ECOSYSTEM WORKGROUP REPORT ON POTENTIAL FISHERY ECOSYSTEM PLAN INITIATIVES: COORDINATED ECOSYSTEM INDICATOR REVIEW INITIATIVE AND CLIMATE SHIFT INITIATIVE

1.0 Introduction

The Pacific Fishery Management Council (Council) adopted a Fishery Ecosystem Plan (FEP) and FEP appendix in April 2013. From its Purpose and Need Statement, the FEP is intended in part to provide "management policies that coordinate Council management across its Fishery Management Plans (FMPs) and the California Current Ecosystem (CCE)." For FMP policies, the FEP is needed to "identify and prioritize research needs and provide recommendations to address gaps in ecosystem knowledge and FMP policies, particularly with respect to the cumulative effects of fisheries management on marine ecosystems and fishing communities." The FEP's appendix provides a series of example ecosystem-based fishery management initiatives exploring how the Council could address issues that affect two or more Council FMPs or coordinate major Council policies across the FMPs to fulfill identified FEP needs. As of this September 2015 meeting, the Council is in the final stages of FEP Initiative 1: Protecting Unfished and Unmanaged Forage Fish Species.

At its March 2015 meeting, the Council reviewed the potential initiatives in its FEP appendix and recommended:

- Adding a new draft initiative A.2.10 to the appendix, *Coordinated Ecosystem Indicator Review Initiative*, on a process to evaluate and improve the utility of the National Marine Fisheries Service's (NMFS's) annual California Current Ecosystem Status Report (CCES Report) to Council decision-making processes;
- That its Ecosystem Workgroup (EWG) describe the potential workload associated with the CCES Report initiative and draft a timeline for completing that workload;
- That its EWG work with its Scientific and Statistical Committee's Ecosystem Subcommittee (SSCES) and with NMFS's Integrated Ecosystem Assessment (IEA) team to begin assessing the CCES Report's potential to inform Council decision-making under each of its FMPs and to evaluate consistency with the purpose of the FEP; and

- That its EWG draft revisions to potential FEP Initiative A.2.8, *Cross-FMP Climate Shift Initiative*, to make that initiative more consistent with NMFS's Draft Climate Science Strategy (http://www.st.nmfs.noaa.gov/ecosystems/climate/national-call-for-comments), and describe the potential workload and timeline for that initiative.

Section 2.0 of this report provides a draft workload description and timeline for draft initiative, A.2.10, *Coordinated Ecosystem Indicator Review Initiative* and policy and management background discussion for considering ecosystem indicators that support Council decision-making. Section 3.0 describes the potential workload and timeline associated with a climate shift initiative and proposes revisions to draft initiative A.2.8, *Cross-FMP Climate Shift Initiative*.

2.0 Coordinated Ecosystem Indicator Review Initiative

In March 2015, the NMFS Northwest and Southwest Fisheries Science Centers presented their third annual CCES Report (Agenda Item E.1.b., NMFS Report), which included ecosystem status indicators within the broad categories: Climate and Ocean Drivers (indicators of shifting climate and other oceanographic trends); Focal Components of Ecological Integrity (indicators of shifting abundance of biological components of the ecosystem); and Human Activities and Human Wellbeing (indicators of human interactions with the ocean ecosystem).

The Scientific and Statistical Committee's Ecosystem Subcommittee (SSCES) provided the Council with guidance on the quality of the scientific information and analyses that support the CCES Report (see SSC report at H.1.b, November 2014, and SSCES report at Agenda Item E.1.b, March 2015). In that report, the SSCES stated:

> *The SSCES also emphasizes the importance of involving the Council and its advisory bodies in the process of selecting indicators for Council use. Indicator selection involves both technical considerations and policy issues. Technical review by the SSC would ensure that candidate indicators meet scientific standards. A workshop or series of workshops could solicit input from management teams and advisory subpanels on indicators that represent the ecosystem objectives expressed in the Council's FMPs and FEP, and are relevant to Council decision-making.*

The Council's direction from its March 2015 meeting to launch the *Coordinated Ecosystem Indicator Review Initiative* began the process of considering policy issues that might be supported by information provided in the annual CCES Report. At that meeting, the Council asked of the CCES Report:

i. What can we reasonably expect to learn from or monitor with the existing indicators in the CCES Report?
ii. How well do the existing indicators accomplish their intent? Are any redundant?
iii. Are there alternate indicators (or information or analysis) that may perform better in context? Are there additional indicators that could help inform Council decision-making under each of its fishery management plans (FMPs) and consistent with the purpose of the FEP?

In this section, we provide a draft timeline and workload review (Section 2.1), and review existing major Council policy documents for guidance on better aligning the contents of the CCES Report with the Council's decision-making requirements. Section 2.2 reviews the FEP goals and objectives for guidance on CCES Report contents in support of ecosystem-based decision-making. Section 2.3 reviews FMP goals and objectives and required FMP-related Council decision processes for guidance on CCES Report contents in support of FMP-related decision-making. Section 2.4 provides excerpts from the Council's 2013 Research and Data Needs document, which the Council significantly revised when it adopted its FEP, so

that the Research and Data Needs document would include expanded discussion of the Council's priorities on science in support of ecosystem-based management.

2.1 Coordinated Ecosystem Indicator Review Initiative Workload and Timeline

Under the FEP, the Council receives its CCES Report annually at its March meetings. The Science Center analyses provided for the CCES Report are conducted in the fall and winter prior to the March briefing book deadline. For this September 2015 meeting, the SSC and IEA scientists are meeting to discuss technical guidance for the March 2016 CCES Report. Therefore, the EWG-proposed timeline for this initiative assumes that guidance for the March 2016 CCES Report must be completed by September 2015, and that guidance for the March 2017 CCES Report must be completed by September 2016.

To address the Council's workload and timeline questions for this initiative, the EWG suggests providing education and dialogue opportunities between the IEA team and the Council's advisory bodies in late 2015, followed by more detailed reviews of and comments on the CCES Report's contents in spring 2016. Among other things, the increased communication would be provide the management teams and advisors better understanding of the current state of the science on indicators and provide the IEA team exposure to the conservation and management questions. The EWG suggests the following workload timeline:

1st Council meeting (September 2015). Council to review this EWG report on Council decision points and policy priorities, make suggestions for revisions, and send out to advisory bodies and the public for review and comment. Specifically, Council would seek comment from its advisory bodies and the public on whether it should include additional or different decision points and policy priorities within a set of policies intended to frame an annual ecosystem report. SSC and IEA scientists to meet; SSC to provide technical guidance for anticipated 2016 CCES Report.

September 2015 through January 2016. Council and NMFS staff to hold a series of webinars to discuss the existing contents of the 2015 CCES Report. The first webinar would introduce listeners to the report and broadly discuss its contents. The remaining webinars would be intended to educate Council advisory bodies and the public about the different major sections of the report: Climate and Ocean Drivers (indicators of shifting climate and other oceanographic trends); Focal Components of Ecological Integrity (indicators of shifting abundance of biological components of the ecosystem); and Human Activities and Human Wellbeing (indicators of human interactions with the ocean ecosystem). Webinars would be brief, available to the public, and would include a question-and-answer period at the end of each session. Webinars would also be recorded and made available on the Council's website, so that members of Council advisory bodies and the public who are not able to attend a webinar in person may later watch and listen to the presentation. Formal comments from Council advisory bodies and the public about overall CCES contents and intent would be due in mid-February for the March 2016 Council meeting.

2nd Council meeting (March 2016). NMFS to present 2016 CCES Report. Council's advisory bodies to comment to the Council on the completeness of the September 2015 list of Council decision points and policy priorities, and on whether they want to see new or different ecosystem information in future CCES Reports. Council to provide preliminary guidance to NMFS IEA scientists on revisions to the CCES Report for 2017 and beyond, and to request a future report on the feasibility of those revisions given available information and personnel.

Spring 2016. Ecosystem Advisory Subpanel (EAS), EWG and SSCES to meet with IEA scientists to discuss how CCES Report might be modified to address the Council's March 2016 guidance.

3rd Council meeting (June or September 2016). NMFS to provide suggestions for revising the CCES Report for 2017 and beyond, based on input received from prior Council meetings. SSC and IEA scientists to meet; SSC to provide technical guidance for anticipated 2017 CCES Report, including comments on NMFS suggestions for revising the CCES Report. Council's advisory bodies to make final comments on future contents of CCES Reports. Council to provide final guidance on CCES Report contents for 2017 and beyond.

Ongoing SSC Review: The SSC and the Council may wish to consider an annual September review and discussion between the SSC and IEA scientists to plan for the upcoming CCES Report.

2018 FEP Review: If the Council formalizes its recommendations on CCES Report contents through this initiative, those recommendations should be included in a new section of the updated FEP and perhaps re-reviewed as part of the larger FEP review.

2.2 FEP Objectives

Chapter 2 of the FEP describes the FEP's objectives, which build on the Council's four FMPs by recognizing that the Magnuson-Stevens Fishery Conservation and Management Act (MSA) supports the ongoing participation of U.S. citizens in commercial and recreational fisheries off U.S. coasts, while also requiring that fish stocks be conserved and managed for optimum yield. The Council's FEP has three major objectives, each of which includes clarifying details. Table 1 lists the FEP's objectives and notes whether those objectives might be met by the FEP itself, in NMFS's CCIEA, in the CCES Report, or in other Council or NMFS documents or processes.

Table 1: Pacific Coast FEP Objectives and Potential Implementation Documents (http://www.pcouncil.org/wp-content/uploads/FEP_FINAL.pdf)

Objective	Potential Implementation Document
1. *Improve and integrate information used in Council decision-making across the existing FMPs by:*	
a. Describing the key oceanographic, physical, biological, and socioeconomic features of the CCE and dependent fishing communities	FEP includes these descriptions in Chapters 3 and 4, which may be revised and updated when the Council decides whether to review and potentially revise the FEP, beginning in 2018.
b. Identifying measures and indicators, and informing reference points to monitor and understand trends and drivers in key ecosystem features	Objective is directly related to the annual CCES Report. Draft potential FEP Initiative A.2.10, *Coordinated Ecosystem Indicator Review Initiative* would begin to address this objective.
c. Identifying and addressing gaps in ecosystem knowledge, particularly with respect to the cumulative and longer-term effects of fishing on marine ecosystems	Discussed throughout the FEP development process and implemented in the Council's 2013 Research and Data Needs document, next scheduled for updating in 2018: http://www.pcouncil.org/resources/research-and-data-needs/.
d. Examining the potential for a science and management framework that allows managing fish stocks at spatial scales relevant to the structure of those stocks	Draft potential FEP Initiative A.2.2., *Bio-Geographic Region Identification and Assessment Initiative*, would begin to address this objective.
2. Build toward fuller assessment of the greatest long-term benefits from the conservation and management of marine fisheries, of optimum yield, and of the tradeoffs needed to achieve those benefits while maintaining the integrity of the CCE through:	

Table 1: Pacific Coast FEP Objectives and Potential Implementation Documents (http://www.pcouncil.org/wp-content/uploads/FEP_FINAL.pdf)	
Objective	Potential Implementation Document
a. Assessing trophic energy flows and other ecological interactions within the CCE	Should be analyzed under the CCIEA, although elements of the analysis could be reported in the CCES Report.
b. Assessing the full range of cultural, social, and economic benefits that fish and other living marine organisms generate through their interactions in the ecosystem	Should be analyzed under the CCIEA, although elements of the analysis could be reported in the CCES Report.
c. Improving assessment of how fisheries affect and are affected by the present and potential future states of the marine ecosystem	Could be analyzed under the CCIEA. Objective is directly related to the annual CCES Report.
3. Provide administrative structure and procedures for coordinating conservation and management measures for the living marine resources of the U.S. West Coast Exclusive Economic Zone (EEZ):	
a. Guiding annual and regular reporting of status and trends to the Council	Objective is directly related to the annual CCES Report.
b. Providing a nexus to regional, national, and international ecosystem-based management endeavors, particularly to address the consequences of non-fishing activities on fisheries and fish habitat	FEP at Chapter 5 provides policies in support of this objective. CCIEA could include analyses of effects of non-fishing activities on fisheries and fish habitat, although analyses of effects on habitat will also be related to NMFS and Council efforts to implement the MSA's essential fish habitat (EFH) provisions.
c. Identifying ecological relationships within the CCE to provide support for cross-FMP work to conserve non-target species essential to the flow of trophic energy within the CCE	Council began this work with its first FEP Initiative: Comprehensive Ecosystem-Based Amendment 1 to Protect Unfished and Unmanaged Forage Fish Species. CCIEA could identify both ecological relationships within the CCE and those non-target species essential to the flow of trophic energy within the CCE.

The FEP objectives suggest that the annual CCES Report should include information that helps us better understand:

- the effects of physical oceanographic processes on the biological community, and on the abundance and distribution of fishery resources and other ecosystem components interacting with fishing vessels (e.g., marine mammals, sea turtles, seabirds and others);
- the effects of fishing activities on the marine ecosystem, particularly on trophic flows within the ecosystem;
- whether and which non-fishing activities have effects on the abundance and distribution of fishery resources and other ecosystem components interacting with fishing vessels (e.g., marine mammals, sea turtles, seabirds and others);
- which fishing communities are most dependent upon fishery resources and which types of fishery management decisions have the greatest effects on those communities;

2.3 FMP Goals, Objectives, and Known Decision Points

The Council's four FMPs each have suites of goals and objectives that differ in their precise language, but which fit within five common themes consistent with principles of ecosystem-based fishery management: avoid overfishing, minimize bycatch, maintain stability in landings, minimize impacts to habitat, and accommodate existing fisheries sectors. The Coastal Pelagic Species (CPS) FMP has an additional goal of providing adequate forage for dependent species. Table 2 details the commonalities between FMP goals and objectives.

Table 2: Pacific Council FMP Shared Goals and Objectives, by FMP Objective/Goal Number

Ecological	CPS	Gr. Fish	Salmon	HMS
Prevent overfishing and rebuild depleted stocks.	7	3	1	10
Provide adequate forage for dependent species.	6,*	*	*	*
Describe, identify and minimize adverse impacts on essential fish habitat		5		14
Minimize bycatch (incl. protected species) and encourage full utilization of resources	5	9, 11	4	9, 17
*see FEP Initiative 1				
Economic				
Achieve greatest possible net benefit (economic or OY) from resource	2	6	5	5
Promote efficiency and profitability in the fishery, including stability of catch	1	2, 7, 14	6	2
Accommodate existing fishery sectors	4	12	2, 3	4, 18
Minimize gear conflicts.	11	13		13
Minimize adverse impacts on fishing communities and other entities		15, 16	2, 3	3
Use gear restrictions to minimize need for other management measures wherever practicable		8		
Management				
Acquire biological information and develop long term research	8			11
Foster effective monitoring and enforcement.	9	1		12
Establish management measures to control fisheries impacts, use management resources effectively	10	4, 10		3, 15
Encourage cooperative international and interstate management	3		8	1, 6, 7, 8
Promote the safety of human life at sea		17	9	
Support enhancement of stock abundance			7	
Promote outreach and education efforts				16

Beyond the FMPs' goals and objectives, each of the FMPs also describes the Council's decision-making processes for its fisheries. Issues the Council must consider and decisions the Council must make dictate much of the Council's schedule for its five yearly meetings. Some decisions, like adopting ocean salmon management measures, must occur on an annual basis. Other required decisions are on longer and sometimes more flexible time-frames, but still must be considered and made, like evaluating EFH reviews. Finally, the Council must meet ongoing requirements, like minimizing bycatch, that may not have set places in the Council's schedule, but which require constant effort from the Council and public for West Coast fisheries management to comply with the MSA. Table 3 details known annual and biennial Council decision points for each Council meeting, as provided in the FMPs, the FEP, and the Pacific Halibut Catch Sharing Plan (CSP). Table 4 lists required Council decisions scheduled for longer rotation periods, such as every 3-10 years. Below Tables 3 and 4, we suggest information and analyses that could be provided in the CCES Report to support both FMP goals and objectives, and anticipated Council decision making.

Table 3: Annual and Biennial Required Council Decision Points and Schedule

Council Meeting	Decision Point	Authority
March		
Ecosystem	1. Receive annual CCES Report; 2. Review progress to date on ecosystem initiatives and, in odd-numbered years, decide whether to begin any new initiatives.	FEP
Halibut	1. Receive report on annual meeting of the International Pacific Halibut Commission; 2. Consider draft salmon troll and fixed gear sablefish incidental halibut catch management measures.	CSP
HMS	Consider management recommendations to US delegations to Regional Fisheries Management Organizations.	HMS FMP
Salmon	1. Review prior year's fisheries and current year's stock abundance forecasts; 2. Identify current year's management objectives and preliminarily define management alternatives.	Salmon FMP 50 CFR 660.408
CPS, Groundfish: N/A		
April		
CPS	Adopt final Pacific sardine harvest specifications and management measures for July 1 – June 30 fishing year, beginning current year.	CPS FMP 50 CFR 660.508
Groundfish	1. In even-numbered years, identify range of new management measures to be analyzed for inclusion in next biennial specifications and management measures for January 1 – December 31 fishing year, beginning subsequent year. 2. Review U.S.-Canada coastwide total allowable whiting catch, set whiting yield set-asides for current year research activities and incidental catch.	Groundfish FMP 50 CFR 660.60
Halibut	Adopt final salmon troll and fixed gear sablefish incidental halibut catch management measures.	CSP
Salmon	Adopt final Ocean Salmon Management Measures for current year ocean salmon fisheries and submits to NMFS.	Salmon FMP 50 CFR 660.408
HMS: N/A		
June		
CPS	In odd-numbered years, adopt biennial Pacific mackerel harvest specifications and management measures for July 1 – June 30 fishing year, beginning current year.	CPS FMP 50 CFR 660.508

Table 3: Annual and Biennial Required Council Decision Points and Schedule		
Council Meeting	**Decision Point**	**Authority**
Groundfish	In even-numbered years, adopt biennial groundfish specifications and management measures, including exempted fishing permits (EFPs), for January 1 – December 31 fishing year, beginning subsequent year.	Groundfish FMP 50 CFR 660.60
HMS	1. In even-numbered years: Council updated on status of HMS fisheries and, as appropriate, receives proposed adjustments to the numerical estimates of maximum sustainable yield (MSY,) optimum yield (OY,) and status determination criteria (SDC) in preliminary Stock Assessment and Fishery Evaluation report. If needed, Council directs HMS Management Team to prepare draft regulatory analysis to implement revised estimates of reference point values, annual catch limits (ACLs) or other harvest objectives and/or management measures. 2. Consider EFP proposals and advisory body recommendations on those proposals for preliminary action. 3. Consider management recommendations to US delegations to Regional Fisheries Management Organizations	HMS FMP 50 CFR 660.709
Salmon: N/A		
September		
Groundfish	In odd-numbered years, receive new stock assessments and Council approve stock assessment recommendations for upcoming biennium.	Groundfish FMP 50 CFR 660.60
Halibut	Receive preliminary catch data for current calendar year and draft a range of CSP revisions and management measure regulations for upcoming calendar year.	CSP
HMS	1. Receive annual SAFE document and, if necessary, Council directs HMS Management Team to prepare a draft regulatory analysis to implement revised estimates of reference point values, ACLs or other harvest objectives, and/or management measures. Council adopts for public review proposed actions addressing concerns from current and previous SAFE reports. 2. Final action on EFPs.	HMS FMP 50 CFR 660.709
Salmon	Preliminary annual methodology review for analyzing impacts of fisheries on salmon stocks.	Salmon FMP
CPS: N/A		
November		
CPS	Methodology review	CPS FMP
Groundfish	In odd-numbered years, outstanding stock assessments and rebuilding analyses – SSC reviews and makes recommendations. In odd-numbered years, EFPs proposals reviewed for upcoming biennium.	Groundfish FMP
Halibut	Adopt final CSP revisions and management measure regulations for upcoming calendar year.	CSP
HMS	In even-numbered years, Council adopts biennial management measures and submits to NMFS. Consider management recommendations to US delegations to Regional Fisheries Management Organizations	HMS FMP 50 CFR 660.709
Salmon	Completed annual methodology review for analyzing impacts of fisheries on salmon stocks.	Salmon FMP

Table 4: Longer Time Frame Required Council Decision Points and Schedule		
Council Decision Point	**Time Frame**	**Requiring Authority**
Research and Data Needs Document, Review and Update	Every 5 years, next due 2018	MSA, §302(h)(7)
CPS EFH, Review and Update	Every 5 years, next due 2015	50 CFR 600.815(a)(10)
Groundfish EFH, Review and Update	Every 5 years, currently ongoing	50 CFR 600.815(a)(10)
HMS EFH, Review and Update	Every 5 years, overdue since 2009	50 CFR 600.815(a)(10)
Salmon EFH, Review and Update	Every 5 years, next due 2018	50 CFR 600.815(a)(10)
5-year review of groundfish trawl rationalization program	Every 5 years, next due 2015	MSA, §303A(c)(1)(G)
5-year review of groundfish fixed gear tier program	Every 5 years, next due 2019	MSA, §303A(c)(1)(G)
FEP Review	Every 5 years, begin 2018	FEP

FMP goals, objectives, and required decision-making processes suggest that the annual CCES Report should include information that helps us better understand:

- Total and FMP-specific fishery removals within the U.S. portion of the CCE, and the ecosystem effects of those fishery removals;
- Stock status of Council-managed fisheries
- Total and FMP-specific discard levels;
- U.S. West Coast fisheries' landings, by both volume and value;
- Metrics to assess fisheries' effects on essential fish habitat and EFH effects on fisheries;
- Efficiency, profitability, and employment in FMP fisheries and fishing community stability;
- Metrics to assess the potential effects of near-term climate shift and long-term climate change on managed species and West Coast fisheries;
- Metrics to assess effects of major weather events on fisheries activity;
- Available forage base levels for FMP-managed, MMPA-managed, and ESA-managed species.
- Effects of non-fishery activities on Council-managed fisheries, fishing communities affected by those fisheries, and EFH.

2.4 Research and Data Needs Document

The Council's July 2013 Research and Data Needs document provides the Council's multi-year research priorities for fisheries, fisheries interactions, habitats and other areas of research that are necessary for management purposes (MSA, §302(h)(7).)[1] Chapter 2 of the Research and Data Needs document identifies priority research issues under ecosystem-based fishery management, many of which should be considered in the development of this initiative. One of the highest priority issues identified in that document references the annual ecosystem report:

> *Provide a status of the ecosystem report to the Council annually that includes, but is not limited to, evaluation of current and future oceanographic conditions, analysis of ecosystem responses to management measures and these conditions, updated habitat mapping or evaluation, observations of recruitment patterns across species, shifts in species distribution and community composition, and changes in trophic dynamics.*

[1] http://www.pcouncil.org/resources/research-and-data-needs/

Additional highest priority issues also discuss indicators of ecosystem status that could be useful in the development of this initiative, some of which are addressed in past CCES Reports:

- Identify key physical and biological indicators for prediction of salmon early ocean survival and groundfish recruitment, as well as other conditions that are directly applicable to management.
- Identify indices of ecosystem state:
    - upwelling, El Niño, Pacific Decadal Oscillation, Sea Surface Temperature, etc.;
    - abundance of key ecosystem process indicators, such as zooplankton and forage fishes;
    - larval and juvenile fish abundance;
    - total annual production and surplus production;
    - species diversity and other measures of ecological health and integrity; describe rationale underlying each;
    - a measure of ocean acidification and its associated impacts on marine resources and ecosystem structure and function.
- Estimate total catch for target and nontarget species and their prey and predators.

Many of the research priorities identified in the Research and Data Needs document seek longer-term analyses and more detailed analyses than those provided in a CCES Report. However, the Council and its advisory bodies should consider reviewing the Research and Data Needs document for previously-identified indicator and analysis needs that could be supported through this initiative.

3.0 Cross-FMP Climate Shift Initiative

At its March 2015 meeting, the Council asked that the EWG draft revisions to potential FEP Initiative A.2.8, *Cross-FMP Climate Shift Initiative*, to make that initiative more consistent with NMFS's Draft Climate Science Strategy (http://www.st.nmfs.noaa.gov/ecosystems/climate/national-call-for-comments). In particular, the Council asked for revisions that would help the Council assess and further its decision making related to the potential effects of climate on fisheries and fishing communities, not just on the species that we manage.

Independent of the draft NMFS Climate Science Strategy, there is a broad and significant body of scientific research on the potential effects of climate change on marine and terrestrial environments. States and tribes are working independently and with each other to develop policy responses to the known and anticipated effects of climate change. With respect to the effects of climate change on the oceans, the states of Washington, Oregon, and California are promoting a number of independent and collaborative initiatives focused on ocean acidification and hypoxia. In 2013, the Washington State Legislature continued the state's attention to ocean acidification by creating the Marine Resources Advisory Council and the Washington Ocean Acidification Center (http://www.ecy.wa.gov/water/marine/oceanacidification.html). The Council and Center are intended to "maintain a sustainable coordinated focus" and increase the "state's ability to work to address impacts of ocean acidification." California and Oregon are working together, and in cooperation with Washington, within the West Coast Ocean Acidification and Hypoxia Science Panel, which is developing science products intended to help West Coast managers and policymakers understand and develop responses to the potential effects of ocean acidification and hypoxia on the marine ecosystem.

The Oregon State Legislature established the Oregon Global Warming Commission (OGWC) and the Oregon Climate Change Research Institute. The OGWC's general charge is to recommend ways to coordinate state and local efforts to reduce Oregon's greenhouse gas emissions consistent with Oregon's goals and to recommend efforts to help the state, local governments, businesses and residents prepare for the effects of global warming. In support of the OGWC's efforts, Oregon Department of Fish and Wildlife has produced "Preparing Oregon's Fish, Wildlife, and Habitats for Future Climate Change: A Guide for

State Adaptation Efforts". The Climate change Research Institute is a network of researchers tasked with facilitating research, providing climate change information to the public, supporting the Global Warming Commission to develop its strategies, and providing technical assistance to local governments, among others.

Recent actions in California are designed to advance the California Global Warming Solutions Act of 2006. California's newly released Climate Change Research Plan articulates near-term climate change research needs to ensure that the state stays on track to meet its climate goals. The Fourth Climate Change Assessment is the first inter-agency effort to implement that plan and includes projects that will provide critical additional information to support decisions that will safeguard the people, economy and resources of California. Examples include gaining a better understanding of the climate impacts from extreme events such as more frequent and more severe wildfires and drought, and filling other information gaps related to accurately understanding climate risks and management options. California Department of Fish and Wildlife is updating its 2005 Wildlife Action Plan which in part will address objectives designed to stratify analysis of impacts and stressors by ecoregions, incorporate climate change impacts and adaptation strategies, and update species at risk, vulnerable species and species of greatest conservation need.

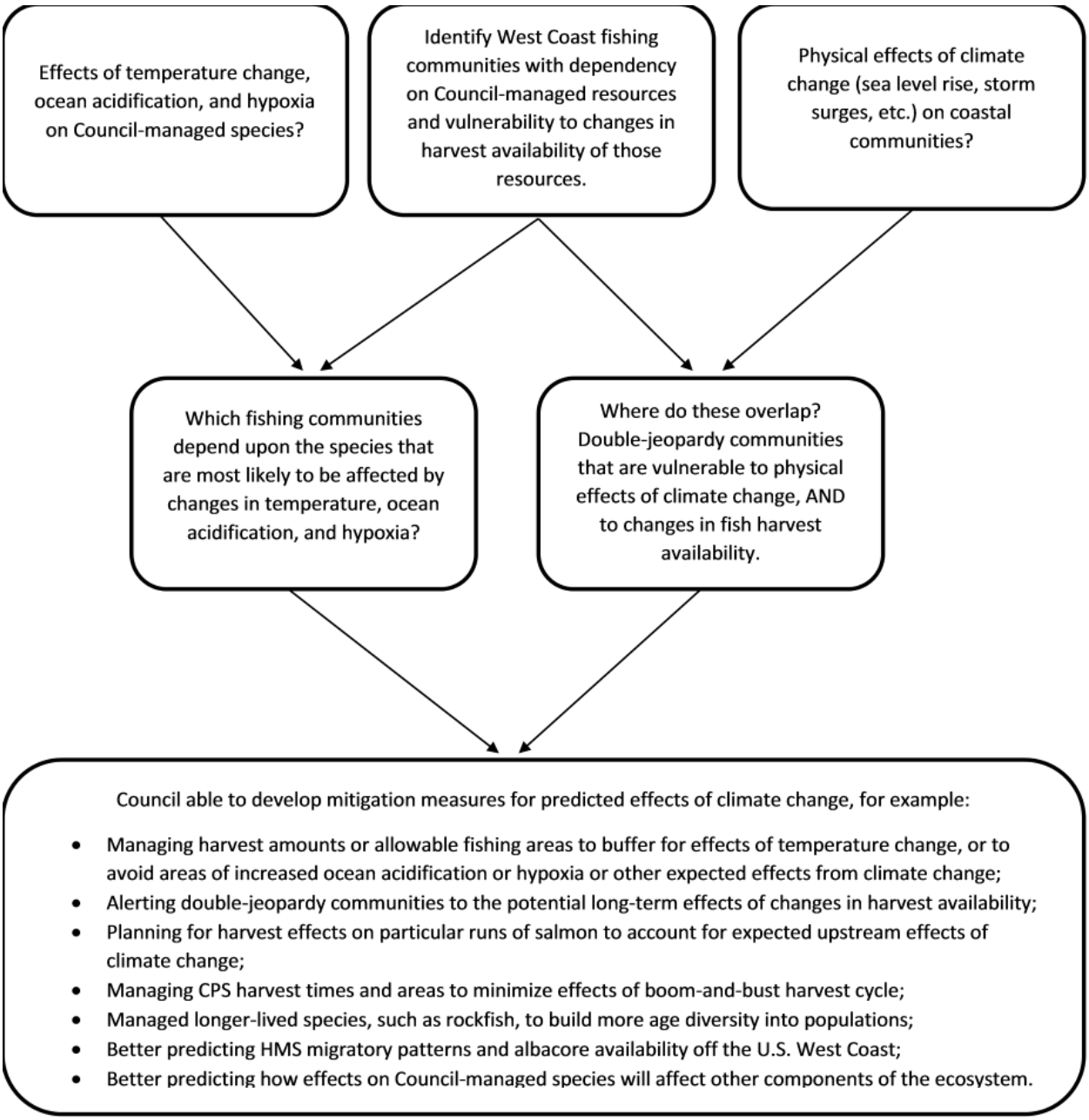
Individual Treaty Indian Tribes have developed climate change adaptation plans, and many tribes that participate in the Council process have led or participated in nationwide efforts to assess and plan for climate change and ocean acidification.[2] West Coast tribes are developing tribe-specific plans to address the potential effects of climate change, and have joined together to share resources on planning for climate change. The Jamestown S'Klallam and Swinomish tribes have completed detailed assessments and adaptations plans responding to threats from sea-level rise. The Quinault Indian Nation and Hoh and Quileute tribes are developing vulnerability assessments that will include considerations of climate change impacts on their communities and economic well-being.[3]

Nationally, state and tribal fish and wildlife agencies have worked with NOAA and the US Fish and Wildlife Service to develop a *National Fish, Wildlife, and Plants Climate Adaptation Strategy*.[4] The Council should take advantage of the existing work of its participating states, tribes, and federal agencies to help it develop its Climate Shift Initiative.

3.1 Climate Shift Initiative Workload and Timeline

At its March 2015 meeting, the Council expressed an interest in knowing not just which fish species were likely to be affected by climate change, and how, but also which fishing communities were likely to be more affected by any changes in harvest availability that could result from climate change. This initiative could be developed through a multi-stage science and policy process, illustrated in Figure 1, below. Some of the scientific analyses described in Figure 1 are part of NMFS's Draft Climate Science Strategy, or are otherwise already underway.

[2] http://nca2014.globalchange.gov/report/sectors/indigenous-peoples
http://www.firststewards.org/
[3] http://tribalclimate.uoregon.edu/tribal-profiles/
[4] http://www.wildlifeadaptationstrategy.gov/strategy.php



3.2 Suggested Text Revisions for Climate Shift Initiative

Most of the existing text of the Cross-FMP Effects of Climate Shift Initiative, listed as draft Initiative A.2.8 in the FEP's appendix, is compatible with NMFS's Draft Climate Science Strategy. Below, the EWG suggests revisions to the text intended to address the Council's request that the initiative more explicitly look at the effects of climate on fisheries-dependent communities. Any text that is to be added to the initiative is shown underlined, <u>like this</u>. Any text that is to be removed from the initiative is shown struck out, ~~like this~~.

* * *

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 and fisheries-dependent communities, 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, fisheries, or fishing businesses, the focus of this initiative would be on the combined, long-term effects of such changes on West Coast fishing communities and 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. Additionally, there are numerous communities near navigable rivers within the coastal states and Idaho that benefit economically and socially from sport and tribal salmon and steelhead fisheries. 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 current and 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 indicators such as 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 and report on 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 on fisheries, ecosystem components and communities. In addition, that committee could develop an inventory of proactive fishery management strategies and adaptive processes to promote resilience in fisheries and communities. Inventory sources could, at a minimum, include work from state and tribal partners and federal entities, as well as coastal communities and academia. 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~~ within 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. The Council may also wish to consider whether it needs to periodically review how and whether climate shifts are affecting West Coast fish populations and fisheries, so that it may determine whether and how it needs to act in response to those changes.

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