NOAA Scientific Publications Report
June 25, 2014

Highlighted Articles

Climate change and wind intensification in coastal upwelling ecosystems

Winter and spring controls on the summer food web of the coastal West Antarctic Peninsula

Tropical coastal seas and quality of life in the 21st century

Unusually cold water temperatures and high ice cover persist on Great Lakes through spring of 2014

Additional Articles

Maturity and growth of sablefish, *Anoplopoma fimbria*, along the U.S. West Coast

The trophodynamics of marine top predators: current knowledge, recent advances and challenges

Native fish community structure and Indo-Pacific lionfish (*Pterois volitans*) densities along a depth-temperature gradient in Onslow Bay, North Carolina, USA

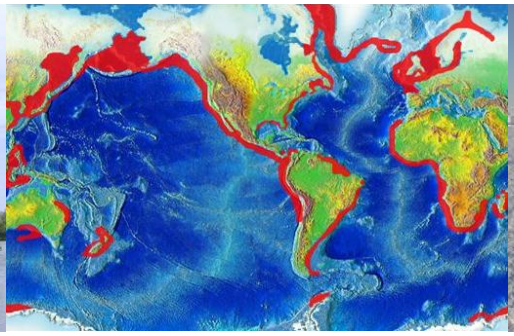
A regime shift in Lake Superior ice cover, evaporation, and water temperature following the warm El Nino winter of 1997-98

Development of natural growth regimes for hatchery-reared steelhead to reduce residualism, fitness loss, and negative ecological interactions

Structured expert judgment to forecast species invasions: bighead and silver carp in Lake Erie

Decadal distribution and abundance trends for the late stage copepodites of *Pseudocalanus spp.* (Copepoda: Calanoida) in the U. S. Northeast continental shelf ecosystem

Factors affecting partial migration in Puget Sound coho salmon



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Use of genetic data to infer population-specific ecological and phenotypic traits from mixed aggregations

A record-breaking low ice cover over the Great Lakes during winter 2011/2012: Combined effects of a strong +NAO and La Nina

Modeling landfast ice and coastal circulation in the nearshore Beaufort and Chukchi Seas using CIOM

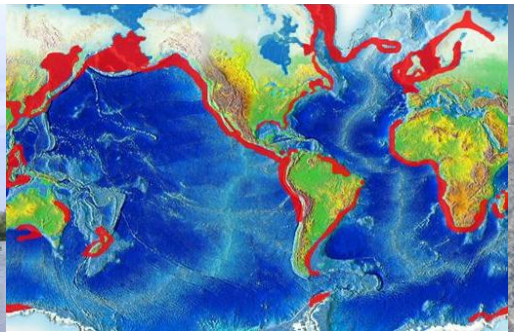
Variation in minijack rate among Columbia River Basin Chinook salmon hatchery populations

Other Reports, Book Chapters, and Internal Publications

California's marine fisheries: tradeoffs in transition

Accelerating Arctic summer sea ice decline driven by the dipole anomaly

Great Lakes ice and climate: from research to forecast



NOAA SCIENTIFIC PUBLICATIONS REPORT
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HIGHLIGHTED ARTICLES

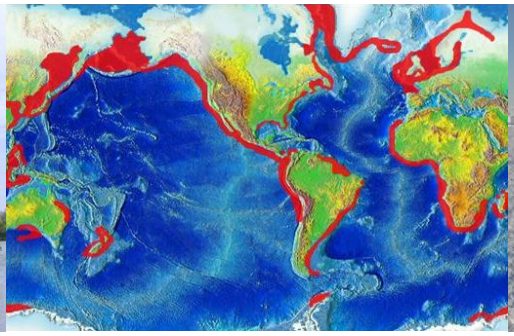
Climate change and wind intensification in coastal upwelling ecosystems
Science
W. J. Sydeman, M. García-Reyes, D. S. Schoeman, R. R. Rykaczewski, S. A. Thompson, B. A. Black, and **S. J. Bograd (NMFS/SWFSC)**

- This paper synthesizes current knowledge of the potential impacts of climate change on upwelling dynamics in eastern boundary current systems.
- These findings are useful for understanding the impacts of climate change on large scale oceanographic, atmospheric, and biological processes.

In 1990, Andrew Bakun proposed that increasing greenhouse gas concentrations would force intensification of upwelling-favorable winds in eastern boundary current systems which contribute substantial services to society. Because there is considerable disagreement about whether contemporary wind trends support Bakun's hypothesis, the authors performed a meta-analysis of the literature on upwelling-favorable wind intensification. The preponderance of published analyses suggests that winds have intensified in the California, Benguela, and Humboldt, and weakened in the Iberian upwelling systems from timescales ranging to 60 years; wind change is equivocal in the Canary system. Stronger intensification signals are observed at higher latitudes, consistent with the warming pattern associated with climate change. Overall, reported changes in coastal winds, while subtle and spatially variable, support Bakun's hypothesis of upwelling intensification in eastern boundary current systems.
Expected Publication Date: 10 July 2014

Winter and spring controls on the summer food web of the coastal West Antarctic Peninsula
Nature Communications
G. Saba, W. Fraser, **V. Saba (NMFS/NEFSC)**, R. Iannuzzi, K. Coleman, S. Doney, H. Ducklow, D. Martinson, T. Miles, D. Patterson-Fraser, S. Stammerjohn, D. Steinberg, and O. Schofield

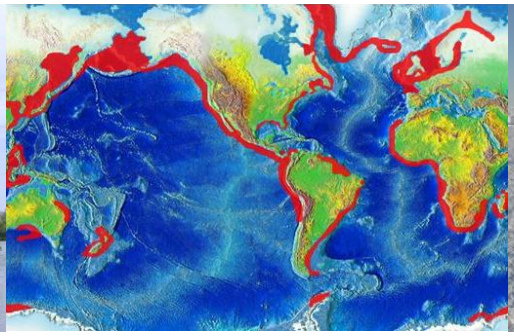
- Both large-scale and local climate forcing drive primary and secondary production, which



in turn cascade up the food web to marine predators such as Adélie penguins.
- Projected climate change in this region may have significant, negative impacts on phytoplankton biomass, krill recruitment, and upper trophic level predators in this coastal Antarctic ecosystem.

Understanding the mechanisms by which climate variability affects multiple trophic levels in food webs is essential for determining ecosystem responses to climate change. The authors used over two decades of data collected by the Palmer Long Term Ecological Research program (PAL-LTER) to determine how large-scale climate and local physical forcing affect phytoplankton, zooplankton, and an apex predator along the West Antarctic Peninsula (WAP). They showed that positive anomalies in chlorophyll-*a* (chl-*a*) at Palmer Station, occurring every 4-6 years, are constrained by physical processes in the preceding winter/spring and a negative phase of the Southern Annular Mode (SAM). Years of positive chl-*a* anomalies are associated with the initiation of a robust krill cohort the following summer, which is evident in Adélie penguin diets, thus demonstrating tight trophic coupling.
Expected Publication Date: 6 July 2014

Tropical coastal seas and quality of life in the 21st century
Marine Pollution Bulletin
P. F. Sale, C. H. Ainsworth, **B. E. Feist**, J. D. Bell, P. Christie, O. Hoegh-Guldberg, P. J. Mumby, D. A. Feary, M. I. Saunders, T. Agardy, T. M. Daw, S. J. Foale, **P. S. Levin**, K. C. Lindeman, K. Lorenzen, R. S. Pomeroy, E. H. Allison, R. H. Bradbury, J. Corrin, A. J. Edwards, D. O. Obura, Y. J. Sadovy de Mitcheson, M. A. Samoilys, and C. R. C. Sheppard **(NMFS/NWFSC)**
- One fifth of world's population lives on coastal areas. Article analyzes distance and population density to create an index of human impact and builds from a Marine Spatial Planning (MSP) approach to management.
- Concludes that MSP will require a holistic approach that reconciles food security, livelihoods and biodiversity conservation issues.



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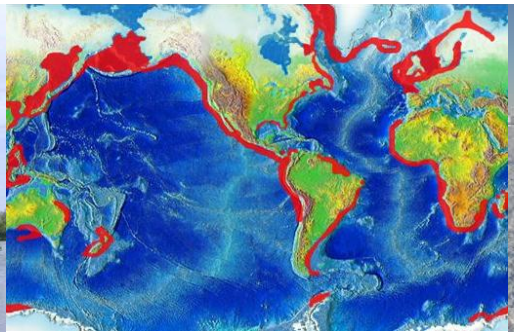
Over 1.3 billion people live on tropical coasts, primarily in developing countries. Many depend on adjacent coastal seas for food, and livelihoods. Coastal fisheries and ecosystem services are being progressively degraded by a wide range of local and global anthropogenic stressors. Current efforts to improve management are inadequate, and more effective approaches are sorely needed. Use of marine spatial planning (MSP), using distance and population density as a spatially integrated index of human impact, creates a framework for more effective, pragmatic management based on ocean zones to accommodate conflicting uses of tropical coastal seas. Expanded MSP will force a holistic, regional-scale reconciliation of food security, livelihoods, and biodiversity conservation. Transforming how countries manage their coastal resources will require major change in policy and politics, implemented with sufficient flexibility to accommodate societal variations. Achieving this change is a major challenge – one that affects the lives of one fifth of humanity.
Accepted: 2 June 2014

Unusually cold water temperatures and high ice cover persist on Great Lakes through spring of 2014
Eos, Transactions American Geophysical Union
A. H. Clites, J. Wang, K. B. Campbell, **A. D. Gronewold**, **R. A. Assel, X. Bai**, and **G. A. Leshkevich (OAR/GLERL)**

- The recent extreme ice and temperature observations on the Great Lakes raise compelling questions about not only the extent to which the Great Lakes might transition to a new hydrologic regime characterized by cooler lake temperatures and rising water levels, but also the extent to which such a regime might persist as the climate system evolves.

Very cold temperatures across much of North America consequent to the recent anomalous meridional upper air flow have contributed to extreme hydrologic conditions on the Great Lakes. Data collected and compiled through the Canadian Ice Service, the National Ice Center, the National Oceanic and Atmospheric Administration (NOAA) CoastWatch and the NOAA Great Lakes Ice Atlas project indicates that very cold surface water temperatures and a



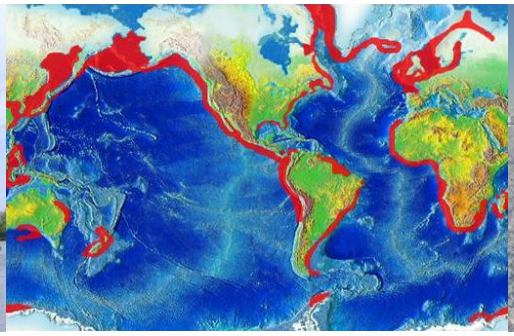
relatively high areal extent of ice cover persisted across the Great Lakes well into May 2014. Comparable ice cover across the Great Lakes has never been recorded (in the 40 years of available data) for the same time of year. These spring 2014 conditions on the Great Lakes contrast sharply with those of the historical record. They are particularly unusual relative to conditions over the past 15 years; a period scientists believe to be strongly influenced by the 1997-1998 El Nino and subsequent increases in Great Lakes surface water temperatures and diminished ice cover, accelerated over-lake evaporation, and rapid water level declines.
Expected Publication Date: Late June 2014

ADDITIONAL ARTICLES

Maturity and growth of sablefish, Anoplopoma fimbria, *along the U.S. West Coast*
Fisheries Research
M. A. Head, **A. A. Keller**, and M. J. Bradburn **(NMFS/NWFSC)**

- This study provides maturity and growth information for *Anoplopoma fimbria,* an economically important species along the U.S. West Coast, using an accurate method of histological analysis.
- Significant differences in measured indicators of growth and maturity were observed north and south of Cape Mendocino.
- Providing up-to-date life history information is critical for population dynamic models that are used to manage fisheries.

Sablefish (*Anoplopoma fimbria*) are a valuable groundfish species that support commercial fishing throughout the North Pacific Ocean, including off the U.S. West Coast. Since maturity and growth are important components of models used to assess the status of sablefish, we explored variation in these life history parameters at different depths among three regions along the West Coast separated by major biogeographic features at Cape Mendocino, CA (40°26′N) and Pt. Conception, CA (34°27′N). Ovaries were histologically assessed for maturity status, intensity of atresia, and presence of post-ovulatory follicles. Growth of female sablefish demonstrated similar differences among geographic areas and by depth. Coast-wide estimates

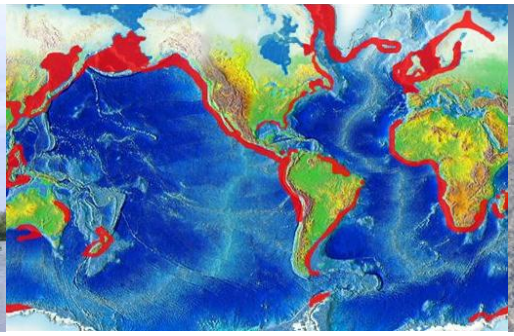


of length (L50) and age (A50) at 50% maturity found by fitting a logistic regression model to the proportion mature were 54.64 cm and 6.86 years, respectively (n = 477). Differences in L50 were found north and south of Cape Mendocino, CA, and by depth (range 55 to 1280 m). Length at 50% maturity (based on the von Bertalanffy growth model) decreased from north to south and with increasing depth within each region (n = 525). Age at 50% maturity also differed north and south of Cape Mendocino, CA, with female sablefish maturing at a younger age further north. Asymptotic size (L∞, cm) tended to increase at higher latitude and decrease with depth, while growth rates (k, yr-1) were elevated north of Point Conception, CA, and generally at depths <550 m. For female sablefish, the larger size and younger age at 50% maturity, and larger asymptotic sizes and somewhat elevated growth rates, were associated with regions within the California Current Eco characterized by elevated productivity and cooler water temperature.system
Expected Publication Date: Fall 2014

The trophodynamics of marine top predators: current knowledge, recent advances and challenges
Deep Sea Research II
J. W. Young, B. P. V. Hunt, T. Cook, J. Llopiz, **E. Hazen (NMFS/SWFSC)**, H. Pethybridge, D. Ceccarelli, A. Lorrain, R. J. Olson, V. Allain, C. Menkes, T. Patterson, S. Nicol, P. Lehodey, R. Kloser, H. Arrizabalaga, and C. Anela Choy

- This paper reviews diet variability of pelagic marine top predators throughout their life histories, and how it may be impacted by climate change.
- Large-scale spatial studies and long term monitoring through international collaborations will strongly contribute to ocean-scale understanding of the climate impacts on marine top predators.

The authors reviewed present understanding of the spatial and temporal diet variability (trophodynamics) of a range of pelagic marine top predators, at both early and adult life history stages. They began with a review of methodologies used to advance our understanding of the

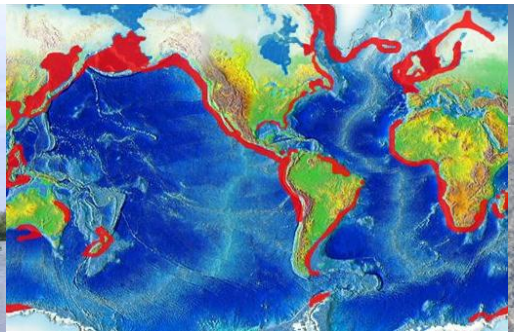


trophodynamics of marine top predators, particularly in relation to climate change. They then explored how these developments are informing our understanding of the major trophic groups in food webs leading to, and including, marine top predators. Through specific examples, the authors investigated how the impacts of ocean warming may affect pelagic food web relationships from both top-down and bottom-up perspectives. They examined the potential, in the absence of long-term data sets, of using large-scale spatial studies to examine how potential changes in biological oceanography could impact the biomass and composition of prey species, particularly the role of phytoplankton size spectra. Examples from regions where biotic change with respect to climate change is likely were emphasized. In particular, detailed effects of climate change were shown in oceanographic and bathymetric "hotspots", including the effects upon seabirds in the Benguela Current system. The authors urged the development of international collaborations and databases to facilitate comprehensive ocean-scale understanding of climate impacts on marine top predators.
Accepted: 3 June 2014

*Native fish community structure and Indo-Pacific lionfish (*Pterois volitans*) densities along a depth-temperature gradient in Onslow Bay, North Carolina, USA*
Marine Ecology Progress Series
P. E. Whitfield (NOS/NCCOS), **R. C. Muñoz (NMFS/SEFSC)**, **C. A. Buckel (NOS/NCCOS)**, **B. P. Degan (NOS/NCCOS)**, D. W. Freshwater, and **J. A. Hare (NMFS/NEFSC)**

- The authors quantified temperature thresholds for 46 species of fish, including invasive lionfish.
- These data will allow projections of community and species distribution shifts, based on different climate change scenarios.
- These findings can help to inform future management of Marine Protected Areas, coastal ecosystems, and fisheries in light of current and projected climate trends.

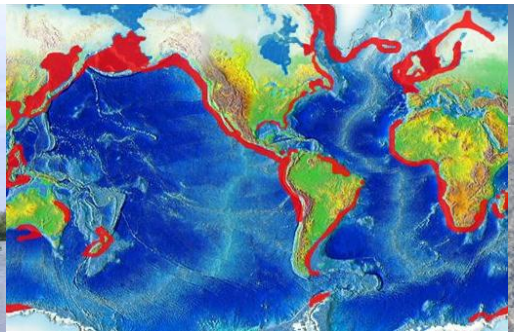
The authors quantified native fish densities along a depth-temperature gradient within a



temperate-tropical marine transition zone (North Carolina continental shelf) to examine the role of depth and temperature in structuring these communities. They also examined the distribution of invasive lionfish (*Pterois volitans, P. miles*) to evaluate a laboratory derived thermal minimum for lionfish. They collected year-round continuous bottom temperature data from 2000 to 2010 and surveyed lionfish (2004-2010), conspicuous fish (2006-2010), and cryptic smaller bodied fishes (2007-2010) at depths from 5-46m on scuba. Bottom water temperatures were constant across the depth gradient during summer and increased from inshore to offshore during winter. The conspicuous fish community was structured by three depth zones; 5-14, 15-37 and 38-46 m that corresponded with winter mean temperatures of 13.9, 17.9, and 20.9°C respectively. The cryptic fish community was structured by four depth zones; 5-15, 18-24, 27-38.5, and 39.5-46 m with corresponding winter mean bottom temperatures of 13.8, 15.6, 18.7, and 20.9^{o}C. In contrast, summer temperatures were not important in structuring either the conspicuous or the cryptic fish community. Thus, fish communities in the spring/summer appear to be structured by the pattern of bottom water temperature experienced the previous winter, supporting previous studies that indicate winter minimum temperature is important for determining fish distribution and abundance in temperate marine ecosystems. In addition, the deeper fish communities were dominated by tropical species. Lionfish, a tropical species, was found in the highest densities from 38-46 m and present in locations with a winter mean of 15.3°C and higher. Increasing temperatures could favor a potential expansion of invasive lionfish and native tropical species into the nearshore waters on the North Carolina shelf resulting in unforeseen community structure and trophic disruptions.
Accepted: 27 May 2014

A regime shift in Lake Superior ice cover, evaporation, and water temperature following the warm El Nino winter of 1997-98
Limnology and Oceanography
K. VanCleave, J. D. Lenters, **J. Wang (OAR/GLERL)**, and E. Verhamme

- A pronounced step change that occurred in Lake Superior following the warm El Niño

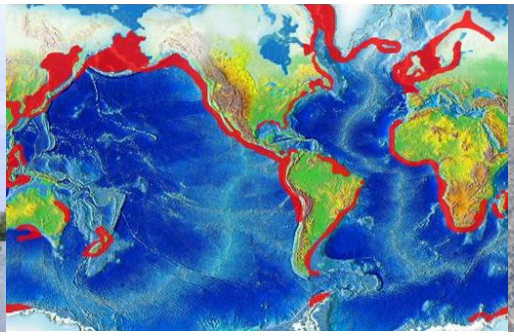


winter of 1997-98 resulted in a 'regime shift' causing increased summer evaporation rate, increased water temperature, and decreased winter ice cover.

- This nonlinear step change can account for longer trends, suggesting that nonlinear approaches should be considered in future work assessing climate impacts in certain regions.

Significant trends in Lake Superior water temperature and ice cover have been observed in recent decades, and these trends have typically been analyzed using standard linear regression techniques. Although the linear trends are statistically significant and contribute to an understanding of environmental change, a careful examination of the trends shows important nonlinearities. The authors of this study identify a pronounced step change that occurred in Lake Superior following the warm El Niño winter of 1997-98, resulting in a 'regime shift' in summer evaporation rate, water temperature, and numerous metrics of winter ice cover. This statistically significant step change accounts for most of the long-term trends in ice cover, water temperature, and evaporation during the period 1973-2010, and it was preceded (and followed) by insignificant linear trends in nearly all of the metrics examined. The 1998 step change is associated with a decrease in winter ice duration of 39 days (a 34% decline), an increase of ~2-3°C in mean surface water temperature (July-September averages), and a 91% increase in July-August evaporation rates, reflecting an earlier start to the summer evaporation season. Maximum wintertime ice extent decreased by nearly a factor of two, from an average of 69% of the lake surface area (before 1997-98) to 36% after the step change. This reassessment of long-term trends highlights the importance of nonlinear regime shifts such as the 1997-98 break point – an event that may be related to a similar shift in the Pacific Decadal Oscillation (PDO) that occurred around the same time. These pronounced changes in Lake Superior physical characteristics are likely to have important implications for the broader lake ecosystem.

Accepted: 5 June 2014



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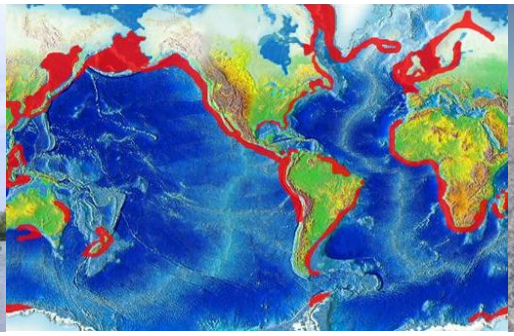
Development of natural growth regimes for hatchery-reared steelhead to reduce residualism, fitness loss, and negative ecological interactions
Environmental Biology of Fishes
B. A. Berejikian, **D. A. Larsen**, **P. Swanson**, **M. E. Moore**, **C. P. Tatara**, W. L. Gale, C. R. Pasley, and **B. R. Beckman (NMFS/NWFSC)**

- Female salmon have been shown to choose mates based on their mates' size where larger males are preferentially chosen
- The authors tested whether fertilization success was a major driver in size selection during mating for the semelparous Pacific salmon, *Oncorhynchus spp.*
- Fertilization success was not shown to explain why females choose larger mates, suggesting that alternative factors must be explored to explain these observations.

Anadromous salmonid females exhibit indicators of mate choice based on male size. Direct benefits to females of mating with larger males have not been identified for semelparous Pacific salmon, *Oncorhynchus spp.* The authors tested the null hypothesis that females forced to spawn naturally in a stream channel and artificially (gametes removed manually) with males about half their body mass would experience egg fertilization rates similar to that of females forced to spawn with males of about equal mass. Fertilization rates did not differ significantly between large- and small-male pairs. The fertilization rates were also very similar for eggs deposited naturally and those that were fertilized artificially. Therefore, the authors conclude that fertilization success does not appear to be the mechanism responsible for female mate choice based on male size. Benefits of females mating with larger males probably have only indirect (i.e., genetic) benefits to a female's offspring, as suggested by previous authors.
Expected Publication Date: Summer 2014

Structured expert judgment to forecast species invasions: bighead and silver carp in Lake Erie
Conservation Biologist
M. E. Wittmann, J. Rothlisberger, **E. Rutherford, H. Zhang, D. Mason**, and D. M. Lodge **(OAR/GLERL)**



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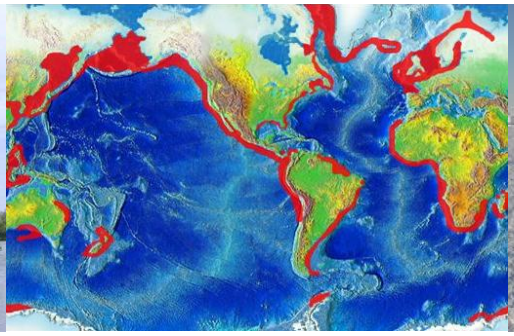
- The authors used Structured Expert Judgement (SEJ) to forecast impacts of nonindigenous Asian carp in Lake Erie, where it is believed not to be established.
- The SEJ results indicate that while Asian carp has the potential to achieve biomass levels similar to the sum biomasses for several commercial or recreationally harvested fish species in Lake Erie, its impact on the biomass of these fishes is estimated to be small, with little uncertainty.
- This approach can enhance understanding of the effects of invasive species when insufficient data prohibits completion of a complete ecological risk assessment

Identifying which nonindigenous species will become invasive, and forecasting their damages is difficult and presents a significant problem for natural resource management. Often, the data or resources necessary for ecological risk assessment are incomplete or absent, leaving environmental decision-makers ill-equipped to effectively manage valuable natural resources. Structured expert judgment (SEJ) is a mathematical and performance-based method of eliciting, weighting and aggregating expert judgments. In contrast to other methods of expert combination where equal weights are assigned to experts, SEJ weights each expert on the basis of his or her statistical accuracy and informativeness, and can be used when the information required for decision-making is sparse or debated. The authors of this study used SEJ to forecast impacts of nonindigenous Asian carp in Lake Erie, where it is believed not to be established. Experts quantified Asian carp biomass, production, consumption and the impact to four fish species if Asian carp were to become established. According to experts, Asian carp can establish in Lake Erie with the potential to achieve biomass levels that are similar to the sum of biomasses for several fishes that are harvested commercially or recreationally. However, the impact of Asian carp on the biomass of these fishes is estimated by experts to be small, with little uncertainty. Impacts in tributaries and to recreational activities, water quality or other species were not addressed. SEJ can be used to quantify key uncertainties of invasion biology and also provide a decision support tool when the necessary information for natural resource management and policy is not available.

Expected Publication Date: 28 May 2014



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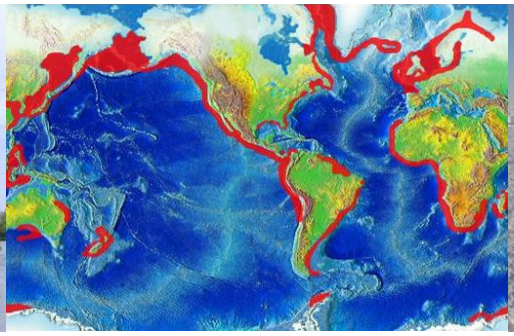
Decadal distribution and abundance trends for the late stage copepodites of Pseudocalanus spp. *(Copepoda: Calanoida) in the U. S. Northeast continental shelf ecosystem*
Journal of Northwest Atlantic Fishery Science

J. Kane (NMFS/NEFSC)

- This study examined seasonal and long-term abundance and distribution trends of the copepod *Pseudocalanus spp*. from 1977 to 2012.
- The long term trend correlates negatively with temperature and positively with phytoplankton abundance, suggesting that warmer temperatures may have a negative impact on phytoplankton abundance, decreasing food sources for copepods.
- Predation from salps and other species may also contribute to the observed summer decline of *Pseudocalanus spp*.

The average annual cycle of abundance and the bimonthly distributions of the copepod *Pseudocalanus spp*. are described for U. S. northeast continental shelf waters from samples collected on broad-scale plankton surveys from 1977 to 2012. Population levels begin to increase during January-February, surge in March-April, and peak throughout the region during May-June. The copepod's population density declines sharply after June and becomes minimal from September-December. Spatially, seasonal high levels persist throughout the year in coastal waters surrounding and adjacent to the Cape Cod peninsula. During late spring, dense concentrations are found in Gulf of Maine coastal waters and in a high abundance band that extends southwestward from Georges Bank into the northern half of Middle Atlantic Bight waters. *Pseudocalanus spp*. interannual abundance variability was substantial, displaying several extended low and high periods through the time series. In general, numbers were high from the late 1970s through the early 1980s, low in the mid 1980s, elevated in the 1990s, and low again in the 2000s. This pattern was correlated negatively with temperature and positively with phytoplankton abundance trends. It is proposed that the copepods low abundance in the 2000s may have been caused by warmer temperatures that indirectly depressed the abundance of phytoplankton that this copepod uses for food. Survey data also indicate that predation pressure from salps and perhaps some additional species may contribute to the precipitous

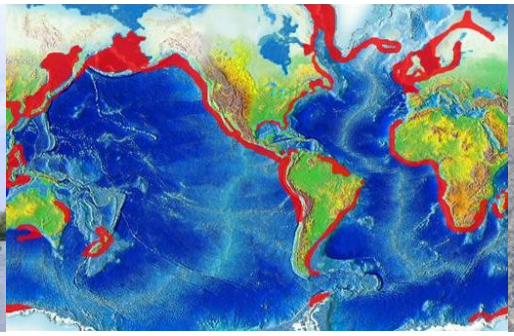


summer decline of *Pseudocalanus spp*. The copepod's abundance was found to be independent from the climatic variation associated with either the North Atlantic or Arctic Oscillation.
Published: 16 May 2014

Factors affecting partial migration in Puget Sound coho salmon
North American Journal of Fisheries Management
J. Rhode, **K. L. Fresh**, and T. P. Quinn **(NMFS/NWFSC)**

- This study examined Coho Salmon in Puget Sound to determine partial migration, or the proportion of the population that migrated out of the sound as compared to those remaining within the sound throughout the year (deemed 'residents')
- The main factor affecting Puget Sound residency of Coho Salmon is where the fish enter Puget Sound.
- The tendency to remain in Puget Sound or not can affect which fisheries they are vulnerable to, their size at harvest, update of contaminants, and their role in food webs.

Partial migration, the behavior pattern in which a portion of a population migrates while others do not, is a widespread phenomenon with ecological and evolutionary consequences. Most Coho Salmon *Oncorhynchus kisutch* from Puget Sound,Washington, migrate to feed over the continental shelf or offshore in the North Pacific Ocean, but some remain in the semi-estuarine waters of Puget Sound and are termed residents. The objective of this study was to determine which of several factors influenced residency in Puget Sound Coho Salmon. Coded wire tag recovery data showed that resident Coho Salmon were smaller than their migratory counterparts, and the authors used this size difference and the relative catch patterns along the coast and in Puget Sound to classify Coho Salmon caught in Puget Sound between November and August as residents. They then analyzed the effects of location of origin, day of release, weight at release, hatchery or wild rearing, and year on the proportion of fish caught as residents. Based on 268 release groups between 1975 and 1992, they classified 3.4% of fish recovered as residents, 61.3% as migrants, and 35.3% as ambiguous because they were recovered in Puget Sound in September and October, when residents and migrants were mixed.

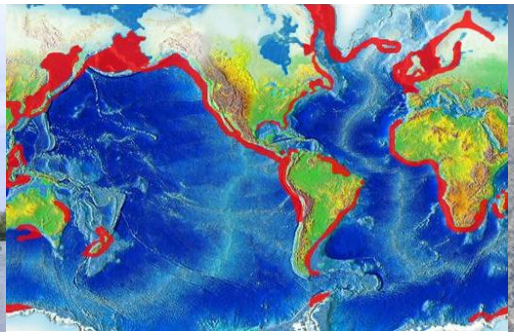


The proportion of residents varied as a function of year, basin, and day of the year. Releases into south Puget Sound produced the highest proportion of residents, and resident fish tended to be recovered in the basin where they entered Puget Sound. While other factors may influence residency in Coho Salmon, the effects of day of release and location of origin may be useful for management of these populations, as the tendency to remain in Puget Sound or migrate to the coast affects the fisheries in which the fish are taken and their growth rate, their uptake of contaminants, and their role in food webs.
Expected Publication Date: Spring 2014

Use of genetic data to infer population-specific ecological and phenotypic traits from mixed aggregations
PLoS ONE
P. Moran, (NMFS/NWFSC), J. F. Bromaghin, and **M. Masuda (NMFS/AKFSC)**

- The authors compared two methods for using genetic data collected in mixed aggregations to infer ecological and phenotypic traits in populations: individual assignment to population of origin and Bayesian mixture modeling.
- This study showed that the Bayesian mixture model extended to incorporate parameters for the phenotypic trait outperformed individual assignment under some trait inference conditions.
- The authors provide specific guidance for method selection under various genetic relationships among populations with different trait distributions.

Many applications in ecological genetics involve sampling individuals from a mixture of multiple biological populations and subsequently associating those individuals with the populations from which they arose. Analytical methods that assign individuals to their putative population of origin have utility in both basic and applied research, providing information about population-specific life history and habitat use, ecotoxins, pathogen and parasite loads, and many other non-genetic ecological, or phenotypic traits. Although the question is initially directed at the origin of individuals, in most cases the ultimate desire is to investigate the

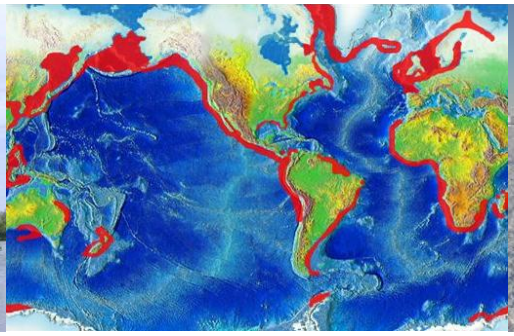


distribution of some trait among populations. Current practice is to assign individuals to a population of origin and study properties of the trait among individuals within population strata as if they constituted independent samples. It seemed that approach might bias population-specific trait inference. In this study, the authors made trait inferences directly through modeling, bypassing individual assignment. They extended a Bayesian model for population mixture analysis to incorporate parameters for the phenotypic trait and compared its performance to that of individual assignment with a minimum probability threshold for assignment. The Bayesian mixture model outperformed individual assignment under some trait inference conditions. However, by discarding individuals whose origins are most uncertain, the individual assignment method provided a less complex analytical technique whose performance may be adequate for some common trait inference problems. These results provide specific guidance for method selection under various genetic relationships among populations with different trait distributions.
Published: 6 June 2010

A record-breaking low ice cover over the Great Lakes during winter 2011/2012: Combined effects of a strong +NAO and La Nina
Climate Dynamics
X. Bai, J. Wang, J. Austin**, D. Schwab, R. Assel, A. Clites,** and **J. Bratton (OAR/GLERL)**

- This study finds that the combined effects of a +NAO and La Nina resulted in a weather pattern that prohibited movement of Arctic air into the Great Lakes regional leading to the extreme warmth and record-breaking low ice cover during the 2011/12 winter.
- The authors also discuss the effect of extreme warmth on phytoplankton abundance, and thus productivity of the region.
- This study is significant in advancing the projection of issues and impacts of climate change in the Great Lakes.

A record-breaking low ice cover occurred in the North American Great Lakes during winter 2011/2012, in conjunction with a strong positive Arctic Oscillation/North Atlantic Oscillation

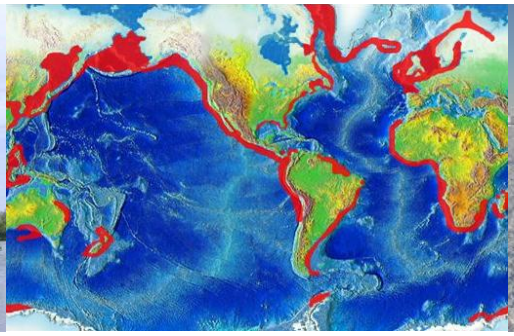


(+AO/NAO) and a La Niña event. Large-scale atmosphere circulation in the Pacific/North America (PNA) region reflected a combined signal of La Niña and +NAO. Statistical analysis indicates that neither La Niña nor +NAO alone can be responsible for the extreme warmth; the typical mid-latitude response to La Niña events is a negative PNA pattern, which does not have a significant impact on Great Lakes winter climate; the positive phase of NAO is usually associated with moderate warming in the Great Lakes region. When the two occurred simultaneously, the combined effects of La Niña and +NAO resulted in a negative East Pacific pattern with a negative center over Alaska/Western Canada, a positive center in the eastern North Pacific (north of Hawaii), and an enhanced positive center over the eastern and southern United States. The overall pattern prohibited the movement of the Arctic air mass into mid-latitudes and enhanced southerly flow and warm advection from the Gulf of Mexico over the eastern United States and Great Lakes region, leading to the extreme warmth and record-breaking low ice cover during the 2011/12 winter. A very similar event occurred in the winter of 1999/2000. This extreme warm winter and spring in 2012 had significant impacts on the physical environment, as well as counterintuitive effects on phytoplankton abundance.
Expected Publication Date: July/August 2014

Modeling landfast ice and coastal circulation in the nearshore Beaufort and Chukchi Seas using CIOM
Journal of Geophysical Research
J. Wang, C. Cao, K. Mizobata, **H. Hu, X. Bai**, Y. Yu, H. Eicken, M. Ikeda, W. Johnson, W. Periie, and **A. Fujisaki (OAR/GLERL)**

- This study investigates sea ice and ocean circulation using a 3-D Coupled Ice-Ocean Model under daily atmospheric forcing for the period 1990–2008.
- The results of this study demonstrate that coastal landfast ice is controlled by the following processes: wind forcing, Bering Strait inflow, and sea ice dynamics.

This study investigates sea ice and ocean circulation using a 3-D, 3.8 km CIOM (Coupled Ice-Ocean Model) under daily atmospheric forcing for the period 1990–2008. The CIOM was

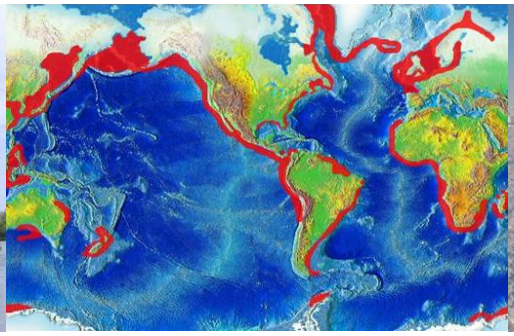


validated using both in situ observations and satellite measurements. The CIOM successfully reproduces some observed dynamical processes in the region, including the Bering-inflow-originated coastal current that splits into three branches: Alaska Coastal Water (ACW), Central Channel branch, and Herald Valley branch. In addition, the Beaufort Slope Current (BSC), the Beaufort Gyre, the East Siberian Current (ESC), mesoscale eddies, and seasonal landfast ice are well simulated. The CIOM also reproduces reasonable interannual variability in sea ice, such as landfast ice, and anomalous open water (less sea ice) during the positive Dipole Anomaly (DA) years, vice versa during the negative DA years. Sensitivity experiments were conducted with regard to the impacts of the Bering Strait inflow (heat transport), onshore wind stress, and sea ice advection on sea ice change, in particular on the landfast ice. It is found that coastal landfast ice is controlled by the following processes: wind forcing, Bering Strait inflow, and sea ice dynamics.
Published Online: 4 June 2014

Variation in minijack rate among Columbia River Basin Chinook salmon hatchery populations
Transactions of the American Fisheries Society
D. L. Harstad, **D. A. Larsen**, and **B. R. Beckman (NMFS/NWFSC)**

- Authors measured minijack rates at several spring- and summer-run Chinook salmon hatchery programs (including segregated and integrated programs) throughout the Columbia River Basin among brood years 1999 through 2010.
- Results show that hatchery rearing practices affect rate of early male maturation (age 2) in spring-run Chinook salmon.

In Chinook salmon (*Oncorhynchus tshawytscha*), age of maturation ranges from age-1 (microjack), -2 (minijack), -3 (jack), to -4 or -5 (adult) years. The presence of age-2 minijacks has been noted in several experimental studies and documented for a few hatchery programs but a comprehensive survey of their occurrence in hatchery production programs has never been conducted. Authors measured minijack rates at several spring- and summer-run Chinook salmon hatchery programs throughout the Columbia River Basin among brood years 1999



through 2010. The hatcheries surveyed included both segregated (only hatchery-origin broodstock) and integrated (some natural-origin broodstock) programs. Minijacks were found in all programs monitored, and rates varied approximately tenfold across release groups ranging from 7.9 - 71.4% among males in spring Chinook salmon programs and 4.1 - 40.1% among males in summer Chinook salmon programs. There was a significant relationship between size at release and minijack rate in the integrated but not the segregated spring Chinook salmon programs. Minijack rates were significantly higher in the integrated programs compared to the segregated programs despite the fact that most of the integrated programs released smaller fish, suggesting that artificial selection for age at maturation has occurred in segregated programs.
Expected Publication Date: Summer 2014

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

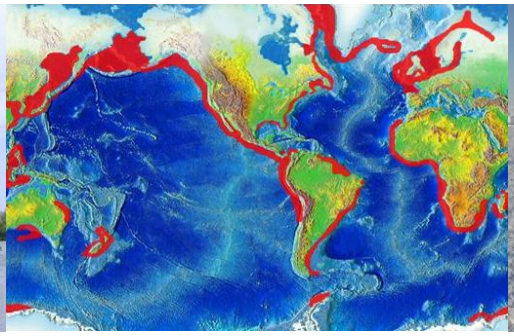
California's marine fisheries: tradeoffs in transition
Ecosystems of California (an edited text)
E. Bjorkstedt, J. C. Field, M. Love, L. Rogers-Bennett, and R. Starr **(NMFS/SWFSC)**

- This is a resource for academic, policy, and management professionals that broadly discuss fisheries, especially those in California.

This paper reviews the basic principles of fisheries management, the history of California marine fisheries, and challenges and strategies for achieving a sustainable future. It includes discussion of changes in traditional fisheries management, the economics of fisheries, ecosystem-based fisheries management, and marine protected areas.
Expected Publication Date: Late 2014

Accelerating Arctic summer sea ice decline driven by the dipole anomaly
Proceedings, 22nd IAHR International Symposium on Ice
J. Wang, X. Bai, J. Brantton, Wu, and Greene **(OAR/GLERL)**

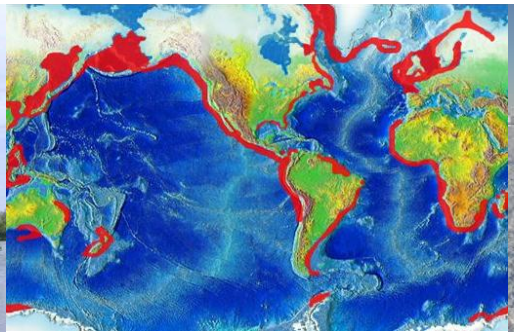
- The extent of Arctic sea ice reached its all-time low in September 2012, shattering all previous record lows since satellite record-keeping began 33 years ago.



NOAA SCIENTIFIC PUBLICATIONS REPORT
JUNE 25, 2014

Since the beginning of the satellite era (1979), record lows and highs of Arctic summer sea ice extent are found to be caused not only by dynamically-forced meridional wind advection, but also by the intensified ice/ocean albedo feedback, both of which are triggered by the Arctic atmospheric Dipole Anomaly (DA) pattern. This local, secondary mode of anomalous sea-level pressure (SLP) in the Arctic produces a strong anomalous meridional wind, which was responsible for driving more sea ice out of the Arctic Ocean from the western to the eastern Arctic into the northern Atlantic during the summers of 1995, 1999, 2002, 2005, and 2007-2012 during its positive phase. In September of 2012, a new record minimum in Arctic sea ice extent was caused by the combined dynamic wind forcing of +DA and thermodynamic forcing, accelerating melting, and advective loss of Arctic sea ice.
Expected Publication Date: August 2014

Great Lakes ice and climate: from research to forecast
Proceedings, 22nd IAHR International Symposium on Ice
J. Wang, X. Bai, A. Fujisaki, H. Hu, and **D. Beletsky (OAR/GLERL)**

- Studies showed that teleconnection patterns such as the Pacific/North America (PNA; Wallace and Guztler 1981), North Atlantic Oscillation (NAO), Pacific Decadal Oscillation (PDO), and West Pacific (WP), are associated with anomalous ice cover on the Great Lakes and other small lakes in North America

This paper describes recent progress made by a team from the NOAA Great Lakes Environmental Research Laboratory (GLERL) and the University of Michigan (UMich) Cooperative Institute for Limnology and Ecosystems Research (CILER). Over the past six years (since 2007), this team has studied Great Lakes ice and regional climate in response to global climate changes and how to transfer scientific research results into predictions of lake ice on the scales of several days to several months.
Expected Publication Date: August 2014