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### HIGHLIGHTED ARTICLES

*Examining the utility of survey data to detect prey removal effects on Steller sea lions*  
(*Eumetopias jubatus*)

Canadian Journal of Fisheries & Aquatic Sciences

**P. B. Conn, D. S. Johnson, L. W. Fritz, and B. S. Fadely (NMFS/AKFSC)**

- The authors' analysis suggests that many of the statistical hypothesis tests previously applied to assess the existence of a relationship between fish abundance and Steller sea lion population trends may be flawed because they use inappropriate dependent and/or independent variables.
- More broadly, this approach stresses how simulation can be used to better assess the power of a particular hypothesis test, or better yet, how Bayes factors can be developed to embody evidence for different ecological hypotheses about the relationship between fish availability and Steller sea lion vital rates.

One focus of mitigation for Steller sea lion declines in Alaska has been to restrict commercial fishery activity around sea lion rookeries and haul-outs. However, a variety of statistical hypothesis tests have failed to relate sea lion population metrics to fish and fishing variables, prompting speculation that regulations may be unwarranted. In this study, authors use simulation to show that standard hypothesis tests often have overstated power to detect a relationship between Steller sea lion vital rates and fish/fishing variables. The power and utility of hypothesis tests largely depend on choosing appropriate dependent and independent variables. In particular, pup counts were the most effective for diagnosing fecundity effects and successive ratios of adult counts were the most effective for diagnosing survival effects. Fish relative abundance was the most effective independent variable, with other choices (e.g. fishery catch) often resulting in misleading inferences. The authors argue that Bayes factors are best suited for characterizing the relationship between fish abundance and Steller sea lion vital rates, and that existing evidence does not preclude a strong relationship between sea lion fecundity and the availability of commercially harvested fish stocks.

Accepted: 5 April 2014





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### *Commonness and rarity in the marine biosphere*

Proceedings of the National Academy of Sciences of the United States of America

S. R. Connolly, M. A. MacNeil, M. J. Caley, N. Knowlton, E. Cripps, M. Hisano, L. M. Thibaut, B. D. Bhattacharya, L. Benedetti-Cecchi, **R. E. Brainard**, (NMFS/PIFSC), A. Brandt, F. Bulleri, University of Pisa, Dipartimento di Biologia; K. E. Ellingsen, S. Kaiser, I. Kröncke, K. Linse, E. Maggi, T. D. O'Hara, G. C. B. Poore, S. K. Sarkar, K. K. Satpathy, U. Schückel, A. Williams, and R. S. Wilson

- Neutral theory attributes differences in species abundances to chance variation in individuals' fates, rather than differences in species traits.
- The authors use an approximation that captures common features of “neutral” biodiversity models, which assume ecological equivalence of species, to test whether neutrality is consistent with patterns of commonness and rarity in the marine biosphere.
- Species abundances vary more among species than neutral theory predicts, challenging the hypothesis that community dynamics are approximately neutral, and implicating species differences as a key driver of community structure in nature.

Explaining patterns of commonness and rarity is fundamental for understanding and managing biodiversity. Consequently, a key test of biodiversity theory has been how well ecological models reproduce empirical distributions of species abundances. However, ecological models with very different assumptions can predict similar species abundance distributions, while models with similar assumptions may generate very different predictions. This complicates inferring processes driving community structure from model fits to data. Here, we use an approximation that captures common features of “neutral” biodiversity models—which assume ecological equivalence of species—to test whether neutrality is consistent with patterns of commonness and rarity in the marine biosphere. We do this by analyzing 1185 species-abundance distributions from 14 marine ecosystems ranging from intertidal habitats to abyssal depths, and from the tropics to polar regions. Neutrality performs substantially worse than a classical non-neutral alternative: empirical data consistently show greater heterogeneity of species abundances than expected under neutrality. Poor performance of neutral theory is driven





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by its consistent inability to capture the dominance of the communities' most abundant species. Previous tests showing poor performance of a neutral model for a particular system often have been followed by controversy about whether an alternative formulation of neutral theory could explain the data after all. However, our approach focuses on common features of neutral models, revealing discrepancies with a broad range of empirical abundance distributions. These findings highlight the need for biodiversity theory in which ecological differences among species, such as niche differences and demographic tradeoffs, play a central role.  
Expected Publication Date: Summer 2014

*Release mortality in the red snapper (*Lutjanus campechanus*) fishery: a meta-analysis of three decades of research*

Fishery Bulletin

**M. D. Campbell, W. B. Driggers, B. Sauls, and J. F. Walter (NMFS/SEFSC)**

- Release mortality rates in catch and release fishing can vary with depth and water temperature. Using three decades of research, the authors changed the release mortality estimates from a single point estimate to a functional form that is related to depth, which was used in the most recent Red Snapper stock assessment.
- These analyses simultaneously incorporate the effects of venting, hook type, and seasonality to produce release mortality estimates specific to those treatments (e.g. estimates for each season can be produced).
- Results highlight the need to understand that surface release methods are likely underestimating release mortality rates because they are unlikely to capture mortality following fish submergence and which occurs over longer periods of time (i.e. days).

The value of catch and release fishing as a conservation measure is highly dependent upon discard frequency and release mortality rates. Therefore, it is important to understand how estimates are impacted by factors such as capture depth and water temperature. The meta-analytical modeling approach used here for red snapper (*Lutjanus campechanus*) provides a robust method of dealing with study-specific differences in experimental protocols, while





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estimating discard mortality as a function of key factors. Results of the analysis showed significant increases in mortality by depth and for the commercial-sector. The most consistent result was the positive correlation between depth and release mortality estimates which was present regardless of study methodology, fishing sector, hook type used, or season of study. The effect of venting was dependent on if the study produced estimates of immediate or delayed mortality. Immediate estimates suggested mortality rates are lowered by venting whereas delayed estimates suggested venting increased rates. This result is largely reflective of using submergence ability, from surface-release studies, as a proxy of mortality. The model's interaction result suggests that recompression of fish might be a viable alternative to venting, but if a recompression device is not available, venting at least improves the likelihood that a fish can submerge and return to protective habitat. The depth-based functional relationships developed in this model were used in the most recent red snapper stock assessment, which was a change from previous assessments which used region-specific point estimates.

Accepted: 7 May 2014

### *Anticipating exit from North Carolina's commercial fisheries*

Society and Natural Resources

#### **S. Crosson (NMFS/SEFSC)**

- Commercial fishermen leaving the industry may not be driven by fishing income specifically, or frustration with regulations, but instead is related to the security of household income and family/community support, as well as age.
- The results of the model could be used to aid regulatory goals regarding to fisheries entry and exit.

If access to commercial licenses has been limited, then understanding the factors that contribute to movement out of these fisheries (fisheries exit) has value for managers. Studies on the causes of fisheries exit have focused on economic or social factors, but rarely both. The author tested the relative influence of fifteen social and economic attributes from the fisheries exit and job satisfaction literature on fishermen's expectation of eventual exit from fisheries, with the hope





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that this will contribute to better predictions of fisheries participation and useful feedback for current management. He used available data from four comprehensive demographic and attitudinal surveys in North Carolina. Participation in the state's limited-access commercial fisheries has steadily declined since 2000, leading to concerns that the long-term infrastructure of the industry may be collapsing.

Accepted: 10 May 2014

*Compliance with vessel speed restrictions to protect North Atlantic right whales*

PeerJ

**G. K. Silber, J. D. Adams** and C. J. Fonnesebeck (NMFS/OPR)

- This study quantifies the response of a large and diverse international industry to both non-punitive and citation/fine agency actions as methods of enforcement of a novel resource conservation regulation
- The authors demonstrate a cost-effective means (involving a near census rather than a sample) to precisely quantify compliance with an environmental regulation.
- Citations/fines had the greatest influence on compliance in notified vessels/companies, followed in order of effectiveness by enforcement-office information letters, monthly summaries of vessel operations, and direct at-sea radio contact.
- This study represents, to the authors' knowledge, the first time that the effectiveness of NMFS Office of Law Enforcement enforcement compliance activities have been quantified.

Environmental regulations can only be effective if they are adhered to, but the motivations for regulatory compliance are not always clear. The authors assessed vessel operator compliance with a December 2008 regulation aimed at reducing collisions with the endangered North Atlantic right whale that requires vessels 65 feet or greater in length to travel at speeds of 10 knots or less at prescribed times and locations along the U.S. eastern seaboard. Extensive outreach efforts were undertaken to notify affected entities both before and after the regulation





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went into effect. Vessel speeds of 201,862 trips made between November 2008 and August 2013 by 8,009 individual vessels were quantified remotely, constituting a nearly complete census of transits made by the regulated population. Of these, 437 vessels (or their parent companies), some of whom had been observed exceeding the speed limit, were contacted through one of four non-punitive information programs. A fraction ( $n=26$  vessels/companies) received citations and fines. Despite the efforts to inform mariners, initial compliance was low ( $<5\%$  of the trips were completely  $<10$  knots) but improved in the latter part of the study. Each notification/enforcement program improved compliance to some degree and some may have influenced compliance across the entire regulated community. Citations/fines appeared to have the greatest influence on improving compliance in notified vessels/companies, followed in order of effectiveness by enforcement-office information letters, monthly summaries of vessel operations, and direct at-sea radio contact. Trips by cargo vessels exhibited the greatest change in behavior followed by tanker and passenger vessels. These results have application to other regulatory systems, especially where remote monitoring is feasible, and any setting where regulatory compliance is sought.

Accepted: 7 May 2014

*Visualizing seasonal and inter-annual relationships between hydrology, climate, and water level fluctuations on the earth's largest lakes*

Journal of Great Lakes Research

**A. Clites, J. P. Smith, A. D. Gronewold, and T. S. Hunter (OAR/GLERL)**

- This tool helps scientists explain why levels in the Great Lakes fluctuate.
- This paper highlights the data and design features that make this product unique; primarily the ability to overlay Great Lakes monthly average water levels with hydroclimate components.

Understanding drivers behind monthly, annual, and decadal water level fluctuations on the North American Great Lakes is a high priority for regional research and water resource





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management planning. The need for improved understanding of these relationships is underscored by a series of recent unprecedented extreme water level patterns, including (but not limited to) record low water levels on Lakes Michigan and Huron in December 2012 and January 2013. To address this need, we developed the Great Lakes Hydro-Climate Dashboard (GLHCD), a dynamic Flash-based web interface that builds upon the previously-released Great Lakes Water Level Dashboard (GLWLD). In addition to including water level data and projections from the GLWLD, the GLHCD presents a range of hydrological and climatological data through an improved (relative to the GLWLD) graphical user interface specifically designed to manage, and display simultaneously, a variety of data time series from different sources. By serving as a common portal to critical regional hydro-climate and water level data, the GLHCD helps visualize and explain lake level phenomena including (for example) the decreasing water levels across all of the Great Lakes in the early 1960s and their relationship to changes in regional precipitation, as well as the abrupt water levels declines in the late 1990s and their relationship to remarkable changes in over-lake evaporation. By providing insight into these, and other important regional hydro-climate events, the GLHCD helps practitioners, researchers, and the general public improve their understanding of the drivers behind Great Lakes water levels, and to employ that understanding in prudent water resource management planning.

Accepted: 7 May 2014





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### ADDITIONAL ARTICLES

*Spatio-temporal temperature variation influences juvenile steelhead (*Oncorhynchus mykiss*) use of thermal refugia*

Ecosphere

K. Brewitt and E. Danner (NMFS/SWFSC)

- Describes fine-scale use of thermal refugia by steelhead on the Klamath River.
- Concludes that mainstem temperature, degree of diel temperature variation, and body size are predictors of thermal refugia use.

Thermal refugia form potentially critical habitat for species at the limits of their thermal tolerance, especially given large-scale habitat degradation and rising temperatures across ecosystems. The Klamath River is a highly altered system where summer mainstem temperatures reach levels that are physiologically stressful to threatened Pacific salmonid populations, making thermal refugia critical for over-summer survival when temperatures near upper thermal thresholds. Small changes in water temperature can have a large effect on salmonid growth and survival, and therefore fine-scale spatio-temporal temperature variation could influence when and where refugia are important for both individual survival and population persistence. In this study, we combined monitoring of environmental variables with measures of fish temperature (a proxy for refugia use) to quantify juvenile steelhead (*Oncorhynchus mykiss*) use of thermal refugia. We used a logistic mixed effects model to determine the relative influence of instantaneous mainstem temperature and flow, sub-daily temperature variation, body size, and time of day on steelhead refugia use. Mainstem temperature was the strongest predictor of refugia use; the majority (> 80%) of juvenile steelhead moved into refugia when mainstem temperatures reached 22-23°C, and all fish moved in by 25°C. Fish were more likely to use refugia with increased diel mainstem temperature variation and larger temperature differential between the mainstem and tributary. In addition, steelhead exhibited a distinct diel behavioral shift in refugia use that varied with body size; smaller juveniles (~160 mm) were much more likely to use refugia during the night than day, whereas larger juveniles (~210 mm) exhibited a much less pronounced diel behavioral shift.





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Given impacts of watershed alteration and climate change, and the growing importance of refugia habitat, these findings suggest that species persistence may depend on extremely fine-scale spatial and temporal temperature dynamics.

Accepted: 18 April 2014

*The sun, moon, wind, and biological imperative—shaping contrasting wintertime migration and foraging strategies of adult male and female northern fur seals (*Callorhinus ursinus*)*

PLoS ONE

**J. T. Sterling**, A. M. Springer, S. J. Iverson, S. P. Johnson, N. A. Pelland, **D. S. Johnson**, M. Lea, and N. A. Bond (NMFS/AKFSC)

- Manuscript details different foraging behaviors and habitats of adult male and female northern fur seals. It shows that fur seals are sexually segregated and migrate to different regions of the North Pacific Ocean.
- It identifies important habitat regions and factors such as wind speed or storms as influencing the seals movement behavior.
- The study contributes to the Conservation Action Narrative of the Northern Fur Seal Conservation Plan 2007 by adding knowledge to the objectives in the plan.

Adult male and female northern fur seals (*Callorhinus ursinus*) are sexually segregated in different regions of the North Pacific Ocean and Bering Sea during their winter migration. Explanations for this involve interplay between physiology, predator-prey dynamics, and ecosystem characteristics; however possible mechanisms lack empirical support. To investigate factors influencing the winter ecology of both sexes, we deployed five satellite-linked conductivity, temperature, and depth data loggers on adult males, and six satellite-linked depth data loggers and four satellite transmitters on adult females from St. Paul Island (Bering Sea, Alaska, USA) in October 2009. Males and females migrated to different regions of the North Pacific Ocean: males wintered in the Bering Sea and northern North Pacific Ocean, while females migrated to the Gulf of Alaska and California Current. Horizontal and vertical movement behaviors of both sexes were influenced by wind speed, season, light (sun and





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moon), and the ecosystem they occupied, although the expression of the behaviors differed between sexes. Male dive depths were aligned with the depth of the mixed layer during daylight periods and we suspect this was the case for females upon their arrival to the California Current. We suggest that females, because of their smaller size and physiological limitations, must avoid severe winters typical of the northern North Pacific Ocean and Bering Sea and migrate long distances to areas of more benign environmental conditions and where prey is shallower and more accessible. In contrast, males can better tolerate often extreme winter ocean conditions and exploit prey at depth because of their greater size and physiological capabilities. We believe these contrasting winter behaviors: 1) are a consequence of evolutionary selection for large size in males, important to the acquisition and defense of territories against rivals during the breeding season; and 2) ease environmental/physiological constraints imposed on smaller females.

Accepted: 3 March 2014

*Patterns of growth and environmental isolation of quillback rockfish (*Sebastes maliger*) in Puget Sound and the Strait of Georgia*

Bulletin of Marine Science

J. West, **T. E. Helser** (NMFS/AKFSC), and **S. O'Neill** (NMFS/NWFSC)

- Variability in life history characteristics across space indicate environmentally isolated populations of quillback rockfish, suggesting spatially explicit management.
- Environmental gradients may be determinants of life history variability.

Identifying and quantifying spatial patterns in population structure and the degree to which individuals mix among populations is important for the management of temperate marine fishes. Quillback rockfish (*Sebastes maliger*, Jordan and Gilbert, 1880) in the coastal waters of the eastern Pacific are thought to consist of numerous population segments and have been an important commercial and recreational fishery resource in that region for the past 50 years. We tested the validity of some of these population segments over a relatively small range occupied





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by the species, by comparing growth patterns of quillback rockfish from four oceanographically distinct inland marine and estuarine water bodies, including Puget Sound and the Strait of Georgia. The largest asymptotic size occurred in quillback rockfish from oceanic waters, followed by significantly smaller asymptotic sizes in the Strait of Georgia and still smaller from Puget Sound. Inland rockfish also grew faster and reached their asymptotic size sooner than oceanic individuals. Water temperature increased and salinity decreased from oceanic-to-inland waters, illustrating the range of environmental conditions in the area we studied. We conclude that quillback rockfish in these inland marine and estuarine waters comprise four environmentally isolated populations, and discuss three factors that may have contributed to the patterns we observed.

Accepted: 6 February 2014

### *Vessel strikes to large whales before and after 2008 ship strike rule*

#### Conservation Letters

J. M. Van der Hoop, A. S. M. Vanderlaan, **T. V. N. Cole (NMFS/NEFSC)**, **A. G. Henry (NMFS/NEFSC)**, **L. Hall (NMFS/GARFO)**, **B. Mase-Guthrie (NMFS/SERO)**, T. Wimmer, and M. J. Moore

- Since seasonal management areas were implemented in 2008, authors found that large whale vessel-strike mortalities have significantly declined inside active seasonal management areas, and increased outside inactive seasonal management areas.
- A longer time series is needed to detect changes in where and when interactions between whales and vessels occur.
- The authors suggest that increasing the spatial and temporal extent of seasonal management areas in the mid-Atlantic should be considered to improve the Ship Strike Rule's effectiveness.

To determine effectiveness of Seasonal Management Areas (SMAs), introduced in 2008 on the U.S. East Coast to reduce lethal vessel strikes to North Atlantic right whales, the authors





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analyzed observed large whale mortality events from 1990 to 2012 in the geographic region of the “Ship Strike Rule” to identify changes in frequency, spatial distribution, and spatiotemporal interaction since implementation. Though not directly coincident with SMA implementation, right whale vessel-strike mortalities significantly declined from 2.0 (2000–2006) to 0.33 per year (2007–2012). Large whale vessel-strike mortalities have decreased inside active SMAs, and increased outside inactive SMAs. This study detected no significant spatiotemporal interaction in the 4-year pre- or post-Rule periods; although a longer time series is needed to detect these changes. As designed, SMAs encompass only 36% of historical right whale vessel-strike mortalities and 32% are outside managed space but within managed timeframes. The authors suggest increasing spatial coverage in order to improve the Rule’s effectiveness.

Available online: <http://onlinelibrary.wiley.com/enhanced/doi/10.1111/conl.12105/>

*Global genomic diversity and oceanic divergence of humpback whales (Megaptera novaeangliae)*

Proceedings of the Royal Society B

J. A. Jackson, D. J. Steel, P. Beerli, B. C. Congdon, C. Olavarria, **M. S. Leslie** (NMFS/SWFSC), C. Pomilla, H. Rosenbaum, and C. S. Baker

- Genetic evidence suggests that humpback whales in the North Pacific, North Atlantic and Southern Hemisphere are on independent evolutionary trajectories.
- The authors’ results support taxonomic revision of *M. novaeangliae* to three sub-species.
- These results will afford more targeted protection of these independent evolutionary units.

Humpback whales (*Megaptera noveangliae*) annually undertake the longest migrations between seasonal feeding and breeding grounds of any mammal. Despite this dispersal potential, discontinuous seasonal distributions and migratory patterns suggest that humpbacks form discrete regional sub-populations within each ocean. To better understand the worldwide population history of humpbacks, and the interplay of this species with the oceanic environment through geological time, the authors assembled a collection of mitochondrial DNA control





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region sequences representing ~2,700 individuals (465bp, 219 haplotypes) and 8 nuclear intronic sequences, representing ~70 individuals (3,700bp, 140 alleles) from the North Pacific, North Atlantic and Southern Hemisphere. Bayesian divergence time reconstructions date the origin of humpback mtDNA lineages to the Pleistocene period (880,000 years, 95% posterior intervals 550 – 1,320 Kya) and estimate radiation of northern hemisphere lineages between 50-200 Kya, suggesting long-term colonization of the northern oceans by current matriline. Coalescent analyses reveal restricted gene flow between ocean basins, with long-term migration rates (individual migrants per generation) of  $< 3.3$  for mtDNA and  $< 2$  for nuclear genomic DNA. Considered in concert, genetic evidence suggests that humpbacks in the North Pacific, North Atlantic and Southern Hemisphere are on independent evolutionary trajectories, supporting taxonomic revision of *M. novaeangliae* to three sub-species.

Expected Publication Date: Summer 2014

*Modeling the fallout from stabilized nuclear clouds using the HYSPLIT atmospheric dispersion model*

Journal of Environmental Radioactivity

**G. Rolph, R. Draxler, and F. Ngan (OAR/ARL)**

- Using meteorological data at the resolution of current operational meteorological models shows that HYSPLIT can produce a realistic estimate of the location and magnitude of a radiological plume from a nuclear explosion.
- Forecasters will now have a tool available to provide local emergency responders with model products for use in emergency exercises.

The HYSPLIT dispersion model was configured to simulate the dispersion and deposition of nuclear material from a surface-based nuclear detonation using publicly available information on nuclear explosions. The model was then run for six nuclear tests conducted in the 1950's using both coarse resolution (NCEP/NCAR Reanalysis Project - NNRP) and fine resolution (Weather Research and Forecasting - WRF) meteorological data and the predicted dose rates





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were compared with measured dose rates. The model was able to reproduce the general direction and deposition patterns using the coarse NNRP meteorological data with overlap scores in excess of 50% for four of six simulations. When finer resolution WRF data were used, the scores improved by 5% to 20%, especially at the higher dose rates. When compared with measurements of dose rate and time of arrival from the Town Data Base, similar results were found with the WRF simulations providing better results for four of six simulations.

Expected Publication Date: June 2014

### *Kinship analyses identify fish dispersal events on a temperate coast line*

Proceedings of the Royal Society B: Biological Sciences

C. Schunter, M. Pascual, **J. C. Garza (NMFS/SWFSC)**, N. Raventos, and E. Macpherson

- The first demonstration of the use of pedigree-based techniques to estimate rates and direction of larval dispersal in a temperate marine ecosystem.
- The first such study to utilize both parentage and sibship reconstruction methods in a complementary manner.

Connectivity is crucial for the persistence and resilience of marine species, the establishment of networks of Marine Protected Areas (MPAs) and the delineation of fishery management units. In the marine environment, understanding connectivity is still a major challenge, due to the technical difficulties of tracking larvae. Recently, parentage analysis has provided a means to address this question effectively. To be effective, this method requires limited adult movement and extensive sampling of parents, which is often not possible for marine species. An alternative approach that is less sensitive to constraints in parental movement and sampling could be the reconstruction of sibships. Here, we directly measure connectivity and larval dispersal in a temperate marine ecosystem through both analytical approaches. We use data from 178 SNP markers to perform parentage and sibship reconstruction of the black faced blenny (*Tripterygion delaisi*) from an open coastline in the Mediterranean Sea. Parentage analysis revealed a decrease in dispersal success in the focal area over 1 km distance and





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approximately 6.5% of the juveniles were identified as self-recruits. Sibship reconstruction analysis found that, in general, full siblings did not recruit together to the same location, and that the largest distance between recruitment locations was much higher (11.5 km) than found for parent/offspring pairs (1.2 km). Direct measurements of dispersal are essential to understanding connectivity patterns in different marine habitats and show the degree of self-replenishment and sustainability of populations of marine organisms. We demonstrate that sibship reconstruction allows direct measurements of dispersal and family structure in marine species while more easily applied in those species for which the collection of the parental population is difficult or infeasible.

Expected Publication Date: Summer/Fall 2014

### *Assessing the vulnerability of marine benthos to fishing gear impacts*

Reviews in Fisheries Science & Aquaculture

J. H. Grabowski, M. Bachman, **C. Demarest (NMFS/NEFSC)**, S. Eayrs, B. P. Harris, V. Malkoski, **D. Packer (NMFS/NEFSC)**, and **D. Stevenson (NMFS/GARO)**

- The findings of this study highlight the importance of considering the resilience of specific components of habitat such as emergent epifauna or geological formations that serve as essential fish habitat by providing shelter and a source of food for fish.
- When coupled with the distribution of geological substrates and energy environments that exist in a particular region, the framework developed in this study offers fisheries resource managers a tool to assess gear-specific spatial impacts on benthic substrates and identify benthic habitat vulnerability hotspots.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires US fishery management plans to minimize, to the extent practicable, the adverse effects of fishing on essential fish habitats (EFHs). The authors develop a framework to quantify and assess benthic impacts of the six most common bottom-tending gears (>99% of bottom-tending fishing effort) in New England: otter trawls, scallop dredges, hydraulic clam dredges, gillnets, longlines, and traps. They use relevant habitat impacts literature to develop a framework for generating and





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organizing quantitative susceptibility (based on percent loss of structural habitat from a single interaction with the gear) and recovery (i.e., the time required for recovery of lost structure) parameters for each biological (e.g., sponges, ascidians, mollusks) and geological (e.g., mud burrows, sand ripples, cobble, and boulder piles) feature common to the following five substrates: mud, sand, granule–pebble, cobble, and boulder in low- and high-energy environments. In general, we found that both susceptibility and recovery scores were highest for hydraulic dredges, slightly lower for otter trawls and scallop dredges, and much lower for fixed gears (i.e., gillnets, longlines, and traps). For bottom trawls and scallop dredges, geological features in mud, sand, and cobble-dominated substrates were more susceptible to gear impacts than features found in granule–pebble and boulder substrates. Meanwhile, biological features were largely equally susceptible to impacts across the five substrate types. Average susceptibility scores for both biological and geological substrate features were not affected by energy level. Average recovery times for geological features affected by bottom trawls and dredges were much longer in low-energy granule–pebble, and low- and high-energy cobble and boulder than in mud and sand substrates. Meanwhile, there was no difference among substrates or energy levels for biological feature recovery times. These results collectively suggest that cobble and boulder substrates are the most vulnerable to impacts from mobile bottom-tending gear. Recovery from the relatively minor impacts caused by fixed gear required slightly longer in the three coarser substrate types than in mud and sand.

Available online: <http://www.tandfonline.com/doi/pdf/10.1080/10641262.2013.846292>

### *Time-varying natural mortality in fisheries stock assessment models: Identifying a default approach*

ICES Journal of Marine Science

K. Johnson, C. Monnahan, **C. McGilliard** (NMFS/AKFSC), K. Vertpre, S. Anderson, C. Cunningham, F. Hurtado-Ferro, R. Licandeo, M. Muradian, K. Ono, C. Szuwalski, J. Valero, A. Whitten, and A. E. Punt.

- This paper explored options for dealing with populations where natural mortality ( $M$ )





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may vary over time without explicitly estimating  $M$  as a time-varying parameter.

- Estimating time-invariant natural mortality ( $M$ ) in an assessment (rather than fixing time-invariant  $M$  to an arbitrary value) led to the least biased estimates of SSB when  $M$  was thought to vary over time, but was not estimated as a time-varying parameter.

A typical assumption used in most age- and size-structured fishery stock assessments is that natural mortality ( $M$ ) is constant across time, sex, and age. However,  $M$  is rarely constant in reality as a result of the combined impacts of exploitation history, predation, environmental factors, and physiological trade-offs. Methods to estimate even an age- and time-invariant (i.e., constant)  $M$  within age-structured assessment models rely on informative length- and age-composition data, which are often not available. Misspecification or poor estimation of  $M$  can lead to bias in quantities estimated using stock assessment methods, potentially resulting in biased estimates of fishery reference points and catch limits, with the magnitude of bias being influenced by life history and trends in fishing mortality. Monte Carlo simulations were used to evaluate the ability of statistical age-structured population models to estimate spawning stock biomass, fishing mortality, and total allowable catch when the true  $M$  was age-invariant, but time-varying. Configurations of the stock assessment method, implemented in Stock Synthesis, included a single age- and time-invariant  $M$  parameter, specified at one of three levels (high, medium, and low) or an estimated  $M$ . The min-max approach to specifying  $M$  (i.e., finding the stock assessment configuration for which the analyst could go least wrong about terminal spawning stock biomass and total allowable catch, given no information about  $M$ ) when it is thought to vary across time was to estimate  $M$ . The least robust approach for the majority of scenarios examined was to fix  $M$  at a high value, suggesting that the consequences of misspecifying  $M$  are asymmetric.

Accepted: 3 March 2014

### *Sampling harmful benthic dinoflagellates: comparison of artificial and natural substrate methods*

Harmful Algae





## NOAA SCIENTIFIC PUBLICATIONS REPORT MAY 23, 2014

**P. A. Tester, S. R. Kibler, W. C. Holland, G. Usup, M. W. Vandersea, C. P. Leaw, L. P. Teen, J. Larsen, N. Mohammad-Noor, M. A. Faust, and R. W. Litaker (NOS/NCCOS)**

- The authors developed a method that provides a way to normalize sampling efforts for toxic benthic dinoflagellates across multiple studies, large geographic distances and possibly over long timescales.

This study compared two collection methods for Bottom-Dwelling (Benthic) Harmful Algal Bloom (BHAB) dinoflagellates, an artificial substrate method and the traditional macrophyte substrate method. The authors report the results of a series of field experiments in tropical environments designed to address the relationship of benthic dinoflagellate abundance on artificial substrate and adjacent aquatic plants (macrophytes). The data indicated abundance of BHAB dinoflagellates associated with new, artificial substrate was directly related to the overall abundance of BHAB cells on macrophytes in the surrounding environment. There was no difference in sample variability among the natural and artificial substrates. BHAB dinoflagellate abundance on artificial substrates reached equilibrium with the surrounding population within 24 h. Calculating cell abundance normalized to surface area of artificial substrate, rather than to the wet weight of macrophytes, eliminates complications related to the mass of different macrophyte species, problems of macrophyte preference by BHAB dinoflagellates and allows data to be compared across studies. The protocols outlined in this study are the first steps to a standardized sampling method for BHAB dinoflagellates that can support a cell-based monitoring program for ciguatera fish poisoning. While this study is primarily concerned with the ciguatera-associated genus *Gambierdiscus*, the authors also include data on the abundance of benthic *Prorocentrum* and *Ostreopsis* cells.

Expected Publication Date: May 2014

*Biological and environmental influences on the trophic ecology of leatherback turtles in the Northwest Atlantic Ocean*

Marine Biology

B. P. Wallace, **J. Schumacher, J. A. Seminoff**, and M. C. James (NMFS/SWFSC)





## NOAA SCIENTIFIC PUBLICATIONS REPORT MAY 23, 2014

- Leatherback turtles foraging in the Canadian Atlantic demonstrate trophic histories that are consistent with leatherbacks foraging along the U.S. eastern seaboard.
- Stable isotopes are an ideal tool to study trophic status of species from which conventional diet samples are difficult to obtain.

Understanding the causes and consequences of variability in trophic status is important for interpreting population dynamics and for identifying important habitats for protected species like marine turtles. In the Northwest Atlantic Ocean, many leatherback turtles (*Dermochelys coriacea*) from distinct breeding stocks throughout the wider Caribbean region migrate to Canadian waters seasonally to feed, but their trophic status during the migratory and breeding cycle and its implications have not yet been described. In this study, the authors used stable isotope analyses to characterize the trophic status of leatherbacks in Atlantic Canadian waters by identifying trophic patterns among turtles and the factors influencing those patterns.  $\delta^{15}\text{N}$  values of adult males and females were significantly higher than those of turtles of unknown gender (i.e., presumed to be subadults), and  $\delta^{15}\text{N}$  increased significantly with body size. No significant differences were found among average stable isotope values of turtles according to breeding stock origin. Significant inter-annual variation in  $\delta^{15}\text{N}$  among cohorts probably reflects broad-scale oceanographic variability that drives fluctuations in stable isotope values of nutrient sources transferred through several trophic positions to leatherbacks, variation in baseline isotope values among different overwintering habitats used by leatherbacks, or a combination of both. Understanding effects of demographic and physiological factors, as well as oceanographic conditions, on trophic status is key to explaining observed patterns in population dynamics and for identifying important habitats for widely distributed, long-lived species like leatherbacks.

Expected Publication Date: Fall 2014

*Brucella placentitis and seroprevalence in northern fur seals (Callorhinus ursinus) of the Pribilof Islands, Alaska*

Journal of Veterinary Diagnostic Investigation





## NOAA SCIENTIFIC PUBLICATIONS REPORT MAY 23, 2014

C. G. Duncan, R. Tiller, D. Mathis, R. Stoddard, G. J. Kersh, **B. Dickerson**, and **T. Gelatt**  
(NMFS/AKFSC)

- The results of this study provide evidence that *Brucella* is present in northern fur seals inhabiting the Pribilof Islands, albeit in low frequency.
- Because *Brucella* is known to have detrimental effects on herd animals, this evidence of *Brucella* presence can inform future research investigating reasons for the observed population decline in the eastern Pacific stock of northern fur seals.
- *Brucella* is a zoonotic disease and these results provide evidence of *Brucella* infection causing pathology in pinnipeds.

*Brucella* species infect a wide range of hosts with a broad spectrum of clinical manifestations. In mammals, one of the most significant consequences of *Brucella* infection is reproductive failure. There is evidence of *Brucella* exposure in many species of marine mammals, but the outcome of infection is often challenging to determine. The eastern Pacific stock of northern fur seals (NFS, *Callorhinus ursinus*) has declined significantly, spawning research into potential causes for this trend, including investigation into reproductive health. The objective of the current study was to determine if NFSs on St. Paul Island, Alaska have evidence of *Brucella* exposure or infection. Archived DNA extracted from placentas (n = 119) and serum (n = 40) samples were available for testing by insertion sequence (IS) 711 polymerase chain reaction (PCR) and the *Brucella* microagglutination test (BMAT), respectively. Placental tissue was also available for histologic examination. Six (5%) placentas were positive by PCR, and a single animal had severe placentitis. Multilocus variable number tandem repeat analysis profiles were highly clustered and closely related to other *Brucella pinnipedialis* isolates. A single animal was positive on BMAT, and 12 animals had titers within the borderline range; 1 borderline animal was positive by PCR on serum. The findings suggest that NFSs on the Pribilof Islands are exposed to *Brucella* and that the organism has the ability to cause severe placental disease. Given the population trend of the NFS, and the zoonotic nature of this pathogen, further investigation into the epidemiology of this disease is recommended.

Expected publication date: July 2014





## NOAA SCIENTIFIC PUBLICATIONS REPORT MAY 23, 2014

*Too much is never enough: the cautionary tale of Soviet illegal whaling*  
Marine Fisheries Review

**Y. V. Ivashchenko (NMFS/AKFSC), R. L. Brownell, Jr. (NMFS/SWFSC), and P. Clapham (NMFS/AKFSC)**

- This work examines the ways the USSR and other nations exploited weaknesses in the Convention to block or delay decisions unfavorable to the industry.
- The evolution of the USSR's public stance at the IWC while the nation was illegally whaling is traced, and its evolving positions on catch limits, national quotas, the status of whale populations, and the International Observer Scheme are summarized.
- The inadequacy of the IWC's existing procedures for inspection and enforcement with regard to current and possible future commercial whaling are underscored.

Despite being a signatory to the International Convention for the Regulation of Whaling (1946), the USSR conducted a 30 year campaign of illegal whaling which arguably represents one of the greatest failures of management in the history of the industry. Here, using a variety of sources including published literature, formerly secret Soviet industry reports and interviews with former biologists and whalers, we provide an overview of the history, scope, and economic origins of Soviet whaling, and examine the domestic and international political context in which it was set. At various times during the period from 1933 into the 1970's, the USSR operated a total of seven whaling factory fleets and several shore whaling stations. We estimate that 534,119 whales were killed, of which 178,726 were not reported to the International Whaling Commission (IWC). In the Southern Hemisphere, the greatest impact of these catches was on humpback whales, *Megaptera novaeangliae*, where (mostly illegal) takes of more than 48,000 whales precipitated a population crash and closure of shore whaling stations in Australia and New Zealand. The Southern Hemisphere also saw large illegal catches of southern right whales (*Eubalaena australis*). In the North Pacific, the greatest impacts were on sperm whales, *Physeter macrocephalus*, (where data on sex and length were routinely misreported together with falsified total catches), as well as on the two already-small populations of right whales, *Eubalaena japonica*, across the North Pacific and bowhead whales, *Balaena mysticetus*, in the





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Okhotsk Sea. Soviet whaling was driven by the state industrial planning system, which frequently set high production targets without regard to the ability of the resource to sustain the resulting large catches. It is clear that many at IWC knew that the USSR was whaling illegally, but they were probably unaware of the large scope of this activity. It is also clear that the Soviets were not alone in falsification of catch data, a problem which underscores the inadequacy of the IWC's existing procedures for inspection and enforcement with regard to current and possible future commercial whaling.

Expected Publication Date: May 2014

### OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

#### *Modelling anadromous salmonid life-history*

Evolutionary Biology of the Atlantic Salmon. CRC Press, Boca Raton, FL

M. Mangel and **W. H. Satterthwaite (NMFS/SWFSC)**

- This book chapter describes the theory behind models that have been applied to predict potential effects of variation in freshwater environmental conditions and fish passage on demography and life history expression in anadromous salmonids.

We give an overview of the main methods that could be used to model anadromous life histories, focusing on state dependent life history theory implemented by Stochastic Dynamic Programming (SDP). That is, in order to understand anadromy, particularly in changing environments, we need to understand how natural selection acts on development and behavior in the context of trade-offs and fitness. Natural and sexual selection act to optimize from available variants, which are products of previous optimization events. Thus, state dependent life history theory, implemented by SDP is a powerful tool allowing us to formally analyze the outcomes of living systems at any point in evolutionary history. We begin with a discussion of what it means to model anadromy, with a focus on organisms living in seasonal environments and their preparation for developmental transitions. We then give an overview of the kinds of modeling methods that could be used. We then describe how state dependent life history modeling works, in an equation-free manner so that the intuition is developed before we turn to the details of equations. After that we give a simple example, not intended to capture the life history of any specific salmonid but having much in common with many salmonids. Within the





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framework of this ‘practice problem’ we consider obligate anadromy in detail, and later consider facultative anadromy vs. residency, or facultative maturation followed by anadromy, in the discussion. We then describe how these methods have been applied to steelhead in California. We close with a discussion of what we have learned from these models and what the most promising avenues for future endeavors are.

Expected Publication Date: Late 2014

### *Using In Situ Video Analysis to Assess the Effects of Hypoxia on Juvenile Flatfish Performance and Behavior*

California Cooperative Oceanic Fisheries Investigations Reports

A. Stinton, L. Ciannelli, D. C. Reese, and **W. W. Wakefield (NMFS/NWFSC)**

- Results suggest that the video beam trawl effectively monitors behavioral metrics and community composition of nearshore flatfish assemblages.
- Juvenile fish reaction duration, defined as the time in seconds from first reaction to capture, decreased with decreased dissolved oxygen.
- Results suggest that the ability of juvenile flatfishes to escape predation could be affected by dissolved oxygen concentrations, but this result may be confounded by the covariation of water temperature and species assemblages.

The authors examined the feasibility of using a video beam trawl system to assess behavioral responses of juvenile flatfishes in relation to co-occurring habitat features, most notably dissolved oxygen (DO) concentrations. Sixteen samples were collected along a cross shelf transect in the central Oregon coast during summer 2008. The Authors found that juvenile fish reaction duration, defined as the time in seconds from first reaction to capture, decreased with decreased DO. However, other variables such as bottom water temperature, fish size, and fish species composition by site are potentially confounding factors of the analysis. The dominant flatfish species shifted from English sole (*Parophrys vetulus*) to Pacific sanddab (*Citharichthys sordidus*) with increased depth. Escape behavior varied from “burying” in the shallows, to “hovering” at mid-depth stations, and “running” at the deepest site. Collectively, these results suggest that the video beam trawl effectively monitors behavioral metrics and community composition of nearshore flatfish assemblages.

Expected Publication Date: Summer 2014

