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Crude oil exposures reveal roles for intracellular calcium cycling in haddock craniofacial and cardiac development
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Impact of the 2008 Global Recession on air quality over the United States: Implications for surface ozone levels from changes in NO_x emissions
Geophysical Research Letters (4.456)

Physically plausible methods for projecting changes in Great Lakes water levels under climate change scenarios
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Passive acoustic monitoring of the decline of Mexico's critically endangered vaquita
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Interannual variability in the feeding and condition of subyearling Chinook salmon off Oregon and Washington
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Environmental Biology of Fishes (1.356)

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HIGHLIGHTED ARTICLES

Crude oil exposures reveal roles for intracellular calcium cycling in haddock craniofacial and cardiac development

E. Sørhus, **J. P. Incardona (NMFS/NWFSC)**, Ø. Karlsen, **T. L. Linbo (NMFS/NWFSC**), L. Sørensen, T. Nordtug, T. van der Meeren, A. Thorsen, M. Thorbjørsen, S. Jentoft, R. Edvardsen, S. Meier

- Findings underscore the unique susceptibility of haddock embryos to dispersed crude oil toxicity as a likely consequence of oil droplet binding. Compounding this phenomenon, haddock show distinctive craniofacial malformations that could be linked to novel mechanisms of crude oil toxicity.
- This study reveals the extreme sensitivity of an economically and ecologically important Arctic fish to crude oil in comparison to other species studied to date.
- Molecular methods refined for this study may be used to test sensitivity in important North American arctic stocks such as Alaska pollock.

Recent studies have shown that crude oil exposure affects cardiac development in fish by disrupting excitation-contraction (EC) coupling. We previously found that eggs of Atlantic haddock (*Melanogrammus aeglefinus*) bind dispersed oil droplets, potentially leading to more profound toxic effects from uptake of polycyclic aromatic hydrocarbons (PAHs). Using lower concentrations of dispersed crude oil (0.7-7 μg/L ∑PAH), here we exposed a broader range of developmental stages over both short and prolonged durations. We quantified effects on cardiac function and morphogenesis, characterized novel craniofacial defects, and examined the expression of genes encoding potential targets underlying cardiac and craniofacial defects. Because of oil droplet binding, a 24-hr exposure was sufficient to create severe cardiac and craniofacial abnormalities. The specific nature of the craniofacial abnormalities suggests that crude oil may target common craniofacial and cardiac precursor cells either directly or indirectly by affecting ion channels and intracellular calcium in particular. Furthermore, down-regulation of genes encoding specific components of the EC coupling machinery suggests that crude oil disrupts excitation-transcription coupling or normal feedback regulation of ion channels blocked by PAHs. These data support a unifying hypothesis whereby depletion of intracellular calcium pools by crude oil-derived PAHs disrupts several pathways critical for organogenesis in fish.

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NOAA SCIENTIFIC PUBLICATIONS REPORT
AUGUST 1, 2016

Impact of the 2008 Global Recession on air quality over the United States: Implications for surface ozone levels from changes in NO_x emissions
Geophysical Research Letters (4.456)
D. Tong (OAR/ARL), L. Pan (OAR/ARL), W. Chen (OAR/ARL), L. Lamsal, **P. Lee (OAR/ARL), Y. Tang (OAR/ARL), H. Kim (OAR/ARL), S. Kondragunta (NESDIS/STAR), I. Stajner (NWS/STI)**

- This is the first paper to present a credible assessment of the impact of the 2008 global recession on air quality in the United States.
- The authors find that the 2008 recession significantly affected surface ozone levels over the United States, with widespread decreases over the East and Pacific West and a slight increase over the Rocky Mountain region.

Satellite and ground observations detected large variability in nitrogen oxides (NO_x) during the 2008 economic recession, but the impact of the recession on air quality has not been quantified. This study combines observed NO_x trends and a regional chemical transport model to quantify the impact of the recession on surface ozone (O_3) levels over the continental United States. The impact is quantified by simulating O_3 concentrations under two emission scenarios: business-as-usual (BAU) and recession. In the BAU case, the emission projection from the Cross-State Air Pollution Rule (CSAPR) is used to estimate the "would-be" NO_x emission level in 2011. In the recession case, the actual NO_2 trends observed from Air Quality System (AQS) ground monitors and the Ozone Monitoring Instrument (OMI) on the Aura satellite are used to obtain "realistic" changes in NO_x emissions. The model prediction with the recession effect agrees better with ground O_3 observations over time and space than the prediction with the BAU emission. The results show that the recession caused a 1-2 ppbv decrease in surface O_3 concentration over the eastern United States, a slight increase (0.5-1 ppbv) over the Rocky Mountain region, and mixed changes in the Pacific West. The gain in air quality benefits during the recession, however, could be quickly offset by the much slower emission reduction rate during the post-recession period.
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2016GL069885/full

NOAA SCIENTIFIC PUBLICATIONS REPORT
AUGUST 1, 2016

Physically plausible methods for projecting changes in Great Lakes water levels under climate change scenarios

Journal of Hydrometeorology (3.57)

B. M. Lofgren, **J. Rouhana (OAR/GLERL)**

- An empirically-based model widely used for projections of Great Lakes water levels under future climate change scenarios greatly overestimates evapotranspiration in this region.
- The authors find significant discrepancies between water level projections using empirically-based and physically-based formulations of evapotranspiration.

A method for projecting the water levels of the Laurentian Great Lakes under scenarios of human-caused climate change, used almost to the exclusion of other methods in the past, relies very heavily on the Large Basin Runoff Model (LBRM) as a component for determining the water budget for the lake system. This model uses near-surface air temperature as a primary predictor of evapotranspiration (ET); as in previous published work, we show here that its very high sensitivity to temperature makes it overestimate ET in a way that is greatly at variance with the fundamental principle of conservation of energy at the land surface. The traditional formulation is characterized here as being equivalent to having several suns in the virtual sky created by LBRM. Alternative, more physically-based, methods show, relative to the traditional method, often astoundingly less PET and less ET, more runoff from the land and net basin supply for the lake basins, and higher lake water levels in the future. Using various methods of estimating the statistical significance, we find that, at minimum, these discrepancies in results are significant at the 99.998% level. The lesson for the larger climate impact community is to use caution about whether an impact is forced directly by air temperature itself, or is significantly forced by season or latitude independently of temperature. The results here apply only to the water levels of the Great Lakes and the hydrology of its basin, and do not affect larger questions of climate change.

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NOAA SCIENTIFIC PUBLICATIONS REPORT
AUGUST 1, 2016

Passive acoustic monitoring of the decline of Mexico's critically endangered vaquita.

Conservation Biology (4.267)

A. Jaramillo-Legorreta, G. Cardenas-Jinojosa, E. Nieto-Garcia, L. Rojas-Bracho**, J. Ver Hoef (NMFS/AKFSC), J. Moore (NMFS/SWFSC),** N. Tregenza, **J. Barlow (NMFS/SWFSC), T. Gerrodette (NMFS/SWFSC),** L. Thomas**, B. Taylor (NMFS/SWFSC)**

- Data from an acoustic monitoring array was used to understand the decline of the elusive and critically endangered vaquita from 2011-2015
- The results of this study were used to inform the Mexican government's decision to implement an emergency 2-year gillnet ban in the vaquita's range, the Gulf of California

The vaquita (*Phocoena sinus*) is the world's most endangered marine mammal with ≈245 individuals remaining in 2008. This species of porpoise is endemic to the northern Gulf of California, Mexico, and has historically suffered population declines from unsustainable bycatch in gillnets. An illegal gillnet fishery for an endangered fish, the totoaba (*Totoaba macdonaldi*), has recently resurged throughout the vaquita's range. The secretive but lucrative wildlife trade with China for totoaba swim bladders has probably increased vaquita bycatch mortality, but by an unknown amount. Precise population monitoring by visual surveys is difficult because vaquitas are inherently hard to see and have now become so rare that sighting rates are very low. However, their echolocation clicks can be identified readily on specialized acoustic detectors. Acoustic detections on an array of 46 moored detectors indicate that vaquita acoustic activity declined by 80% between 2011 and 2015 in the central part of the species' range. Statistical models estimate an annual rate of decline of 34% (95% Bayesian Credible Interval -48% to -21%). Based on preliminary acoustic monitoring results from 2011–2014 the Government of Mexico enacted and is enforcing an emergency 2-year ban of gillnets throughout the species' range to prevent extinction, at a cost of $74 million USD to compensate fishers. Developing precise acoustic monitoring methods proved critical to exposing the severity of vaquitas' decline and emphasizes the need for continual monitoring to effectively manage critically endangered species
Available online: http://onlinelibrary.wiley.com/doi/10.1111/cobi.12789/abstract

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CROSS LINE OFFICE ARTICLES

The influence of Pacific equatorial water on fish diversity in the southern California Current System
Journal of Geophysical Research (3.426)
S. McClatchie (NMFS/SWFSC), A. R. Thompson (NMFS/SWFSC), S. R. Alin (OAR-PMEL), S. Siedlecki, **W. Watson (NMFS/SWFSC), S. J. Bograd (NMFS/SWFSC)**

- We use ichthyoplankton assemblages near the cores of the California Current and the California Undercurrent to determine whether PEW influenced fish diversity.
- Species richness increased between the decades consistent with intrusion of warm water with more diverse assemblages into the southern California region.

The California Undercurrent transports Pacific Equatorial Water (PEW) into the Southern California Bight from the eastern tropical Pacific Ocean. PEW is characterized by higher temperatures and salinities, with lower pH, representing a source of potentially corrosive (aragonite, $\Omega<1$) water to the region. We use ichthyoplankton assemblages near the cores of the California Current and the California Undercurrent to determine whether PEW influenced fish diversity. We use hydrographic data to characterize the inter-annual and seasonal variability of estimated pH and aragonite saturation with depth. Although there is substantial variability in PEW presence as measured by spice on the 26.25-26.75 isopycnal layer, as well as in pH and aragonite saturation, we found fish diversity to be stable over the decades 1985-1996 and 1999-2011. We detected significant difference in species structure during the 1998 La Niña period, due to reduced species evenness. Species richness due to rare species was higher during the 1997/98 El Niño compared to the La Niña but the effect on species structure was undetectable. Lack of difference in the species abundance structure in the decade before and after the 1997/99 ENSO event showed that the assemblage reverted to its former structure following the ENSO perturbation, indicating resilience. While the inter-decadal species structure remained stable, the long tail of the distributions shows that species richness increased between the decades consistent with intrusion of warm water with more diverse assemblages into the southern California region.
Publication date: July 20, 2016
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2016JC011672/full

ADDITIONAL ARTICLES

NMFS Publications

CO_2 sensitivity experiments are not sufficient to show an effect of ocean acidification

ICES Journal of Marine Science (2.525)

P. McElhany (NMFS/NWFSC)

- CO_2 sensitivity experiments are not sufficient to show an effect of ocean acidification (OA),
- Field time series data are needed to show an effect of OA in the wild.
- There are no unambiguous examples of a contemporary effect of OA on abundance or distribution for any species.

The ocean acidification (OA) literature is replete with laboratory studies that report species sensitivity to seawater carbonate chemistry in experimental treatments as an "effect of OA". I argue that this is unintentionally misleading, since these studies do not actually demonstrate an effect of OA but rather show sensitivity to CO_2. Documenting an effect of OA involves showing a change in a species (e.g. population abundance or distribution) as a consequence of anthropogenic changes in marine carbonate chemistry. To date, there have been no unambiguous demonstrations of a population level effect of anthropogenic OA, as that term is defined by the IPCC.

Published: July 10, 2016

Available online:
http://icesjms.oxfordjournals.org/content/early/2016/07/07/icesjms.fsw085.full.pdf+html

First record of Antarctic minke whale, Balaenoptera bonaerensis, *in the northern Gulf of Mexico*

Marine Biodiversity Records (0.700)

P. E. Rosel (NMFS/SEFSC-Lafayette), L. A. Wilcox (NMFS/SEFSC-Lafayette), C. Monteiro, M. C. Tumlin

- Southern Ocean minke whales were previously thought to not migrate above 7°S
- This paper describes the first record of an Antarctic minke whale being found in the northern Gulf of Mexico and is one of the few records for the Northern Hemisphere.

The Antarctic minke whale, *Balaenoptera bonaerensis*, is a Southern Hemisphere species of balaenopterid whale generally found south of 60°S in austral summer. In the Atlantic Ocean, they migrate north during austral winter as far as approximately 7°S. On 05 February, 2013, a 7.7m baleen whale was observed floating dead off of Iberia Parish, Louisiana, USA in the northern Gulf of Mexico. Genetic analysis of mitochondrial and nuclear DNA sequences obtained from this animal determined that it was an Antarctic minke whale, *Balaenoptera bonaerensis*. This is the first record of an Antarctic minke whale in the Gulf of Mexico.
Published: July 22, 2016
Available online: https://mbr.biomedcentral.com/articles/10.1186/s41200-016-0058-x

*Natural selection on morphology varies among years and by sex in Magellanic Penguins (*Spheniscus magellanicus*)*
The Auk: Ornithological Advances (1.871)
L. E. Koehn, **J. J. Hard (NMFS/NWFSC)**, E. P. Akst, P. D. Boersma

- This is the first long-term (28 years) study of natural selection and evolution in a seabird.
- Temporal variability in selection reflects environmental variation that, surprisingly, can foster stability in evolution of morphology through time.
- Results highlight the importance of long-term studies in identifying patterns and trends in the environment that can influence patterns of phenotypic and genetic responses in morphology and life history through natural selection.

The evolution of morphology in a population reflects several factors, including the influence of environmental variability on natural selection. We estimated natural selection on and heritability of four individual morphological traits: bill length, bill depth, flipper length, and foot length, and two multivariate morphological traits, in adult Magellanic Penguins (*Spheniscus magellanicus*) at Punta Tombo, Argentina from 1983–2010. We estimated heritability of morphology with parent-offspring regression and animal models, conditioning on sex because these penguins are sexually dimorphic. For the analysis of selection on each trait, we estimated both linear and quadratic selection gradients, based on the number of fledglings produced, for breeding males and females in each year. Estimates from animal models indicated that all six traits were heritable; in parent-offspring regressions, corresponding heritabilities were significantly higher in sons than daughters in

100% of tests. Over 28 years, we could not detect selection in 21 years for males and 21 years for females. For the years we did detect selection, the direction and intensity of selection on traits varied, and was especially variable for females. We detected selection on primarily multivariate body size but also on male bill sizes and female bill and foot length. Selection on male flipper and foot length and female bill depth was detectable only in relation to selection on body size. When there was selection in males, selection on body and bill sizes was mainly toward larger sizes and occurred in four of six years with low chick starvation. The absence of detectable selection on morphology in most years suggests that it is not tightly linked to fitness and that the dynamic environment where Magellanic Penguins live helps maintain morphological variation. The temporal variability in selection, likely fosters stability of morphology through time, a pattern that might not be evident in short term studies.
Accepted: July 11, 2016
Expected publication date: August 2016

*Insights into Blainville's beaked whale (*Mesoplodon densirostris*) echolocation ontogeny from recordings of mother-calf pairs*
Marine Mammal Science (1.820)
C. Dunn, D. Clardidge, **J. Durban (NMFS/SWFSC)**, J. Schaffer, D. Moretti, P. Tyack, L. Rendell.

- First description of ontogeny of beaked whale echolocation behavior
- Insight into anti-predation strategies of vulnerable young calves

Studying the ontogeny of vocal behavior is crucial to understanding the roles of factors such as social influence or acoustic environment in the development of normal adult vocal repertoires. We investigated the ontogeny of Blainville's beaked whale (*Mesoplodon densirostris*) clicks using recordings from mother-calf pairs in the Bahamas. Results indicate calves from three months of age echolocate using clicks similar to those of adults. As neonates are not vocalizing immediately after birth, they may be eavesdropping on their mothers' clicks allowing them to follow during foraging dives shortly after birth, minimizing their time left alone at the surface and vulnerable to predation.
Accepted: July 7, 2016
Expected publication date: Late summer 2016

NOAA SCIENTIFIC PUBLICATIONS REPORT

AUGUST 1, 2016

Penalized nonparametric scalar-on-function regression via principal coordinates
Journal of Computational and Graphical Statistics (0.482)
P. T. Reiss, **D. L. Miller (NMFS/NEFSC)**, P. Wu, W. Hua

- New methodology for functional data analysis.

A number of classical approaches to nonparametric regression have recently been extended to the case of functional predictors. This paper introduces a new method of this type, which extends intermediate-rank penalized smoothing to scalar-on-function regression. The core idea is to regress the response on leading principal coordinates defined by a relevant distance among the functional predictors, while applying a ridge penalty. Our publicly available implementation, based on generalized additive modeling software, allows for fast optimal tuning parameter selection and for extensions to multiple functional predictors, exponential family-valued responses, and mixed-effects models. In an application to signature verification data, the proposed principal coordinate ridge regression is shown to outperform a functional generalized linear model.
Acceptance date: July 15, 2016
Available online: https://works.bepress.com/phil_reiss/42/download/

West Coast communities and catch shares: the early years of social change
Coastal Management (1.748)
S. Russell (NMFS/NWFSC), A. Arias-Arthur, K. Sparks, A. Varney

- This study reports on the social impacts of a Pacific Coast catch shares program since it was established in 2011.

The Pacific Coast Groundfish Trawl Fishery transitioned to a catch shares program in January 2011. The Pacific Coast Groundfish Fishery Social Study was designed to measure associated social changes and impacts to individuals and communities. Selected survey and interview data from the baseline data collection in 2010 and the first supplemental data collection effort in 2012 are aggregated at the community level and analyzed for initial signs of social change. Communities are sorted into top, mid, and low tier communities based on the percentage of quota share (QS) permit owners that live in each community. A higher number of QS permit owners in a place is expected to result in relatively greater benefits to those communities. Questions analyzed include percent of income from fishing, multiple jobs worked, job stability, job satisfaction, standard of living, and how individuals were personally affected. Significant results include improvements in job satisfaction and increases in multiple jobs worked for TOP tier communities,

and improved standard of living in LOW tier communities. MID tier communities appear to be in the middle, with no significant changes. Interview data indicate variation between owners, where some can fish their allocations and others need to lease more to fish.
Accepted: 30 July 2015

Survival and travel times of in-river and transported yearling Chinook salmon in the lower Columbia River and estuary
Fisheries Research (1.843)
J. P. Dietrich (NMFS/NWFSC), K. Eder, D. E. Thompson, R. A. Buchanan, J. R. Skalski, G. A. McMichael, D. S. Fryer, F. J. Loge

- Salmon with different FCRPS outmigration histories (barged or in-river) have different transit and survival rates in the lower Columbia River and estuary.
- Salmon mortality varied during the outmigration season and was greater in the estuary than in the lower river reaches
- Acoustic telemetry technology can be used to characterize salmon survival and transit within the LRE for in-river and barged outmigrants, but data collection and experimental methods need to be standardized for multi-year analysis.

The lower Columbia River and estuary (LRE) is a critically important environment for outmigrating salmonids, yet uncertainties remain about the survival and behavior of barged and in-river migrating fish. Although studies have used telemetry to monitor Chinook salmon movement and survival through the LRE, comparisons between outmigration years are confounded by differences in tag technologies, array locations, and experimental designs. In the present study, multiple releases of barged and in-river Snake River spring/summer Chinook salmon were implanted with acoustic tags and monitored at multiple locations between Lower Granite Dam on the Snake River (695 km from the mouth of the Columbia River) to within 3 km of the Pacific Ocean. LRE survival estimates and transit rates of barged fish significantly varied throughout the outmigration season. The transit rates of in-river fish also varied, but without a corresponding seasonal difference in LRE survival estimates. Early release groups of barged salmon were slower and had lower survival in the LRE than in-river salmon. Estuary arrival timing and the magnitude of transit rates may contribute to significant differences in LRE mortality between in-river and barged juvenile salmon. Survival in the Lower River reaches was stable and exceeded 0.90 for both barged and in-river

fish, while survival decreased markedly in the Estuary. Differential distributions of arrival to the LRE, transit rates, and survival suggest that the outmigration experience is not homogenous for barged and in-river yearling Snake River Chinook salmon, and that previous outmigration experience of threatened and endangered salmon should be considered in future management decisions and recovery plans.
Accepted: July 3, 2016

apex: phylogenetics with multiple genes
Molecular Ecology Resources (3.28)
T. Jombart, **F. Archer (NMFS/SWFSC)**, K. Schliep, Z. Kamvar, R. Harris, E. Paradis, J. Goudet, H. Lapp

- Provides managers with ability to do multi-gene analyses in R.

Genetic sequences of multiple genes are becoming increasingly common for a wide range of organisms including viruses, bacteria, and Eucaryotes. While such data may sometimes be treated as a single locus, in practice a number of biological and statistical phenomena can lead to phylogenetic incongruence. In such cases different loci should, at least as a preliminary step, be examined and analysed separately. The R software has become a popular platform for phylogenetics, with several packages implementing distance-based, parsimony, and likelihood-based phylogenetic reconstruction, and an even greater number of packages implementing phylogenetic comparative methods. Unfortunately, basic data structures and tools for analysing multiple genes have so far been lacking, thereby limiting potential for investigating phylogenetic incongruence. In this paper, we introduce the new R package apex to fill this gap. apex implements new object classes which extend existing standards for storing DNA and amino-acid sequences, and provides a number of convenient tools for handling, visualizing, and analyzing these data. In this paper, we introduce the main features of the package and illustrate its functionalities through the analysis of a simple dataset.
Accepted: July 6, 2016

NOAA SCIENTIFIC PUBLICATIONS REPORT
AUGUST 1, 2016

Post-glacial habitat release and incipient speciation in the genus Delphinus
Heredity (3.801)
I. Segura-García, J. P. Gallo, **S. Chivers,** R. Díaz-Gamboa and A. Rus Hoelzel **(NMFS/SWFSC)**

- Provides additional genetic evidence for recognition of ENP common dolphins as separate species
- Contributes to the understanding of speciation in common dolphins

The role of ecological and changing environmental factors in the radiation of species diversity is a fundamental question in evolutionary biology. Of particular interest is the potential for these factors to determine the boundary between what we would consider differentiation among populations, and incipient speciation. Dolphins in the genus *Delphinus* provide a useful test case, exhibiting morphological variation in beak length, colouration and body size across their wide geographic distribution, and in particular among coastal and more pelagic habitats. Two species have been proposed, *D. delphis* and *D. capensis*, but morphologically similar allopatric populations are not monophyletic, indicating that the mostly coastal 'long-beaked' *D. capensis* form is not a single globally distributed species. However, the sympatric populations in the Eastern North Pacific currently designated as these two species are both morphologically and genetically differentiated. Here we use microsatellite DNA and mtDNA markers to investigate the evolutionary mechanisms that led to this incipient speciation event. We used coalescent and assignment methods to investigate the timing and extent of reproductive isolation. Our data indicate that while there is some level of on-going gene flow, the putative species found in the Eastern North Pacific are reciprocally monophyletic. The timing of isolation appears to be associated with regional changes in paleoceanographic conditions within the Holocene timeframe.
Accepted: 27 June 2016

StrataG: An R package for manipulating, summarizing, and analyzing population genetic data
Marine Ecology Resources (1.138)
F. I. Archer (NMFS/SWFSC), P. E. Adams, B. B. Schneiders

- Provides managers with toolkit for easy and reproducible genetic data summaries and analyses.

We introduce the R package strataG as a user-friendly population genetics toolkit. strataG provides easy access to a suite of standard genetic summaries as well as the ability to rapidly manipulate stratified genetic data for custom analyses. Tests of

population subdivision with most common measures of population subdivision (e.g., FST, GST, ϕST, χ2) can be conducted within a single function. The package also provides wrapper functions that allow users to configure and run popular external programs such as Genepop, STRUCTURE, and fastsimcoal from within R, and smoothly interface with popular R packages adegenet, and pegas. strataG is intended to be an open-source dynamic package that will grow with future needs and user input.
Accepted: May 31, 2016

Interannual variability in the feeding and condition of subyearling Chinook salmon off Oregon and Washington
Fisheries Oceanography (3.37)
K. E. Dale, Elizabeth A. Daly, **R. D. Brodeur (NMFS/NWFSC)**

- The diet of subyearling Chinook salmon in the fall varied substantially, based on the prevailing oceanographic conditions and was related to ultimate survival
- Suggests that the fall plankton assemblage is critical to subyearling Chinook salmon, and could have important management implications

Chinook salmon (*Oncorhynchus tshawytscha)* is one of several economically-important species of salmon found in the Northeast Pacific Ocean. The first months at sea are believed to be the most critical for salmon in terms of survival, with the highest rate of mortality occurring during this period. Here, we examine interannual diet and condition trends for late-summer subyearling Chinook salmon caught off Oregon and Washington during from 1998 to 2012. Interannual variability was observed in juvenile salmon diet composition by weight of prey consumed. Juvenile subyearling Chinook salmon were mainly piscivorous, with Northern anchovy (*Engraulis mordax)*being especially important, making up half the diet by weight in some years. Annual diets clustered into two groups, primarily defined by their proportion of invertebrate prey (14% versus 39% on average). For the latter cluster, cool ocean conditions from May-August may have led to a fall plankton community with a larger proportion of invertebrates, leading to salmon having a significantly higher level of euphausiids, crab megalopae, and amphipods in their diets, which was correlated with higher adult returns three years later. However, salmon were found to have overall lower stomach fullness and poorer body condition in cool versus warm years, which may be driven by the enhanced survival of less fit individuals in better ocean conditions (top-down effect). Our

results suggest that the fall plankton community assemblage may be critical to subyearling Chinook stocks in coastal waters of the Pacific Northwest, which may have important consequences for the management of these threatened stocks.
Accepted: 3 June 2016

Estimating behavior in a black box: How coastal oceanographic dynamics influence yearling Chinook salmon marine growth and migration behaviors
Environmental Biology of Fishes (1.356)
B. J. Burke (NMFS/NWFSC), J. J. Anderson, J. A. Miller, L. M. Tomaro, **D. J. Teel** (**NMFS/NWFSC**), N. S. Banas, A. M. Baptista

- We know that ocean conditions can impact salmon survival, but conditions can influence other aspects of salmon ecology as well. For example, salmon behaviorally compensate for changes in the strength and direction of ocean currents, resulting in salmon swimming several times farther than their net movement (straight-line distance) would indicate.

The influence of ocean currents or temperatures on migration behavior may be substantial for many species. However, high–resolution data of animal movement in the marine environment are scarce, typically requiring analysts and managers to make simplifying assumptions regarding movement, behavior, and habitat use. We used a spatially explicit individual based model of early marine migration of two stocks of yearling Chinook salmon to quantify the influence of external forces on estimates of swim speed and consumption/growth. Model results suggest that salmon behaviorally compensate for changes in the strength and direction of ocean currents. This can result in salmon swimming several times farther than their net movement (straight–line distance) would indicate. However, the magnitude of this discrepancy depended on the oceanographic model used. Moreover, relative swim speed among groups of fish was less sensitive to the model used than estimates of absolute swim speed. By comparing groups of fish, this tool can be useful for management applications, such as how fish released from hatcheries early may differ in experiences and behavior from fish released later in the season. By taking into account experiences of individual fish, this approach incorporates both individual behavior and the influence of external physical factors such as ocean currents, allowing a more informed understanding of juvenile salmon behavior upon entering the marine phase of the their life cycle.
Accepted: July 18, 2016

NOAA SCIENTIFIC PUBLICATIONS REPORT
AUGUST 1, 2016

Recreational demand for shellfish harvesting under environmental closures
Marine Resource Economics (2.071)
L.E. Anderson, M. Plummer (NMFS/NWFSC)

- Estimates lost value to recreational shellfish harvesters from pollution or biotoxin closures

The Puget Sound estuary provides one of the most valuable shellfish habitats in the Pacific Northwest, USA. Shellfish are important economically, ecologically, and socially to the Puget Sound basin. The State of Washington manages the safety of shellfish harvest areas by assessing water quality on an ongoing basis and instituting advisories and closures based on water quality thresholds. Managers currently have little information to understand the effect of these closures on harvesting effort or economic values. In order to address this important need, we recently conducted a contingent behavior survey of recreational shellfish harvesters that use Puget Sound beaches. The survey elicited the number of annual trips respondents would expect to take under alternative closure scenarios, including a baseline of no closure. We estimate the demand for recreational trips using a count model system, quantifying the economic value lost to harvesters when beaches are closed due to pollution or biotoxins.
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Understanding the determinants of hired skipper use in the Alaska halibut IFQ fishery
North American Journal of Fisheries Management (1.013)
M. Szymkowiak, **R. Felthoven (NMFS/AKFSC)**

- This study addresses a critical gap in the literature by assessing the determinants of the leasing decision in catch share fisheries and identifies attributes of quota shareholders and their shareholdings that contribute to a higher probability of leasing.
- The findings of this study could be used to customize regulations to lead to their preferred outcomes with respect to leasing of harvesting privileges in catch share fisheries.

There is a growing body of literature evidencing the distributional impacts of leasing in catch share fisheries, but little research on the determinants of the leasing decision itself. This study addresses this gap by using a discrete choice model to examine the determinants of the decision of quota shareholders to use

hired skippers in the Alaska Pacific halibut (*Hippoglossus stenolepis*) Individual Fishing Quota (IFQ) fishery. Since the implementation of the Alaska halibut IFQ program, there has been an increasing reliance on hired skippers by initial quota share recipients in relationships that are often functionally equivalent to leasing. This has hampered the North Pacific Fishery Management Council's efforts to ultimately transition the IFQ catcher vessel fleet to a group of owner-operators. This study shows that the probability of hiring a skipper is statistically significantly related to the residency and shareholdings of shareholders and identifies potential attributes of shareholdings, including quantity and diversity, which may contribute to more hired skipper use. This information may allow fishery managers to both predict the degree of such practices and customize regulations to lead to their preferred outcomes in program design or modification, as it relates to the IFQ program and other catch share programs wherein leasing is a common practice and prone to controversy.
Accepted: July 2016
Expected publication date: October 2016

<u>OAR Publications</u>
Enzyme-level interconversion of nitrate and nitrite in the fall mixed layer of the Antarctic Ocean
Global Biogeochemical Cycles (4.495)
P. C. Kemeny, M. A. Weigand, R. Zhang, **B. R. Carter (OAR-PMEL)**, K. L. Karsh, S. E. Fawcett, and D. M. Sigman

- δ15N and δ18O of NO_3^- + NO_2^- and NO_3^--only suggest expression of NO_3^--NO_2^- equilibrium isotope effect, likely due to enzyme reversibility
- Interconversion of NO_3^- and NO_2^- is correlated with seasonal mixed layer deepening and suggests a role for entrained NO_2^- oxidizers
- Interconversion may occur where NO_2^- oxidizers are transported into regions that inhibit NO_2^- oxidation, including oxygen-deficient zones

In the Southern Ocean, the nitrogen (N) isotopes of organic matter and the N and oxygen (O) isotopes of nitrate (NO_3^-) have been used to investigate NO_3^- assimilation and N cycling in the summertime period of phytoplankton growth, both today and in the past. However, recent studies indicate the significance of processes in other seasons for producing the annual cycle of N isotope changes. This study explores the impact of fall conditions on the 15N/14N (δ15N) and 18O/16O (δ18O) of NO_3^- and nitrite (NO_2^-) in the Pacific Antarctic Zone using depth profiles from late summer/fall of 2014. In the mixed layer, the δ15N and

δ18O of NO_3^- + NO_2^- increase roughly equally, as expected for NO_3^- assimilation; however, the δ15N of NO_3^--only (measured after NO_2^- removal) increases more than does NO_3^--only δ18O. Differencing indicates that NO_2^- has an extremely low δ15N, often < −70‰ versus air. These observations are consistent with the expression of an equilibrium N isotope effect between NO_3^- and NO_2^-, likely due to enzymatic NO_3^--NO_2^- interconversion. Specifically, we propose reversibility of the nitrite oxidoreductase (NXR) enzyme of nitrite oxidizers that, having been entrained from the subsurface during late summer mixed layer deepening, are inhibited by light. Our interpretation suggests a role for NO_3^--NO_2^- interconversion where nitrifiers are transported into environments that discourage NO_2^- oxidation. This may apply to surface regions with upwelling, such as the summertime Antarctic. It may also apply to oxygen-deficient zones, where NXR-catalyzed interconversion may explain previously reported evidence of NO_2^- oxidation.
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Available online: http://onlinelibrary.wiley.com/doi/10.1002/2015GB005350/full

Winter water properties and the Chukchi Polynya
Journal of Geophysical Research (3.426)
C. Ladd, C. W. Mordy, S. A. Salo, P. J. Stabeno (OAR/PMEL)

- Polynyas in the Chukchi Sea are associated with Atlantic water upwelling
- The Chukchi Polynya can often be classified as a hybrid sensible heat/wind-driven polynya

Water properties from moored measurements (2010–2015) near Icy Cape on the eastern Chukchi shelf have been examined in relation to satellite observations of ice cover. Atlantic Water (AW), with temperature > -1°C and salinity > 33.6, has been observed to upwell from deeper than 200 m in the Arctic Basin onto the Chukchi Shelf via Barrow Canyon. Most previous observations of AW on the Chukchi shelf have been in or near Barrow Canyon; observations of AW farther onto the shelf are rare. Despite mooring location on the shelf ∼225 km from the head of Barrow Canyon, five AW events have been observed at mooring C1 (70.8°N, 163.2°W) in four years of data. All but one of the events occurred under openings in the sea ice cover (either a polynya or the ice edge). No events were observed during the winter of 2011/2012, a year with little polynya activity in the region. In addition to changes in temperature and salinity, the AW events are typically associated with southwestward winds and currents, changes in sea-ice cover, and increased nutrient concentrations in the bottom water. Estimates of heat

content associated with the AW events suggest that the Chukchi Polynya can often be classified as a hybrid sensible heat/wind-driven polynya.
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A simple analytical model of the diurnal Ekman layer
Journal of Physical Oceanography (2.345)
J. O. Wenegrat, **M. J. McPhaden (OAR-PMEL)**

- This paper demonstrates that time-variability in eddy viscosity leads to significant changes to the time-averaged velocity and shear fields.
- This has important implications for the interpretation of observations and modeling of the near-surface ocean.

The effects of time-varying turbulent viscosity on horizontal currents in the ocean surface boundary layer are considered using a simple theoretical model that can be solved analytically. This model reproduces major aspects of the near-surface ocean diurnal cycle in velocity and shear, while retaining direct parallels to the steady-state Ekman solution. The parameter dependence of the solution is explored, and quantitative measures of the low-frequency rectification of velocity and shear are derived. Results demonstrate that time-variability in eddy viscosity leads to significant changes to the time-averaged velocity and shear fields, with important implications for the interpretation of observations, and modeling of the near-surface ocean. These findings mirror those of more complete numerical modeling studies, suggesting that some of the rectification mechanisms active in those studies may be independent of the details of the boundary layer turbulence.
Publication date: July 15, 2016
Available online: http://journals.ametsoc.org/doi/abs/10.1175/JPO-D-16-0031.1

Steady-state ocean response to wind forcing in extratropical frontal regions
Nature: Scientific Reports (5.228)
M. F. Cronin (OAR/PMEL), T. Tozuka

- Uses data from the high-resolution Japanese Ocean general circulation model For the Earth Simulator (OFES), to show that frontal effects cannot be ignored in the Tropics or in strong frontal regions in the extratropics, such as found in coastal regions and in western boundary currents of all basins.
- Frontal effects dominate the classic Ekman response in regions of both hemispheres where trade winds change to westerlies.

- These frontal effects on the steady-state surface current response to wind forcing have important implications for vertical motion and for global heat budgets.

In regions of strong sea surface temperature (SST) gradients, the surface "geostrophic" currents have a vertical shear aligned with the surface density front defined by the temperature. This surface geostrophic ("thermal wind") shear can balance a portion of the surface wind stress, altering the classic Ekman response to wind forcing. Here we show that these frontal effects cannot be ignored in the Tropics or in strong frontal regions in the extratropics, such as found in coastal regions and in western boundary currents of all basins. Frontal effects also dominate the classic Ekman response in the regions of both hemispheres where Trade winds change to westerlies. Implications for vertical motion and global heat transport are discussed.

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