. Norman, M.R. Poe, **G.D. Williams, M. Plummer (NMFS/NWFSC)**

- This work uses conceptual social-ecological system models to support Integrated Ecosystem Assessments (IEA) of the California Current ecosystem.
- The new conceptualization shows how the place and role of people in the ecosystem has changed over the course of the history of the California Current IEA and highlights the need for interdisciplinary science.

Improved understanding and management of social-ecological systems (SES) requires collaboration between biophysical and social scientists; however, issues related to research philosophy and approaches, the nature of data, and language hinder interdisciplinary science. Here, we discuss how we used conceptual models to promote interdisciplinary dialogue in support of Integrated Ecosystem Assessments (IEAs) in the California Current ecosystem. Initial conceptualizations of the California Current IEA were based on the Driver-Pressure-State-Impact-Response framework. This initial framing was biophysically-centered, with humans primarily incorporated as impacts on the system. We wished to move from a conceptualization that portrayed an antagonistic relationship between humans and nature to one that integrated humans and social systems into the IEA framework. We propose a new conceptualization of the California Current that functions across temporal and spatial scales, captures the diverse relationships that typify SESs, and highlights the need for interdisciplinary science. The development of this conceptualization reveals how the place and role of people in the ecosystem changed over the course of the history of the California Current IEA. This conceptual model is ever-evolving, but has served as a critical fulcrum to ensure that interdisciplinarity will now be the standard for the California Current IEA and, perhaps, beyond.
Accepted: 3 February 2016

Comparing density and length of Pacific groundfishes using two visual survey vehicles: a manned submersible and remotely operated vehicle
Fishery Bulletin (1.783)
T. Laidig and M. Yoklavich (NMFS/SWFSC)

- This work considers the capabilities of two visual survey vehicles in terms of detection, identification, and estimates of count and size of groundfishes in three habitat types.
- The authors find significant differences between results of remote-operated vehicle (ROV) and manned submersible surveys.
- This study underscores the need to evaluate biases and limitations of visual survey tools.

Visual surveys of sea floor communities in deep water are becoming more common, and the results are being used to provide fishery-independent abundance estimates and to improve stock assessments for some groundfish species. Assumptions, biases, and limitations of these surveys must be considered when selecting survey vehicles and developing survey design. To examine some of these issues, we estimated densities of demersal fishes using 2 survey vehicles (a manned submersible and a remotely operated vehicle [ROV]), and considered vehicle capabilities and fish reactions relevant to these estimates. Visual surveys were conducted in deep water (75-315 m) off the coast of central California in the fall of 2007. Over 4,000 fishes were counted from the manned submersible and >6,000 from the ROV. Fish densities were estimated from 28 paired strip transects in 3 types of sea floor habitat (high-relief hard rock, low-relief mixed rock, and soft sediments). Differences in fish detection, identification, and measurements were observed between vehicles (e.g., densities of unidentified rockfishes, unidentified Sebastomus, and unidentified fishes were significantly higher in ROV surveys). Higher densities of those species most closely associated with the seafloor were observed from submersible surveys than from ROV surveys, which, in part, could be due to the greater reactions of these fishes to the ROV. We could not estimate size for a greater percentage of fishes from video images collected with the ROV compared to in situ observations during the HOV surveys (12 and 2%, respectively). Results of our study will be useful to evaluate potential limitations and biases of these underwater survey vehicles when assessing demersal fishes.
Accepted: 25 February 2016

Are spatial and temporal patterns in Lynn Canal overwintering Pacific herring related to top predator activity?
Canadian Journal of Fisheries and Aquatic Sciences (2.276)
K.M. Boswell, G. Rieucau, **J.J. Vollenweider**, **J.R. Moran**, **R.A. Heintz**, J.K. Blackburn, and **D.J. Csepp (NMFS/AKFSC)**

- The authors use monthly hydroacoustic survey data to study the spatial and temporal dynamics of overwintering Pacific herring and associations with predators.
- Results show that foraging humpback whales disrupt overwinter schools of Pacific herring, likely increasing the risk of predation by other piscivorous predators.

In Southeast Alaska, overwintering Pacific herring (Clupea pallasii) form large conspicuous schools which are preyed upon by an abundance of mammalian and avian predators, thus leading to the question of why herring adopt a strategy that appears counterproductive to predator avoidance during these periods. We examined the spatial and temporal dynamics of overwintering Pacific herring and associations with predators through monthly hydroacoustic surveys during two consecutive winters. Large variation was observed through the winter season in herring distribution, school morphology and density. Herring school characteristics and biomass estimates were negatively correlated with humpback whale abundance patterns during both winters and as whales departed towards the end of winter, herring distributions shifted from dispersed schools in the water column toward deep, dense schools. We postulate that the schooling patterns observed in Lynn Canal overwintering herring are likely to be mediated by predation threat rather than energetics or feeding activities. An additional consequence of humpback whales dispersing herring in the water column may be an increased threat of predation by other surface-oriented predators.

Accepted: 18 February 2016
Available online: http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2015-0192?src=recsys#.VuLhieIrLRY

Temporal shifts in seabird populations and spatial coherence with prey in the southeastern Bering Sea

Marine Ecology Progress Series (2.62)

R. M. Suryan, K. J. Kuletz, **S. L. Parker-Stetter (NMFS/NWFSC**), **P. H. Ressler (NMFS/AKFSC**), M. Renner, J. K. Horne, **E. V. Farley, Jr (NMFS/AKFSC**), E. A. Labunski

- During breeding, seabirds are spatially associated with colonies, but post-breeding they are spatially and temporally associated with forage fish prey
- Seasonal shifts in seabird distributions in the fall are more closely associated with forage fish in the middle and inner shelf regions

The Bering Sea is a highly productive ecosystem with abundant prey populations in the summer that support some of the largest seabird colonies in the world. In the fall, the Bering Sea supports large numbers of migrants and post-breeding birds.

We used over 22,000 km of vessel-based surveys during summer (June-July) and fall (late August-October) of 2008-2010 within a 400,000 km^2 study area to examine annual and seasonal changes in seabird communities and spatial relationships with concurrently sampled prey in the southeastern Bering Sea. Deep diving murres (*Uria spp.*), shallow-diving shearwaters (*Puffinus spp.*), and surface foraging Northern fulmars (*Fulmarus glacialis*) and kittiwakes (*Rissa spp.*) dominated summer and fall seabird communities. Seabird species richness was lower in summer than fall and seabird densities in summer were generally less than half of fall densities. Summer seabird densities had high interannual variation (highest in 2009), whereas fall densities varied little among years. Seabirds were more spatially clustered around breeding colonies and the outer continental shelf in the summer and then dispersed within the middle and inner shelf in fall. In summer, age-1 walleye pollock, *Gadus chalcogrammus* along with spatial (latitude and longitude) and temporal (year) variables best explained broad-scale seabird distribution. In contrast, seabirds in fall had fewer associations with spatial and temporal variables and more associations with different prey species or groups. Our results demonstrate seasonal shifts in the distribution and foraging patterns of seabirds in the southeastern Bering Sea with a greater dependence on forage fish over the middle and inner shelf in fall.
Accepted: 4 February 16

The blurred line between form and process: a comparison of stream channel classification frameworks
PLOS ONE (3.23)
A. Kasprak, N. Hough-Snee, **T. J. Beechie (NMFS/NWFSC)**, N. Bouwes, G. Brierley, R. Camp, K. Fryirs, **H. Imaki (NMFS/NWFSC)**, M. L. Jensen, G. O. O'Brien, J. M. Wheaton

- Four channel classification systems often agree in how they classify streams. However, they differ in some cases due to the relative importance of discriminating variables or the aim of the classification system (e.g., classifies historical channel pattern or current channel pattern).

Stream classification frameworks provide a means to understand the diversity and distributions of channel types that occur across a landscape while drawing linkages between geomorphic form and process. Accordingly, stream classification is frequently employed as a watershed planning tool. In practice, numerous frameworks are available to managers for classifying rivers, yet little information exists about how frameworks compare. Specifically, the data, time, and expertise required to implement a given classification, the consistency of classification results, and the subsequent geomorphic interpretation between multiple

frameworks have not been discussed following data-driven framework comparisons. Here we apply four classification methods across a physiographically-diverse catchment within the American Pacific Northwest. We compare the results of the River Styles Framework (RS), Natural Channel Classification (NCC), Natural Channel Design (NCD), and channel form-based statistical classification. We found moderate agreement between NCC and NCD, as both are driven by reach-scale channel planform. These classifications differ from RS, an effect of RS' emphasizing broader, valley-scale confinement as a driving variable. Statistical classification is likely to shadow any classification based on similar data inputs – in this case channel slope, width and substrate. We discuss the relative effort, disciplinary expertise required to complete each classification, noting that if a framework classifies current or pre-disturbance channel form, results can provide insight on watershed disturbance. By using multiple frameworks to classify the same catchment, we are able to identify trade-offs between frameworks and make recommendations on how each framework mechanistically differs in grouping channels and their driving processes.
Accepted: 12 February 2016

Statistical power to detect change in a mangrove shoreline fish community adjacent to a nuclear power plant
Environmental Monitoring and Assessment (1.44)

- Identifying and dedicating sufficient effort and funds for appropriate, long-term biological monitoring associated with power plants can be challenging.
- The authors examined the statistical adequacy of using an ongoing federal-state biological monitoring effort, initiated and supported for reasons unrelated to the power plant, for detecting fish assemblage changes that may stem from future power plant expansion and/or operation.
- This study indicates that monitoring objectives related to this project may be achieved by adjusting and/or supplementing existing monitoring programs.

An expansion is underway of a nuclear power plant on the shoreline of Biscayne Bay, Florida, USA. While the precise effects of its construction and operation are unknown, impacts on surrounding marine habitats and biota are considered by experts to be likely. The objective of the present study was to determine the adequacy of an ongoing monitoring survey of fish communities associated with mangrove habitats directly adjacent to the power plant to detect fish community changes, should they occur, at three spatial scales. Using seasonally resolved data recorded during 532 fish surveys over an 8-year period, power analyses were performed for four mangrove fish metrics (fish diversity, fish density, and the occurrence of two ecologically important fish species: gray snapper (*Lutjanus*

griseus) and goldspotted killifish (*Floridichthys carpio*). Results indicated that the monitoring program at current sampling intensity allows for detection of <33 % changes in fish density and diversity metrics in both the wet and the dry season in the two larger study areas. Sampling effort was found to be insufficient in either season to detect changes at this level (<33 %) in species-specific occurrence metrics for the two fish species examined. The option of supplementing ongoing, biological monitoring programs for improved, focused change detection deserves consideration from both ecological and cost-benefit perspectives.
Accepted: 20 February 2016

Coccidial infection of the Adrenal Glands of Leatherback Sea Turtles (Dermochelys coriacea)
Journal of Wildlife Diseases (1.355)
Ferguson SD, Wellehan JFX, Frasca S, Innis CJ, Harris HS, Miller M, Weber ES, Stockdale-Walden H, Greiner EC, Merigo C, **Stacy BA (NMFS-OPR)**

- This paper contributes to the very limited information on health and disease that is available for leatherback turtles
- This paper will also assist examiners with interpretation of a common necropsy finding

Histological lesions incidental to the cause of death were observed in the adrenal glands of seventeen subadult and adult leatherback sea turtles found dead or moribund on or near shore in North America. Round bodies measuring 250 to 300 µm in diameter composed of an outer capsule and large multinucleated cells surrounding a central mass of acellular material were distributed throughout the affected glands. Protozoal etiology was suspected based on some resemblance to coccidia; however, features diagnostic for coccidial infection were lacking in all but one case, which had a focal area of adrenalitis containing zoites. A novel eucoccidian partial 18S rRNA genetic sequence was consistently detected in adrenal glands with lesions. Using quantitative PCR, a specific area of the V4 region of the coccidian 18S gene was quantified in affected adrenal glands and correlated significantly with density of the histological lesions. A second distinct but closely related 18S sequence was also amplified from the adrenal gland of one turtle and from a fecal sample containing unsporulated coccidian oocysts. The two 18S sequences identified from leatherback sea turtles form a clade within the Family Eimeriidae. Further investigation is required to better understand the morphology of the life stages, life cycle, and potential effects of this coccidian parasite on adrenal function.
Accepted: 21 February 2016

Validation of Ultrasound as a noninvasive tool to measure subcutaneous fat depth in leatherback sea turtles (Dermochelys coriacea)
Journal of Zoo and Wildlife Medicine (0.42)
HS, Benson SR, James MC, Martin KJ, **Stacy BA (NMFS/OPR)**, Daoust P-Y, Rist PM, Work **TM, Balazs G (NMFS/PIFSC), Seminoff JA (NMFS/SWFSC)**

- Describes a method for quantitative assessment of body condition that is useful for health parameter for future studies

Leatherback turtles (*Dermochelys coriacea*) undergo substantial cyclical changes in body condition between foraging and nesting. Ultrasonography has been used to measure subcutaneous fat as an indicator of body condition in many species but has not been applied in sea turtles. To validate this technique in leatherback turtles, ultrasound images were obtained from 36 live-captured and dead-stranded immature and adult turtles from foraging and nesting areas in the Pacific and Atlantic oceans. Ultrasound measurements were compared with direct measurements from surgical biopsy or necropsy. Tissue architecture was confirmed histologically in a subset of turtles. The dorsal shoulder region provided the best site for differentiation of tissues. Maximum fat depth values with the front flipper in a neutral (45–908) position demonstrated good correlation with direct measurements. Ultrasound-derived fat measurements may be used in the future for quantitative assessment of body condition as an index of health in this critically endangered species.
Accepted: 28 September 2015

Genetic stock composition of marine bycatch reveals disproportional impacts on depleted river herring genetic stocks
Canadian Journal of Fisheries and Aquatic Sciences (2.28)
D. J. Hasselman, **E. C Anderson (NMFS/SWFSC)**, E. E Argo, N. D. Bethoney, S. R Gephard, D. M. Post, B. P. Schondelmeier, T. F Schultz, T. V Willis, Eric P Palkovacs.

- The authors developed statistical methods for fishery-independent abundance and population dynamic estimates using genetic data.
- This method opens the way to considerable development in population dynamics.

Mark-recapture (MR) methods are commonly used to study wildlife populations. Taking advantage of modern genetics one can generalize from “recapture of self” to “recapture of closely-related kin". Abundance and other demographic parameters of adults can then be estimated using, if necessary, only samples from dead animals (live-release is optional). This greatly widens the scope of MR, e.g. to commercial fisheries where large-scale tagging is impractical, and enhances the

power of conventional MR studies where live release and tissue sampling is possible. We give explicit formulae for kinship (i.e. recapture) probabilities in general and specific cases. These yield a pseudo-likelihood based on pairwise comparisons of individuals in the samples. It is shown that the pseudo-likelihood approximates the full likelihood under sparse sampling of large populations. Experimental design is addressed via the principle of maximizing the Fisher information for parameters of interest. Finally, we discuss challenges related to kinship determination from genetic data, focusing on current limitations and future possibilities.
Accepted: 19 November 2015

A comparison between late summer 2012 and 2013 water masses, macronutrients, and phytoplankton standing crops in the northern Bering and Chukchi Seas
Deep Sea Research II (2.76)
S. L. Danielson, **L. Eisner** (**NMFS/AKFSC**), **C. Ladd (OAR/PMEL)**, **C. Mordy (OAR/PMEL)**, L. Sousa, T. J. Weingartnernot

- The results of this study have implications for the total magnitude and seasonal evolution of primary productivity, secondary production, and the fate of fresh water, heat, and pelagic production on the Bering-Chukchi shelves.

Survey data from the northern Bering and Chukchi sea continental shelves in August-September 2012 and 2013 reveal inter-annual differences in the spatial structure of water masses along with statistically significant differences in thermohaline properties, nutrients, and phytoplankton communities. We provide a set of water mass definitions applicable to the northern Bering and Chukchi continental shelves. We find that the near-bottom Bering-Chukchi Summer Water (BCSW) water mass was more saline in 2012 and Alaskan Coastal Waters (ACW) were warmer in 2013. Both of these water masses carried higher nutrient concentrations in 2012, supporting a larger chlorophyll a biomass that was comprised primarily of small (<10 µm) size class phytoplankton, so the classical relation between higher nutrient loads and larger phytoplankton does not hold for this region in late summer. The distributions of phytoplankton biomass and size structure reveal linkages between the wind fields, seafloor topography, water mass distributions and pelagic production. The water mass structure, including the strength and location of stratification and fronts, respectively, differed primarily because of the August regional wind field, which was more energetic in 2012 but was more persistent in direction in 2013. High concentrations of ice in winter and early spring in 2012 and 2013 resembled conditions of the 1980's and early 1990's, but the regional ice retreat rate has accelerated in the intervening years so

the summer and fall ice concentrations more closely resembled those of the last two decades. Sufficient wind forcing can shut down the Alaskan Coastal Current in the NE Chukchi Sea for periods of weeks to months during the ice-covered winter and during the summer when buoyancy forcing is at its annual maximum. We hypothesize that a decrease in salinity and nutrients from 2012 to 2013 was a consequence of a decreased net Bering Strait transport from 2011 to 2012 (Woodgate et al., 2015). Ramifications of an accelerated melt-back, restructuring of shelf flow pathways, and inter-annually varying Bering Strait nutrient fluxes are mostly unknown but all are potentially important to the Arctic ecosystem. Our results have implications for the total magnitude and seasonal evolution of primary productivity, secondary production, and the fate of fresh water, heat, and pelagic production on the Bering-Chukchi shelves.
Accepted: 25 February 2016

Assessing spatial covariance among time series of abundance
Ecology and Evolution (2.320)
J. C. Jorgensen, E. J. Ward, M. D. Scheuerell, R. W. Zabel (NMFS/NWFSC)

- Population spatial structure and diversity is important to species persistence
- Population-level demographic data can be useful in determining species diversity

For species of conservation concern, an essential part of the recovery planning process is identifying discrete population units and their location with respect to one another. A common feature among geographically proximate populations is that the number of organisms tends to co-vary through time as a consequence of similar responses to exogenous influences. In turn, high covariation among populations can threaten the persistence of the larger metapopulation. Historically, explorations of the covariance in population size of species with many (> 10) time series has been computationally difficult. Here we illustrate how dynamic factor analysis (DFA) can be used to characterize diversity among time series of population abundances, and the degree to which all populations can be represented by a few common signals. Our application focuses on anadromous Chinook salmon (*Oncorhynchus tshawytscha*), a species listed under the US Endangered Species Act, that is impacted by a variety of natural and anthropogenic factors. Specifically, we fit DFA models to 24 time series of population abundance and used model selection to identify the minimum number of latent variables that explained the most temporal variation after accounting for the effects of environmental covariates. We found support for grouping the time series according to 5 common latent variables. The top model included two covariates: the Pacific Decadal Oscillation in spring and summer. The assignment of populations to the

latent variables matched the currently established population structure at a broad spatial scale. At a finer scale there was more population grouping complexity. Some relatively distant populations were grouped together, and some relatively close populations - considered to be more aligned with each other - were more associated with populations further away. These coarse- and fine-grained examinations of spatial structure are important because they reveal different structural patterns not evident in other analyses.
Accepted: 2 February 2016

Harvest-induced evolution and effective population size
Evolutionary Applications (3.896)
A. Kuparinen, J. A. Hutchings, **R. S. Waples (NMFS/NWFSC)**

- Evaluated how increased harvest rates have led to fishery-induced-evolution (FIE) of life history traits, and how harvest rates influence effective population size (Ne) and the ratio of Ne to census size (N)
- Found that increased harvest reduced Ne but increased Ne/N because N was reduced more than Ne
- These results apply to any elevation of adult mortality and do not require size-selective harvest and should be generally applicable to a wide range of species

Much has been written about fishery-induced evolution (FIE) in exploited species, but relatively little attention has been paid to the consequences for one of the most important parameters in evolutionary biology—effective population size (Ne). We use a combination of simulations of Atlantic cod populations experiencing harvest, artificial manipulation of cod life tables, and analytical methods to explore how adding harvest to natural mortality affects Ne, census size (N), and the ratio Ne/N. We show that harvest-mediated reductions in Ne are due entirely to reductions in recruitment, because increasing adult mortality actually increases the Ne/N ratio. This means that proportional reductions in abundance caused by harvest represent an upper limit to the proportional reductions in Ne, and that in some cases Ne can even increase with increased harvest. This result is a quite general consequence of increased adult mortality and does not depend on harvest selectivity or FIE, although both of these influence the results in a quantitative way. In scenarios that allowed evolution, Ne recovered quickly after harvest ended and remained higher than in the pre-harvest population for well over a century, which indicates that evolution can help provide a long-term buffer against loss of genetic variability.
Accepted: 17 February 2016

NOAA SCIENTIFIC PUBLICATIONS REPORT

MARCH 15, 2016

Human-induced life-history changes in marine ectotherms: trends and management implications

Fish and Fisheries (8.258)

A. Audzijonyte, E. A. Fulton, M. Haddon, F. Helidoniotis, AJ Hobday, J. Morrongiello, J. Upston, **R. S. Waples (NMFS/NWFSC)**

- Fishing and climate change will alter life history traits of marine fish
- Stock assessments should take these changes into consideration
- Ecosystem models that assume life history traits are constant will produce misleading results

Evidence is accumulating that many marine ectotherms are undergoing rapid changes in their life-history characteristics. These changes have been variously attributed to fisheries-induced evolution, inhibited adult growth rate due to oxygen limitation at higher temperatures, and plastic responses to density dependence or changes in ocean productivity. Here we review the diverse underlying mechanisms by which plastic and evolutionary responses to climate change and fisheries are likely to produce similar life-history trends in harvested marine ectotherms, leading to faster life-histories with earlier maturation and smaller adult size-at-age. While mechanistically understanding these growth and maturation changes may be difficult, it is clear that changing life-histories will lead to modified population dynamics, productivity and natural mortality of the affected species. We discuss how observed and expected life-history changes could affect the assumptions and uncertainty of single and multi-species models currently used in marine ecosystem management, highlighting that models which allow for dynamic life-history traits often report significantly different results on stock biomasses. Given that both climate and harvest induced life-history changes are likely to intensify and possibly amplify each other, there is an urgent need to adequately assess the implications of faster life-histories for marine ecosystem management. This is especially true for data poor stocks, where growth and maturation are not regularly assessed. Targeted monitoring can be used to inform responsive management, but for improved sustainability outcomes, a precautionary approach to management that is robust to life-history trends is advised.

Accepted: 3 February 2016

Saffron cod (Eliginus gracilis) *in North Pacific archaeology*

Alaska Journal of Anthropology

M.A. Partlow and **E. Munk (NMFS/AKFSC)**

- Saffron cod in archaeological sites could be used as a paleoenvironmental indicator using population distribution to indicate temperature of Alaska sites in the past

- The methodology of saffron cod catch would be important to determine before it can be used as a paleoenvironmental indicator

Saffron cod (*Eleginus gracilis*) is a marine species often found in shallow, brackish water in the Bering Sea, although it can occur as far southeast as Sitka, Alaska. Recently, we identified saffron cod remains in two ca. 500-year-old Afognak Island midden assemblages from the Kodiak Archipelago. We developed regression formulae to relate bone measurements to total length using thirty-five modern saffron cod specimens. The archaeological saffron cod remains appear to be from mature adults, measuring 22–45 cm in total length, and likely caught from shore during spawning. Saffron cod may have been an important winter resource for Alutiiq people living near the mouths of freshwater rivers. It is also possible that saffron cod were caught in late summer or fall during salmon fishing.
Expected Publication: Spring 2016

Simulating environmental effects on brown shrimp production in the northern Gulf of Mexico
Ecological Modelling (2.321)
J. P. Leo, **T. J. Minello**, W. E. Grant, H-H. Wang **(NMFS/SEFSC)**

- Modeled shrimp production was sensitive to parameters affecting growth, mortality, and tide height, but production was significantly reduced at low salinities
- Adjusting recruitment timing caused highly variable production output
- The model output is compatible with current stock assessment models and could benefit habitat-based management decisions

Brown shrimp (*Farfantepenaeus aztecus*) support a commercially important fishery in the northern Gulf of Mexico, and juveniles use coastal estuaries as nurseries. Production of young shrimp from any given bay system, and hence commercial harvest of sub-adults and adults from the Gulf, is highly variable from year to year. We describe development of a spatially-explicit, individual-based model representing the cumulative effects of temperature, salinity, and access to emergent marsh vegetation on the growth and survival of young brown shrimp, and we use the model to simulate shrimp production from Galveston Bay, Texas, U.S.A. under environmental conditions representative of those observed from 1983 to 2012. Simulated mean annual (January through August) production ranged from 27.5 kg ha-1 to 43.5 kg ha-1 with an overall mean of 34.3 kg ha-1 (±0.70 kg ha-1 SE). Sensitivity analyses included changing values of key model parameters by ±10% relative to baseline. Increasing growth rates 10% caused a 16% increase in production, whereas a 10% decrease resulted in an 18% decrease in production. A 10% increase in mortality probabilities resulted in a production decrease of 15%

while a 10% decrease resulted in an 18% increase in production. We also changed values of environmental input data by ±10%. Mean production estimates increased 11% in response to increasing tide heights (and thus, marsh habitat access) and decreased 19% with a decrease in tide height (and marsh access). The thirty year mean production was affected negatively by both the 10% increase and decrease in air temperature (-2% and -14% respectively). Simulations in which bay water salinities were entirely low (0-10 PSU), intermediate (10-20 PSU), or high (>20 PSU) resulted in mean baseline production rates being reduced by 55, 7, and 0%, respectively. Uncertainty in model estimates of shrimp production were related to the magnitude and the timing of postlarval shrimp recruitment to the bay system. Simulations indicated that mean production decreased when recruitment occurred earlier in the year under all environmental conditions. Mean production varied with environmental conditions, however, when recruitment was delayed. The model reproduced biomass and size distribution patterns observed in field data. Although annual variability of modeled shrimp production did not correlate well (R^2=0.005) with fisheries independent trawl data from Galveston Bay, there was a significant correlation with similar trawl data collected in the northern Gulf of Mexico (R^2=0.40 p=0.0005). Identifying and representing spatially variable factors such as predator distribution and abundance among bays, therefore, may be the key to understanding bay-specific contributions to the adult stock.
Accepted: 25 February 2016

Movements and distribution of juvenile common thresher sharks (Alopias vulpinus) *in Pacific coast waters of the United States and Mexico*
Marine Ecology Progress Series (2.619)
D.P. Cartamil, **J Wraith**, Wegner**,** D. Kacev, C. Lam, O. Santana-Morales, O. Sosa-Nishizaki, M. Escobedo-Olvera, S. Kohin, J. Graham, P. Hastings
(NMFS/SWFSC)

- Documents the distribution and movements of juvenile common thresher sharks within US and Mexican waters
- Provides information on habitat preference (depth, temperature, etc) for this commercially targeted species

The common thresher shark constitutes an important commercial fishery on the Pacific coasts of both the United States and Mexico. However, little is known regarding the juvenile phase of this species. This study used a combination of pop-up archival satellite tagging, tag and recapture, and fishery catch data to investigate the movement patterns, habitat preferences, ecology, and geographic distribution of juvenile common thresher sharks along the Pacific coast of the United States and Mexico. Juvenile threshers primarily utilized continental shelf waters, with a

core geographic range extending from Punta Eugenia (27.8° N latitude) in Baja California, Mexico, to Morro Bay, California (35.3° N latitude). Within this range, sharks were found at significantly lower latitudes in March and April. Satellite-tagged juvenile threshers exhibited diel patterns of vertical distribution, primarily inhabiting the upper 20 m of the water column by night, and significantly greater depths by day. In addition, juvenile threshers made frequent daytime dives to depths exceeding 50 m, with a maximum recorded dive depth of 192 m. Tracked sharks were most commonly associated with ambient water temperatures of 14 to 17°C, and inhabited significantly warmer temperatures at night than during the day. No tidal or lunar influence on vertical distribution was found, and vertical habitat utilization did not increase concomitantly with shark size. This study is the first to document movements of juvenile threshers between U.S. and Mexican waters, highlighting the need for bi-national management strategies for this shared fishery resource.
Accepted: 24 February 2016

OAR Publications

The pink and white terraces of Lake Rotomahana—What was their fate after the 1886 Tarawera eruption?

Journal of Volcanology and Geothermal Research (2.543)

C. E. J. de Ronde, D. J. Fornari, V. L. Ferrini, **S. L. Walker**, B. W. Davy, C. LeBlanc, F. Caratori Tontini, A. L. Kukulya, R. H. Littlefield **(OAR-PMEL)**

- Pink and White Terraces considered one of natural wonders of the world, pre-1886, majority of both terraces were destroyed during the 1886 Tarawera Rift eruption
- Application of AUV surveys, seismic profiling, water column surveys, deepsea cameras
- Side-scan sonar images of terrace-like structures; photographs of silica sinter

The Pink and White Terraces that once stood regally on the shores of old Lake Rotomahana, and which were unique in their beauty as a natural wonder of the world, were regarded by the local Maori as a taonga, or treasure, because of the therapeutic qualities of the waters and their majestic appearance. The eruption of Mt. Tarawera on June 10 1886 is commonly cited as the cause of their demise, with the lake rapidly rising soon thereafter to drown the large, newly formed Rotomahana crater and other volcanic edifices shaped during the excavation of the old lake. Thus, the effects of the eruption have been masked from onlookers for more than 125 years. However, application of state-of-the-art survey techniques usually applied in the marine realm to modern Lake Rotomahana, including AUV surveys with numerous sensors, seismic profiling, water column surveys and

deployment of deepsea cameras, has provided a wealth of new information about the state of hydrothermal systems in the lake and the probable fortunes of the Pink and White Terraces.

We believe that the majority of both sets of terraces were destroyed during the eruption. However, some tantalizing evidence exists for remnants from both sites to exist to this day. High-resolution bathymetric mapping of the lake floor clearly recognizes some features of the post-1886 landscape, including a prominent landmark known as The Pinnacle. If we accept the postulated location of The Pinnacle on a pre-1886 map of Lake Rotomahana, then we appear to have captured a photograph of one of the buttresses to a tier of the nearby White Terraces. More revealing, are side-scan sonar images of structures located in the correct position of the Pink Terraces with respect to The Pinnacle, albeit ~ 20 m deeper than expected if the pre-1886 lake level of 292 m above sea level is to be believed. This work clearly shows that the greater Pink Terraces hydrothermal system survived the eruption and is very active today, whereas that part of the system that supplied hydrothermal fluids to the White Terraces has largely ceased activity altogether.

Published: 25 February 2016
Available online:
http://www.sciencedirect.com/science/article/pii/S037702731600038X

Reconstruction of the geology and structure of Lake Rotomahana and its hydrothermal systems from high-resolution multibeam mapping and seismic surveys

Journal of Volcanology and Geothermal Research (2.543)

C.E.J. de Ronde, **S.L. Walker,** C. LeBlanc, B.W. Davy, D.J. Fornari, F. Caratori Tontini, B.J. Scott, F.H. Seebeck, T.J. Stewart, A. Mazot, A. Nicol, and M.A. Tivey **(OAR/PMEL)**

- This work presents the results of high resolution bathymetric mapping and 2D seismic reflection survey of Lake Rotomahana, the site of the destructive eruption of Mt. Tarawera in 1886.
- Results provide insight into the present day dynamics of the hydrothermal system in the lake and the effects of the eruption on hydrothermal activity.

Present-day Lake Rotomahana is one of the two focal points of the most destructive eruption in New Zealand's historical record, i.e., that of Mt. Tarawera on 10 June 1886, with devastating loss of life and presumed destruction of the iconic Pink and White Terraces that adorned the margins of the lake. Basaltic dikes are considered to have ascended near surface in the area, intruding into hydrothermally altered and water-saturated ground beneath the existing lake. The consequential hydrothermal and phreatomagmatic eruptions ejected 0.5325 km3 of

material from the lakefloor and below, plastering the nearby landscape for several kilometers with mud and other debris. The eruption buried the natural outlet of the lake, with the bottom of the craters becoming filled by water within months and completely concealed from view within years; today Lake Rotomahana has depths up to 118 m.

High-resolution (0.5 m) bathymetric mapping, when combined with a 2-D seismic reflection survey, enables us to 'see' details of the maar craters on the lakefloor, including those parts subsequently buried by sediment. The large Rotomahana Crater described by workers immediately after the eruption measures ~ 2.5 km in diameter near its southwestern end, and excavated ground to 155 m below present-day lake level. The vent system, as revealed by the present study, forms an array of right-stepping (dextral) craters, with the main crater being host to two sub-craters Rotomahana West Crater and Rotomahana East Crater today buried beneath the lakefloor, and which are in-filled by 36 and 37 m of sediment, respectively. Subordinate craters along the same 057° Tarawera Rift trace include Hochstetter Crater (11 m of infill), Waingongongongo Crater (14 m) and Rotomakariri Crater (26 m). These craters host a total 0.0268 km3 of sediment. Other features highlighted by the bathymetric data include; craters not filled by sediment, sediment fan deltas, volcanic ridges and dikes, submerged wave-cut terraces formed during times of lower lake levels and gas pockmarks, all either related to the 1886 eruptive episode or post-eruption hydrothermal and erosional processes.

Application of results from bubble plume, CO2 flux, magnetic and heat flux surveys of Lake Rotomahana to this study, when combined with regional earthquake relocation analysis and broadband magnetotelluric data, suggest an explanation in terms of a magmatic heat source located south of Waimangu and a corresponding convective water/heat transport system extending thence to beneath the western end of the lake. A holistic approach has provided a coherent context for the eruption and its effect on the historical Pink and White Terraces hydrothermal system that appears to have been the eastern-most extension of a larger system that lay beneath the Waimangu area before the eruption. The newly named Pink Terraces hydrothermal system (~ 1.5 km2) is a continuation of the historical hydrothermal activity that was concentrated on the western shores of the old lake, and together with the formation of the new, post-1886 Patiti hydrothermal system (~ 1 km2) located SW of Patiti Island, mark the two distinct areas of hydrothermal activity in the lake today.

Accepted: 4 February 2016
Available online:
http://www.sciencedirect.com/science/article/pii/S0377027316000378

Cross Line Office Publications

Dependence of subsurface chlorophyll on seasonal water masses in the Chukchi Sea

Journal of Geophysical Research (3.174)

K. I. Martini (OAR/PMEL), P. J. Stabeno (OAR/PMEL), C. Ladd (OAR/PMEL), P. Winsor, T. J. Weingartner, C. W. Mordy (OAR/PMEL), and **L. B. Eisner (NMFS/AKFSC)**

- Using a high-resolution towed sampling platform and traditional shipboard observations, the authors characterized the phytoplankton and nutrient concentration in subsurface layers of water in the northeastern Chukchi Sea.
- The authors found that subsurface phytoplankton contribute significantly to the net biomass in the Chukchi Sea in late summer.

During the late summer, phytoplankton in the northeastern Chukchi Sea are typically found in subsurface layers. These layers and their sensitivity to local changes in hydrography and nutrient concentrations are characterized by combining data from a high-resolution towed sampling platform with traditional shipboard observations. The replacement of surface meltwater and deeper nutrient-rich Chukchi Winter Water by northward flowing nutrient-poor Chukchi Summer Water and Remnant Winter water leads to a net decrease in biomass and smaller phytoplankton. Between 17-67% of phytoplankton biomass is contained within the subsurface layers. This estimate is nearly twice as high as previous estimates from sparser shipboard data and suggests subsurface phytoplankton contribute significantly to the net biomass in the Chukchi Sea in late summer.

Published: 12 February 2016

Available online: http://onlinelibrary.wiley.com/doi/10.1002/2015JC011359/full

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS

Benthic habitat mapping and assessment in the Wilmington-East wind energy call area

Technical Report to Bureau of Ocean Energy Management and NCCOS

J. C. Taylor, A. B. Paxton, C. M. Voss, B. W. Sumners, **C. A. Buckel**, **J. Vander Pluym**, **E. E. Ebert**, **T. S. Viehman**, S. R. Fegley, E. A. Pickering, A. M. Adler, C. Freeman, and C. H. Peterson **(NOS/NCCOS)**

- This report follows decades of research on the importance of hardbottom habitats on the southern Atlantic Outer Continental Shelf (OCS) that support

the ocean ecology and economies of North Carolina and other southeastern U.S. coastal states.

- This study represents an important baseline condition of U.S. south Atlantic benthic habitats offshore Wilmington, NC and of their value to fishes, in preparation for offshore development of wind energy facilities.
- The authors provide the first complete coverage by hydrographic sidescan and multibeam sonar of the Wilmington-East Call Area.

The Bureau of Ocean Energy Management (BOEM) is responsible for oversight and management of the development of energy resources on the Outer Continental Shelf (OCS). In 2012, BOEM identified three Wind Energy Call Areas and later defined Wind Energy Areas on the OCS of North Carolina. Presently, sufficient uncertainty exists regarding cumulative impacts to ecosystem services such as essential fish habitat and maritime cultural resources as a result of the construction or operation of offshore energy facilities to merit preliminary studies. From rocky outcrops to shipwrecks, hardbottom habitats serve as essential fish habitat for reef fisheries off of North Carolina and along the southeast U.S. OCS. This project accomplished the primary objective of describing and delineating rocky outcrops, within the Wilmington-East Call Area. The delineation of rocky outcrops and artificial hardbottom habitats guided an intensive diver visual assessment characterizing the benthic and fish communities, the seasonal changes in communities, and influences of sand and sediment movement around hardbottom habitats. This report is the result of a collaborative effort between the University of North Carolina Institute of Marine Sciences and NOAA's National Centers for Coastal Ocean Science, and the Bureau of Ocean Energy Management.
Published: 19 February 2016
Available online: http://www.boem.gov/BOEM-WECA-Final-Report-NCCOS/

Protected species and longline mussel aquaculture interactions
NOAA/NOS Technical Memorandum
C. Price (NOS/NCCOS), J. A. Morris, Jr. (NOS/NCCOS), D. Bean (NMFS/GARFO), E. Keane (NMFS/GARFO), D. Morin (NMFS/GARFO), and C. Vaccaro (NMFS/GARFO)
This report summarizes the risk posed to protected species by interactions with offshore longline mussel aquaculture in the Atlantic

- This report includes a preliminary risk analysis and needs assessment to highlight the greatest potentials for harmful interactions between aquaculture and marine mammals and sea turtles, identify critical areas of research, and inform decisions about collaborative projects to further knowledge and protect imperiled species.

- The information in this report is useful for guiding the regulatory process of Protected Resources Division (PRD) consultations to meet the agency goals of advancing aquaculture in the open ocean while still meeting its mandates under the ESA.

This report summarizes the current state of knowledge regarding documented and potential interactions of species listed under the Endangered Species Act, such as sea turtles and marine mammals, with offshore longline mussel culture gear. Its primary purpose is to strengthen the ability of the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Greater Atlantic Regional Fisheries Office (GARFO) to make science-based decisions and recommendations as part of the review and consultation process required to permit aquaculture operations in federal waters.

Expected publication date: February 2016

Available online: The tech memo release will be posted in the NCCOS Weekly email and will be featured as a news item on NCCOS, NOS, and NMFS websites. The report will be made publicly available online and will be shared directly with colleagues

NMFS

Evaluating methods for setting catch limits for gag grouper: data-rich versus data-limited

Proceedings of the Data-Limited Fisheries Symposium

S. R. Sagarese, J. F. Walter III, M. D. Bryan (all SEFSC), T. R. Carruthers

- Scientifically-derived annual catch limits are now required for all federally-managed stocks in the US regardless of data availability and quality
- Using gag grouper, a data-rich species, data-limited stock evaluation methods were compared to Stock Synthesis integrated assessment models, which require substantial data inputs and analytical time
- This analysis identifies key issues with using data-limited methods such as hermaphroditism and time-varying selectivity that might confound data-limited approaches for application to other shallow-water grouper stocks

The majority of shallow-water grouper stocks (SWG) in the Gulf of Mexico (GOM) are considered data-poor, with the exceptions of gag, *Mycteroperca microlepis* and red, *Epinephelus morio,* groupers. Both species are data-rich and assessed using Stock Synthesis (SS) integrated assessment models that demand substantial data inputs and analytical time. Given that data limitations hinder the same detailed analysis for other SWG species, there is substantial interest in applying data-limited methods (DLMs) to derive annual catch limits. In this paper we apply a suite of DLMs to GOM gag grouper using the 'DLMtool' package in R

to test whether a similar assessment result can be achieved with less data or with computationally less-intensive methods on aggregated data. Most DLMs provided lower estimates of the overfishing limit (OFL) compared with SS, treated here as the 'true' value, suggesting that in the absence of a data-rich assessment for gag grouper, quotas set by DLMs would constitute precautionary advice. Index—based methods and depletion-based methods such as Depletion-Corrected Average Catch produced results similar to SS. Overall, the broad OFL distributions that resulted from many DLMs suggest a high level of uncertainty. Sensitivity analyses revealed that DLM quota recommendations were often influenced by key data inputs such as natural mortality, catch, current abundance, and depletion estimates where required. These results emphasize important issues including selectivity, episodic mortality, and hermaphroditism which may confound assessment of SWG stocks.
Accepted: January 28, 2016

OAR

Climate Program Office FY15 Annual Report
CPO Website
E. Greenhalgh (NOAA/OAR/CPO)

- CPO will release its FY15 Annual Report on March 11, 2016. The report gives an overview of CPO's achievements in FY15 and highlights the great work done by the Office's Divisions and Programs to advance scientific understanding of climate and improve society's ability to plan and respond.

Every day, communities and businesses in the United States and around the world grapple with environmental challenges stemming from changing climate conditions and extreme events. The NOAA Climate Program Office has made it its mission to help people, businesses, and the environment thrive in the face of a change climate and its impacts.
To this end, CPO will release its FY15 Annual Report on March 11, 2016. The report gives an overview of CPO's achievements in FY15 and highlights the great work done by the Office's Divisions and Programs to advance scientific understanding of climate and improve society's ability to plan and respond.
The visually-rich report offers highlights from this year, what's next for the future, and quick stats of resources and achievements, including: new projects funded by CPO in FY15, high-visibility reports and publications, newsletters, and workshops.
Available Online: http://cpo.noaa.gov/2015CPOAnnualReport.pdf

Climate in Context: science and society partnering for adaptation
Book Publication

A. S. Parris, G. Garfin, K. Dow, R. Meyer, **S. L. Close (OAR/CPO)**

- The Regional Integrated Sciences and Assessments (RISA) program is releasing Climate in Context: Science and Society Partnering for Adaptation, an edited volume being published by Wiley & Sons
- Shows the progress of the RISA program and details the research, partnerships, and results from projects that span the 20 year history of the program
- Contributions from more than 45 authors from universities, federal agencies (including NOAA), state and local agencies, and other partners, this book aims to provide practical advice and examples from core areas of the RISA program: understanding context and risk, managing knowledge networks, innovating services, and advancing science policy

Topics covered in the contributions to Climate in Context include (among many others):

A guide to methods that RISAs employ for engagement research;

How the Consortium for Climate Risk in the Urban Northeast RISA team worked with New York City both before and after Hurricane Sandy to integrate climate science and decision-making and make New York City more resilient to climate hazards;

The relationship between the RISA program and Extension networks (Land and Sea Grant), linking boundary organizations, strengthening engagement across stakeholder groups, and providing climate information that is tailored to local needs;

The development of National Seasonal Wildfire Outlooks, which transitioned an experimental product into an operational one through co-development and cross-disciplinary learning;

Lessons learned from evaluation initiatives in Pacific RISA and the Climate Assessment for the Southwest RISA team.

Expected Publication Date: 25 March 2016

Available online: http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118474791.html