

ECOSYSTEM WORKGROUP REPORT ON THE NORTHWEST AND SOUTHWEST FISHERIES
SCIENCE CENTERS' DRAFT WESTERN REGIONAL ACTION PLAN ON CLIMATE SCIENCE

On May 18, 2016, the Ecosystem Workgroup met via webinar to review the draft Western Regional Action Plan (WRAP) to implement NOAA Fisheries' Climate Science Strategy. NOAA Fisheries' Northwest and Southwest Fisheries Science Centers (NWFSC and SWFSC, the Centers) released the draft WRAP for public review in early April 2016 (<https://www.st.nmfs.noaa.gov/ecosystems/climate/rap/western-regional-action-plan>). Dr. Toby Garfield and Dr. Nate Mantua of the SWFSC, and Dr. Chris Harvey of the NWFSC attended the webinar, presented the draft WRAP to the Ecosystem Workgroup and the public, and fielded questions throughout the webinar. The Ecosystem Workgroup appreciates their participation and insights.

The Ecosystem Workgroup is generally supportive of the research guidance proposed in the draft WRAP, although we are concerned that future research funding may not allow full implementation of the WRAP or may require diversion of research efforts from programs that may otherwise support Council science needs. In addition to our more specific comments on the draft WRAP, below, we see a broader question about how the activities described in the draft WRAP will connect to the Council's ecosystem-related agenda items. Over the longer-term, the Council may be interested in continued engagement with NOAA climate scientists, possibly as part of its work on ecosystem issues and with ecosystem scientists. As the Ecosystem Workgroup prepares for the Council's September 2016 discussion on ecosystem indicators, we will be thinking about how the Council might regularly engage with climate scientists during the annual ecosystem status report process. For the Council's consideration, the Ecosystem Workgroup offers the following specific comments and suggestions on the draft WRAP:

- The draft WRAP states that the Centers have identified Pacific whiting (hake), sablefish, and North Pacific albacore for Management Strategy Evaluations (MSEs) to assess potential management strategies for these species under different future climate scenarios. We do not disagree with the selection of these species, and know that sablefish was selected through a Council discussion on the Fishery Ecosystem Plan, but we suggest that the Centers and the Council family work through a more deliberate selection process going forward. For example, the Council could advise the Centers on those species of greatest interest for climate-related MSEs annually at its March meetings, when the Council regularly hears from the Centers on the annual ecosystem status report. The Ecosystem Workgroup is particularly interested in whether an MSE for a Council-managed salmon species or population might be useful to the Council process; a more deliberate Council discussion of MSE species would allow the Council's advisory bodies and the public to weigh in on that question.
- Because Council management decisions usually affect near-term harvest rates (within 1-3 years) rather than longer-term harvest strategies, the Ecosystem Workgroup notes that investigations into short-term climate forecasts may be more useful to fisheries management than long-term forecasts. In other words, the Ecosystem Workgroup believes that improving our ability to predict El Niños and La Niñas or other brief climate anomalies, both as events and for their potential effects on fisheries, will be more useful to Council decision-making.
- While the draft WRAP included some discussion of improving our knowledge of trophic relationships within the California Current Ecosystem (CCE,) the Ecosystem Workgroup would like to see the final WRAP provide more detailed discussions of the Centers' plans for future work on trophic interactions and on the effects of climate on those interactions.

- The Ecosystem Workgroup is uncertain whether current ocean sampling at the Newport Hydrographic Line and under the California Cooperative Oceanic Fisheries Investigations provides sufficient geographic scope for helping to understand the potential fishery and ecosystem responses to climate variability along the U.S. West Coast. We understand that sampling is also occurring at a hydrographic line off Trinidad Head, and that the Centers are supplementing shipboard sampling with some unmanned glider lines. However, large sections of the coast off central and northern California, and off Oregon and Washington, may be insufficiently monitored. In addition to our concern about the adequacy of north-to-south coverage of the Council's management area, the Ecosystem Workgroup is also concerned that we may not be adequately sampling deeper ocean waters for changing temperature, pH, and dissolved oxygen. The Ecosystem Workgroup recognizes that improving sampling coverage would be costly, but hopes that the final WRAP will provide more discussion of some of these potential spatial gaps in data collection.
- There are many state-level, tribe-level, and academic partnerships that support NOAA's climate science programs. The draft WRAP could be improved through inclusion of a table of major collaborations and partnerships that are supporting the work described in the draft WRAP. Providing that description of the interplay between different partners and research projects would help articulate the West Coast's full vision for climate science, living marine resources, and the communities that depend upon those resources across the CCE. In addition, it would help highlight any outstanding gaps in coverage.
- The draft WRAP mentioned archived or backlogged data that might be of use to future climate science work. The Ecosystem Workgroup is concerned that the draft WRAP may over-emphasize or prioritize new or ongoing modeling efforts, while under-emphasizing data collection and processing. We recommend a stronger emphasis on processing and publishing already-collected data that may benefit WRAP implementation and ongoing modeling. Of potential benefit to the Council, the Centers might prioritize backlogged data processing and publication by reviewing their schedule of upcoming stock assessments and tackling those data most useful to near-term stock assessments.
- The Ecosystem Workgroup recommends that the final WRAP provide a more detailed discussion of the Centers' plans for integrating socio-economic science and analyses into their climate and fisheries science. The Council's Fishery Ecosystem Plan Appendix includes a potential Climate Shift Initiative that, within a broad set of scientific needs, expresses Council interest in assessing the potential effects of near-term climate shift and long-term climate change on our fishing communities. We have appended that Initiative (A.2.8. Cross-FMP Effects of Climate Change Initiative) to this report for reference.
- The draft WRAP discusses climate vulnerability analyses for species listed under the Endangered Species Act and/or managed under the Magnuson-Stevens Fishery Conservation and Management Act. If those analyses are available for review by the Council family and public by the Council's March 2017 meeting, they might inform Council discussions on future MSEs, ecosystem initiatives, and on the annual ecosystem status report.

*** Excerpted from the Fishery Ecosystem Plan Appendix, updated through March 2015
<http://www.pcouncil.org/ecosystem-based-management/fep/>***

A.2.8 Cross-FMP Effects of Climate Shift Initiative

As discussed in Section 3.1.1 and Chapter 4 of the FEP, the CCE is subject to both interannual and interdecadal climate variability that can have significant effects on seasonal and long-term productivity. Over the longer-term, three prominent properties of the environment are predicted to undergo significant change--temperature, ocean surface water pH (acidity versus alkalinity), and deep-water oxygen. Other physical changes are less predictable but relatively likely, including changes in upwelling intensification (generally expected to lead to greater, but potentially more variable, primary and secondary productivity), changes in both the phenology (timing) of the spring transition, and changes in the frequency and intensity of current modes of climate variability (such as the El Niño/Southern Oscillation and the Pacific Decadal Oscillation). Many Council-managed species are known to have developed life-history strategies that respond to shorter-term climate variability, such as large-scale shifts in the abundance of coastal pelagic species, shifts in the distribution of migratory species (including but not limited to most coastal pelagics, Pacific hake, and most highly migratory species), high interannual variability in recruitment rates of most groundfish, and diversified evolutionary strategies in salmon populations.

Under this initiative, the Council would assess and articulate its questions about the longer-term effects of climate change on its managed species, so as to better direct public and private efforts to provide management-relevant science. Whereas individual fisheries management plans will likely examine the potential impacts of climate change on particular species, the focus of this initiative would be on the combined, long-term effects of such changes on multiple species across all management plans. CCE fisheries support, to varying degrees, the economies and social fabric of at least 125 communities in California, Oregon and Washington. As fish populations and the ecosystems that sustain them are altered in response to climate change, there are potentially profound consequences for the fisheries and the communities that they support.

Vulnerability to climate change depends on three fundamental elements: 1) exposure to the physical effects of climate change; 2) the degree of intrinsic sensitivity of fisheries or dependence of the regional economy on socio-economic returns from fisheries, and 3) the extent to which adaptive capacity enables these potential impacts to be offset. Background work for developing this initiative would initially require a literature review on the current state of knowledge about the anticipated effects of climate change on Council-managed species and West Coast coastal communities. Using previous vulnerability assessments as a foundation, this review could focus on measures of exposure, sensitivity and adaptive capacity that best capture the natural and human systems of interest.

Choosing metrics of exposure to climate change, even at the scale of the CCE, is fraught with constraints and assumptions. Information useful to the Council would include a review of what is specifically known about estimated changes in temperature, ocean surface water pH, and deep-water oxygen within the CCE and the rates or speeds at which those changes may occur, not just global estimates of those changes. This review could also identify any additional environmental factors of importance to specific fisheries in the CCE that also might experience significant long-term variability. The Council would also need information about the current state of scientific investigations into the estimated effects of climate change on marine species, particularly CCE marine species. This review may also consider the potential for changes in fish species composition as a result of climate changes. For instance, analytical approaches that estimate the vulnerability of each target species to climate change as well as estimates of the probability that new species will expand into a region will be useful. The Council would also need to know how and whether scientists are assessing the effects of climate change on human communities, whether those effects include those from sea level rise, increasing storm intensity, or the loss or change of revenue from natural resource based industries.

The second key set of information useful in this review is sensitivity to the degree of fisheries dependence of communities. NOAA has already conducted an intensive study (Norman et al. 2007) to identify West

Coast communities with some dependency on fishery resources. Dependence on commercial, recreational and subsistence fishing is based on information available from the U.S. Census as well as the weight and value of fisheries landings, the number of vessels, and the number of participants in the fisheries. While this study identifies those communities NOAA believes may be accurately characterized as “fishing communities,” further work is needed to assess the degrees to which each of those communities have economic dependencies on fishery resources, and the vulnerability of those communities to changes in availability of fishery resources.

Finally, an examination of the adaptive capacity of marine resources and human communities would tie together predicted changes to the environment with anticipated effects on the economies of West Coast fishing communities. Adaptive capacity is dependent on levels of social capital, human capital and governance structures. While there are global analyses of the adaptive capacity that are based on such factors as healthy life expectancy, education, and the size of the economy (Allison et al. 2009), a similar, rigorous assessment of adaptive capacity of CCE fishing communities to climate change has not been conducted.

To develop background information for this initiative, the Council could begin with a request that NOAA provide it with the above-described review of the state of scientific knowledge. To implement this initiative, the Council could assemble an ad hoc advisory committee to discuss both what is known within in the scientific community, and the concerns of fishing communities with regard to the longer-term effects of climate change. That committee would then develop recommendations for forward-looking scientific investigations into the effects of climate change on West Coast fish and fisheries. If that committee concludes that EFH, fisheries safety, or other major Council policy areas could be of concern under future climate-change scenarios, the committee would make recommendations to the Council on ways to address those concerns under the different Council policy arenas. That advisory committee could consist of fisheries, climate, and social scientists, a geographically diverse set of fisheries representatives, fisheries managers, and others the Council deems appropriate to the task.