Atlantic States Marine Fisheries Commission

Executive Committee

August 7, 2018
8:00 – 10:00 a.m.
Arlington, Virginia

Draft Agenda

The order in which these items will be taken is subject to change;
other items may be added as necessary.

A portion of this meeting may be a closed session for Committee members and Commissioners only

1. Welcome/Call to Order *(J. Gilmore)*

2. Committee Consent
   - Approval of Agenda
   - Approval of Meeting Summary from May 2018

3. Public Comment

4. Consider Changes to the Appeals Process *(J. McNamee)*

5. Update on Right Whale Lawsuit *(R. Beal)*

6. Update on Federal Appropriations *(R. Beal)*

7. Discuss the Commission's Role in Aquaculture Activities *(R. Beal/L. Daniel)*

8. Discuss Development and Use of Ecosystem Reports *(T. Kerns)*

9. Review White Paper on Future Scope of Recreational Data Collection Programs *(R. Beal/M. Cahall)*

10. Other Business/Adjourn

Please Note: Breakfast will be served as members arrive; members may arrive as early as 7:30 a.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia; 703.486.1111

MEETING SUMMARY OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

EXECUTIVE COMMITTEE

The Westin Crystal City
Arlington, VA
May 2, 2018

INDEX OF MOTIONS

1. **Approval of Agenda by Consent. (Page 2)**

2. **Approval of Meeting Summary from February 7, 2018 by Consent. (Page 2)**

3. **On behalf of the AOC, Mr. Keliher moved approval of the FY19 Budget as presented. The motion passed unanimously. (Page 2)**

4. **Mr. Boyles moved that we rescind our prior decision about ongoing proxies serving as officers. Dr. McNamee seconded and the motion passed unanimously. (Page 2)**

5. **Adjournment by Consent (Page 3)**

ATTENDANCE

Committee Members

Pat Keliher, ME
Doug Grout, NH
Dennis Abbott, NH (LA Chair)
David Pierce, MA
Pete Aaarrestad, CT (proxy for Craig Miner)
Jason McNamee, RI
Jim Gilmore, NY
Jeff Brust, NJ
John Clark, DE
Roy Miller, DE (GA Chair)
Andy Shiels, PA
David Blazer, MD
Steve Bowman, VA
Steve Murphey, NC
Robert Boyles, SC
Doug Haymans, GA
Jim Estes, FL

Other Commissioners

David Borden, RI (GA)
Raymond Kane, MA (GA)
Ritchie White NH (GA)
Spud Woodward, GA (GA)

Staff

Bob Beal
Laura Leach
Mike Cahall
Deke Tompkins
Geoff White

Others

Chris Batsavage, NC DMF
Joe Cimino, NJDEP
Allison Colden, MD (CBF)
Lynn Fegley, MD DNR
Joseph Gordon, PEW Commission
Dan McKiernan, MA DMF
Mike Millard, USFWS
Alli Murphy, NOAA Fisheries
Ed O'Brien, MD
Derek Orner, NOAA Fisheries
Cheri Patterson, NHF&G

CALL TO ORDER

The Executive Committee of the Atlantic States Marine Fisheries Commission convened in the Crystal VI Room of The Westin Crystal City in Arlington, Virginia May 2, 2018. The meeting was called to order at 8:30 a.m. by Chair Jim Gilmore. Mr. Gilmore welcomed two new Executive Committee members, Steve Bowman from Virginia and Peter Aarrestad (proxy for Craig Miner) from Connecticut.

APPROVAL OF AGENDA

The agenda was approved as presented.

APPROVAL OF PROCEEDINGS

The summary minutes from the February 7, 2018 meeting were approved as presented.

PUBLIC COMMENT

There was no public comment.

AOC REPORT

Mr. Keliher reported that the Administrative Oversight Committee (AOC) met via conference call to review the Proposed FY19 Budget. He asked Mrs. Leach provided an overview of the budget, which had been distributed to the Committee on April 25. Because the amount of Federal funding to the Commission is not known yet, the budget presented was a "best-guess" estimate based on the past several years of funding. The Committee was assured that the activities contained in the 2018 Action Plan would be able to be funded through the proposed budget. On behalf of the AOC, Mr. Keliher moved approval of the FY19 Budget as presented. The motion passed unanimously.

Executive Director Beal noted that there might be an increase to the Commission/Council line in the Federal budget and asked the Committee to be thinking about how we propose that increase be distributed, since NOAA Fisheries will ask for our input.

UPDATE ON WHO CAN SERVE AS OFFICERS

Executive Director Beal consulted with Sean Donahue, the Commission's Attorney, about the issue of proxies serving as officers. Mr. Donahue's opinion, after a thorough review of the Compact, is that it is not appropriate, as the Compact states "The Commission shall elect from its number a Chair and a Vice Chair". Mr. Boyles moved that we rescind our prior decision about ongoing proxies serving as officers. Dr. McNamee seconded and the motion passed unanimously. Mr. Ritchie White requested that it is made known to appointing Commissioners their proxy cannot serve as an officer.

CONFLICT OF INTEREST

The Executive Committee discussed conflict interest and after reviewing several scenarios determined that we need to continue to monitor concerns about conflict of interest on an individual basis.

APPEALS PROCESS

Dr. Mcnamee reported that he, Jeff Brust and Executive Director Beal are working on modifying Criteria #3 & 4 in the Appeals Process to make them more contemporary. They plan to have their recommendations ready in time for discussion at the Summer Meeting.

FUTURE SCOPE OF APAIS/MRIP

Executive Director Beal and Mike Cahall provided an update on the future scope of Recreational Data Collection Programs on the Atlantic Coast. The states are currently conducting the Access Point Angler Intercept Program (APAIS) and due to its success, the Federal government is requesting the states, through ASMFC, increase their participation in recreational data collection to possibly include the Large Pelagic Survey as well as additional For-Hire surveys. Increased state participation will capitalize on the success of APAIS and improve angler confidence in the data. The states requested detailed information on workload and scope of conducting additional surveys and staff was directed to develop a White Paper that broadly discusses the way data collection is currently being conducted. The Executive Committee will consider the options in the White Paper at the Summer Meeting.

OTHER BUSINESS

L/GA LUNCHEON

Mr. Abbott provided a report on the Legislators/Governors Appointees luncheon. They had a spirited discussion about collegiality, or lack thereof these days. There seemed to be more willingness to compromise; now it appears as though people are more concerned about parochial interests. Chair Gilmore asked if there was any discussion about getting back to the good old days? Chair Gilmore appointed a committee to work on developing a strategy to get the Commission back to the old way of decision-making. The Committee is comprised of Pat Keliher, Robert Boyles, David Borden, Doug Grout, as well as himself and Executive Director Beal.

This committee will also work on developing the framework for the next 5 Year Strategic Plan (2019 – 2023).

RIGHT WHALE LAWSUIT

Executive Director Beal briefed the Executive Committee on the most recent lawsuit from Max Strahan regarding right whales and interactions with Lobster/crab gear. The Commission's attorney Sean Donahue is working on a response. Upon his initial review, Mr. Donahue believes the lawsuit does not apply to us and plans to ask for a dismissal.

The Executive Committee went into a closed session at 9:58 top discuss the annual performance review of Executive Director Beal.

ADJOURN

CHAIR JIM GILMORE adjourned the Executive Committee meeting at 10:30 a.m.

Current and Potential Aquaculture Activities Involving ASMFC

Introduction:

Aquaculture activities check all the boxes for the current administration in terms of job creation, trade imbalance, food supply independence, etc. In turn, interest and funding for such programs has increased through NOAA.

The recent congressional funding and subsequent request for proposals developed by the ASMFC and National Marine Fisheries Service resulted in significant interest among constituents of member states. The move forward in developing sustainable aquaculture could lessen demands and subsequent impacts on wild stocks.

Projects funded through ASMFC (n = 7) focus on developing aquaculture infrastructure, education, and techniques that are transferable within our jurisdiction. It appears additional funding will be available for 2019. If there is Commission interest, more could be done in aquaculture.

Commission staff is seeking direction and soliciting input on the level of involvement the ASMFC should have in aquaculture activities. We believe the Commission's focus is best used to inform and educate our member states on potential issues that may arise as the aquaculture sector grows. Further, we suggest a focus on developing position statements on specific issues that impact
Commission activities or managed stocks. The purpose would be to develop consensus statements, when possible, so states may use or expand upon position statements when dealing with the specific state issues that arise. We do not believe ASMFC involvement in issues related to permitting, siting, production, or other criteria developed by the states is within the Commission's purview.

Current Issues:

Numerous issues exist and more are developing within the Commission's jurisdiction. Manna Fish Farms and Cooke Industries, along with specific advances in technology and demand, are bringing aquaculture and its potential benefits and concerns to the forefront. Items such as the genetic integrity of brood stock, escapement impacts to the genetic integrity of wild stocks, habitat degradation concerns, diseases, siting, public health, and public trust are being dealt with by most, if not all, member states.

Limited information and policy statements related to aquaculture are scattered throughout Commission literature. Principle state agencies involved in aquaculture citing, permitting, and development may vary among member states and legislation being developed in various states may or may not address issues of concern to the Commission.

A first step is to gauge the level of Commission interest in addressing aquaculture issues within our jurisdiction. Once identified, the Commission may decide to create a committee or work group to begin examining priority issues and provide input on other issues as they develop.

In addition, engaging other state and federal partners with interest in aquaculture issues should be included as a next step. National Ocean Service, National Marine Fisheries Service, Sea Grant, federal Councils, Army Corp of Engineers, and others are developing plans and policies that directly impact these activities.

Should the Commission elect to move forward with involvement in aquaculture issues, a discussion on the level of involvement in terms of specific compliance criteria, setting policy, or simply providing positions and guidance may be appropriate.

Potential Activities:

The following are a list of items the Commission may want to consider if there is a decision to move forward.

1. **Interstate transfer of shellfish seed**. Seed stock availability is a primary impediment to developing shellfish aquaculture in our region. Seed developed for specific areas or environmental conditions may or may not be suitable for all regions. Testing expenses foster illegal transport and sale and are difficult to trace, creating potential human health risks. An interstate cooperative program to examine seed stock import and export requirements in member states could address seed availability issues, human health, and illegal activities.

2. **Partner and consult with NOS/NMFS Aquaculture staff to focus on priority, interstate needs for aquaculture development.** Opportunities to engage and inform member states on priority, national issues critical to the success, or failure, of this expanding industry. These issues may be broken down in to three primary issues.
    a. **Environmental Interactions with Aquaculture**
    b. **Coastal Planning for Siting**
    c. **Climate Change Effects**

3. **Coordinate with federal Councils.** The South Atlantic Fishery Management Council has expressed interest in developing an aquaculture plan for the federal waters off of NC-FL. Activities of the Mid-Atlantic and New England Councils should be considered. Impacts to defined EFH/HAPC in Council Habitat plans may provide an opportunity for Commission involvement, along with issues related to seasonal closures and enforcement concerns.

4. **Specific Concerns with Finfish Aquaculture.** Concern with genetic integrity of wild stocks, escapement, enforcement, water quality, habitat impacts, and others are real.

Should Commission managed stocks be considered for open water aquaculture activities, e.g., striped bass, cobia, red drum, summer flounder. Does the Commission have a role in addressing potential interjurisdictional issues that may arise from finfish aquaculture initiatives?

5. **Review and consolidate current Commission policies and positions regarding aquaculture.** Aquaculture issues are scattered in the Commission literature, many of which are dated. Should current policies or position statements of the Commission be reviewed to ensure they correspond with recent advances in technology and research (e.g., SAV Policy, spring 2018)? Should the Commission consolidate information into a central repository?

6. **Evaluate how the development of aquaculture of non-Commission managed species impact our efforts.** Interest in aquaculture of sea grass, algae, seaweed**,** live rock, non-native fish species, other shellfish and crustaceans may or may not pose certain risks to Commission jurisdictions. What are the concerns? Is this an issue?

7. **Others?**

Commission staff believes addressing these various issues would provide member states with a consolidated data source that provides scientific opinion and policy to guide the future development of aquaculture. An initial goal may be to support activities that are environmentally and ecologically sound while identifying potential concerns or conflicts with existing Commission policy or plans.

Possible Actions Moving Forward:

Compile aquaculture activities, production, and concerns from individual states. Who is doing what and how consistent are policies across the region?

Begin and foster a relationship with agencies that currently have a major role in the development of aquaculture initiatives, e.g., NMFS/NOS/Sea Grant/Councils. Appendix I and II provide recent background information related to federal Council concerns, issues, and actions.

With Commission concurrence, create an aquaculture TC and Board or other Commission entity to develop an aquaculture plan or guidance document for member states. The intent would be, primarily, to advise and educate on upcoming issues and provide policy guidance as new initiatives develop in member states, e.g., Manna Fish Farms, Cooke Industries.

Provide a forum to discuss new issues as well as advise staff on future RFP priorities and project reviews.

Other?

Appendix I

Potential Aquaculture Issues to be Considered

by Regional Fishery Management Councils and States

Prepared by Dave Whaley (3/18/18)

* Council Role - what role will Regional Fishery Management Councils (Councils) play in permitting and in decisions about species to be farmed?

* Transparency - will aquaculture permitting and specific site plans receive the same transparent process as required under the MSA?

*Scientific review - will there be any review by the Councils' SSCs or any similar scientific review body?

* Economic Impact – what will be the economic impact on commercial fisheries, fishery-dependent communities, coastal communities, working waterfronts, and other related businesses of farmed fish? Socio-economic review is required under MSA.

* Market Impacts – what are the likely market impacts of aquaculture species on commercial fisheries, will there be a required review of these impacts, and what entity will do the review?

* Species Selection - what species could be permitted for offshore aquaculture? Will there be an attempt to limit competition with wild harvest? What entity will make this determination?

* Conflicts with fishing grounds – what are the potential conflicts between permitted offshore aquaculture facilities and traditional fishing grounds and what entity will be doing the review?

* Habitat Conflicts – what are the likely potential conflicts between permitted offshore aquaculture facilities on essential fish habitat (EFH) and habitat areas of particular concern (HAPC) identified under FMPs? How will changes to EFH and HAPCs developed by Councils be imposed on offshore aquaculture facilities and activities.

* Species – indigenous only? Species with direct competition with wild harvest? Who decides?

* Effects of escapes on wild harvest – liability? Compensation?

* Size/Season – what effect will the differences between Council developed size/season regulations have on MSA or State managed species (primarily an enforcement issue, but could also have an impact on market impacts of wild-caught species)? If differences, how will aquaculture species be monitored and tracked?

* State landing laws – how will aquacultured species be tracked/documented by States and how will size/season differences be meshed with State landing laws?

* Brood stock – what will brood stock collection impacts have on managed species? Would juveniles be removed from the wild population for propagation? What impacts might this have on managed species? Would adults be removed for brood stock purposes or for fattening/ranching purposes and, if so, how would this be permitted and what effect would this have on conservation and management measures under MSA (particularly ACLs and AMs and potential for overfishing and/or triggering overfished condition? What impacts might this have on rebuilding requirements under MSA?

* Impacts on marine mammals – many commercial and recreational fisheries operate under Take Reduction Team restrictions. In addition, many fisheries may be near limits on "takes" of marine mammals under PBR and ZMRG provisions of the Marine Mammal Protection Act. What impact will "takes" of marine mammals by offshore aquaculture facilities and offshore aquaculture activities have on commercial and recreational fisheries managed under the MSA?

* Impacts on birds - there is also a similar concern about impacts of aquaculture facilities on birds under the Migratory Bird Treaty Act and other listed bird species and the potential impacts on the wild harvest as a result of aquaculture "takes".

* Jones Act/Coast Guard vessel permitting rules – the commercial fishing industry is required to meet U.S. ownership, U.S. ship building, U.S. manning requirements, etc. Will aquaculture facilities (ownership, cages, supply and transport vessels, etc.) and activities be required to meet the same requirements?

* Consistency with State fishery management plans? State concurrence with siting plans?

* Fees – who pays, how much, what are acceptable uses of fees? Can States charge landing fees as they do on wild-harvest fish?

Other questions:

The U.S. seafood trade deficit is heightened by U.S. wild-harvest fish harvested under the MSA being shipped out of the U.S. for secondary processing and returned as a higher value processed product. How can this aspect of the seafood deficit be mitigated?

How will NEPA review be conducted? Overall permitting process and/or each facility permit?

Labeling differences between wild and aquaculture products – organic label available? "Product of ---- (insert state name)"?

Are there current genetic standards for hatcheries and if so would these be applicable to offshore aquaculture facilities?

Should there be separate Federal funds made available for the marketing of aquaculture products?

Appendix II

Topic 19:

AQUACULTURE

TAB 14, Attachment 4
Report from May 2018 CCC Meeting

Background

Aquaculture is being promoted as a way to reduce the seafood import/export deficit. The Magnuson-Stevens Act (MSA) treats aquaculture as fishing based on a legal opinion by NOAA General Counsel that landings or possession of fish in the exclusive economic zone from commercial marine aquaculture production of species managed under fishery management plans constitutes "fishing" as defined in the MSFCMA [Sec. 3(16)]. Fishing includes activities and operations related to the taking, catching, or harvesting of fish.

In 1994, the South Atlantic and Gulf of Mexico Councils established a live rock aquaculture permitting system for state and federal waters off the coast of Florida under Amendment 2 to the Coral FMP. Live rock is defined as living marine organisms or an assemblage thereof attached to a hard, calcareous substrate, including dead coral or rock. Live rock is used in the marine aquarium trade. This permitting system allows deposition and harvest of material for purposes of live rock aquaculture while maximizing protection of bottom habitat, EFH, and HAPC in federal waters of the South Atlantic Council.
The Gulf of Mexico Council approved an Aquaculture FMP in January 2009. There is a lawsuit underway challenging provision of the FMP.

Consensus Position

The CCC developed the following consensus position:
"The CCC believes that the Councils' existing authority under the Magnuson-Stevens Act allows them to develop fishery management plans to regulate aquaculture in their respective exclusives economic zone (EEZ) waters to address major topics like permitting process and duration, approval of systems and siting, species that may be cultured, and record keeping and reporting. The Gulf Council has an existing fishery management plan and other Councils have programs and/or policies addressing aquaculture in the EEZ. Individual Councils are in the process of determining whether they will develop a fishery management plan and do not feel a consultation role alone would adequately address Council concerns."

Regional Perspectives

NEW ENGLAND:
Drafting

MID-ATLANTIC:
Drafting

SOUTH ATLANTIC:
The South Atlantic Council recognizes that there are several types of environmental risks associates with marine aquaculture. Federal, state, and local regulatory agencies should evaluate these risks as they develop and implement permitting and monitoring processes for the aquaculture industry.

The Council specifically recognizes the following potential interactions between marine aquaculture and essential fish habitat (EFH):
1. Escapement
2. Disease in aquaculture
3. Use of drugs, biologics, and other chemicals
4. Water quality impacts
5. Benthic sediment and community impacts

The South Atlantic Council supports the establishment and enforcement of the following general requirements for marine aquaculture projects authorized under the Magnuson-Steven Fishery Conservation Act (MSA) or other federal authorities, to clarify and augment the general policies already adopted in the Habitat Plan and Comprehensive Habitat Amendment (SAFMC 1998a; SAFMC1998b):
1. Marine aquaculture activities in federal waters of the South Atlantic require thorough public review and effective regulation under MSA and other applicable federal statutes.
2. Aquaculture permits should be for at least a 10-year duration (or the maximum allowed if the applicable law or regulation sets a maximum less than 10 years) with annual reporting requirements (activity reports). Permits of 10 years or more should undergo a 5-year comprehensive operational review with the option for revocation at any time in the event there is no prolonged activity or there are documented adverse impacts that pose a substantial threat to marine resources. SAFMC Marine Aquaculture Policy June 2014
3. Only drugs, biologics, and other chemicals approved for aquaculture by the FDA, EPA, or USDA should be used, in compliance with applicable laws and regulations (see Appendix for current list of approvals).
4. Only native (populations) species should be used for aquaculture in federal waters of the South Atlantic.
5. Genetically modified organisms should only be used for aquaculture in federal waters of the South Atlantic, pending FDA and/or other Federal approval, following a rigorous and documented biological assessment which concludes there is no reasonable possibility for genetic exchange with natural organisms or other irreversible form of ecological impact. Further, aquaculture of genetically modified organisms should be prohibited in federal waters of the South Atlantic when there exists a reasonable opportunity for escapement and dispersal into waters of any state in which their culture and/or commerce are prohibited by state rule or policy.
6. Given the critical nature of proper siting, the permitting agency should require the applicant to provide all information necessary to thoroughly evaluate the suitability of potential aquaculture sites. If sufficient information is not provided in the time allotted by existing application review processes, the permitting agency should either deny the permit or hold the permit in abeyance until the required information is available.

7. Environmental monitoring plans for projects authorized under MSA should be developed by the applicant/permit holder and approved by NOAA Fisheries with input from the Council.
8. Fishery management plans for aquaculture should require permittees to have adequate funds (e.g., assurance bond) committed to ensure removal of organisms and decommissioning of facilities that are abandoned, obsolete, or storm-damaged or have had their permit revoked. The plans should also require that the amount of these funds be determined by NOAA Fisheries with input from the Council and that the funds be held in trust.
9. When issuing permits for aquaculture in federal waters, NOAA Fisheries should specify conditions of use and outline the process to repeal permits in order to prevent negative impacts to EFH. NOAA should take the appropriate steps to modify or revoke permits using its authority if permit conditions are not being met.

GULF OF MEXICO:
The Gulf of Mexico is the only Council to have an implemented plan for aquaculture and echoes many of the sentiments expressed by the South Atlantic, above. Many of the items addressed in the Wicker Aquaculture bill are already included in the GMFMC's fishery management plan (FMP) for aquaculture and by extension are in the final rule establishing the Gulf Aquaculture Permit. There are major differences in the climate and needs of each region; thus, an overarching federal management body (as outlined in Section 4(c)) would lack the regionalized expertise necessary to fully evaluate concerns of each region. Regionalized subcommittees addressing aquaculture would be more appropriate, as should a formalized consultation process with regional management councils.

In Section 2 (b) (4) of the bill, the purpose identifies rationale regarding support for existing jobs, including "watermen, processors, and other traditional fishing industry partners" that would be consistent with incorporating aquaculture-specific language into the MSA. Additionally, it is not clearly delineated if existing management plans, such as the GMFMC's Aquaculture FMP, would supersede this bill. The bill needs to clearly identify if existing management plans for aquaculture by regional councils would cease to be how aquaculture is managed.

Section 5. Administration Section 5(a) and 5(b) of the bill have many elements that have already been addressed and codified based in the GMFMC's Aquaculture FMP. Section 5(e) does not specifically address how veterinary health will be addressed. The GMFMC agrees with the SAFMC that only drugs, biologics, and other chemicals approved for aquaculture by the FDA, EPA, or USDA should be used, in compliance with applicable laws and regulations (as has been identified in the GMFMC Aquaculture plan). Aquaculture facilities are not "closed loop" facilities, and administration of drugs, biologics, and other chemicals can have resounding effects on surrounding marine communities.

Most permitting issues addressed in the bill have already been clearly defined in the Gulf in the GMFMC's Aquaculture FMP and Gulf Aquaculture Permit. The GMFMC is especially concerned with Section 6(b)(2)(B & C) and does not support culture of non-native species. The term "naturalized" is not defined and could be interpreted to include species that are not native to a region but have invaded. Propagation of these invasive species could have major unintended consequences on the surrounding marine environment. Additionally, sterility is not a guaranteed state, and non-native stocks should never be cultured. The GMFMC recommends the culture of only native, non-genetically modified, non-transgenic species with progeny cultured from wild caught brood stock. Lastly, the GMFMC Aquaculture FMP and Gulf Aquaculture Permit strictly prohibit culture of shrimp and corals.

Each regional fishery management council should determine which species should not be cultured if appropriate rationale is provided.
Permitting procedures in Section 6(c) are already addressed in the final rule establishing the Gulf Aquaculture Permit. Additionally, through the FMP, permit procedures can be modified (through a plan amendment) should the necessity arise; this bill would require an act of Congress to modify permitting procedures. In the current process, before a permit is approved, the Regional Administrator of NMFS should consult with the GMFMC on a permit, allowing for the GMFMC to provide comments prior to approval. The process outlined in Section 6 does not require a consultation with the regional council which should be rectified.
Permit duration should not exceed 10 years, with the ability to renew in 5-year increments; a 25-year increment is much too long. Additionally, three years to remove all equipment is too lenient as aquaculture facilities can continue to have biofouling, act as vectors for invasive species and disease, and hinder fishing and marine traffic in the vicinity of the facility, among others. A facility should be completely decommissioned within one year of permit expiration.
There should be financial guarantees associated with escapement events to discourage repeat offenses and encourage best practices in the face of catastrophic weather events. It is likely that these event will occur and will require federal agency involvement to mitigate.
One tradeoff for removing aquaculture authority from the MSA would be the elimination of the need for MSY or OY measures. However, establishing an MSY for all cultured species (with the ability to increase or decrease this cap) allows managers to assess whether the practice of aquaculture in a region is having cascading effects on the surrounding environment, thus modifying this measure as appropriate. By not having such a measure on production poundage, there could be unintended consequences for wild stocks from overutilization of marine resources dedicated to aquaculture.

Section 7 indicates that there are two different types of aquaculture permits, those from Section 6, and those under the MSA. Permitting requirements may not be consistent between the two which could create confusion and inconsistencies in application. This should be addressed. Also, all aspects of Section 8 in the bill are outlined in the Gulf Aquaculture Permit and GMFMC's Aquaculture FMP.

In Section 10 (b)(3), more explicit language is needed regarding intent. It is recommended that only the culture of native, non-genetically engineered, non-transgenic species be used for research, and that this be explicitly outlined in the bill.

CARIBBEAN:
Drafting

PACIFIC:
Drafting

WESTERN PACIFIC:
The Western Pacific Council recognizes that aquaculture is a rapidly developing industry and that aquaculture presents both potential benefits and potential negative impacts to the environment and society. The Western Pacific Council has had an aquaculture policy in place since 2007 that includes guidelines on cultured species; habitat; research, location, design, and operation; water quality; health management and disease control; indigenous people's rights and access; permitting and reporting; enforcement; protected species; and social and economic considerations. The Western Pacific Council is also working with NMFS on developing a programmatic Environmental Impact Statement (EIS) for aquaculture and in the process of amending its Fishery Ecosystem Plans to include an aquaculture management framework that

includes permitting and reporting. The Western Pacific Council recognizes the push for aquaculture and is working to ensure that aquaculture is treated as a fishery in the Western Pacific and minimizes or eliminates impacts on other fisheries and the environment.

Commonwealth of Massachusetts

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TO: Bob Beal, ASMFC Executive Director

FROM: Daniel J. McKiernan, Deputy Director
David E. Pierce, Director

DATE: November 13, 2017

SUBJECT: Request for ASMFC to coordinate improved shellfish seed interstate shipment accountability

Please consider this request to assist states to improve the accountability of interstate shellfish seed shipments. While this activity has not been an area that ASMFC has been involved in a substantial way, the Commission has a history of providing coordination and guidance on matters concerning aquaculture through the publication in 2002 of *Guidance Relative to Development of Responsible Aquaculture Activities in Atlantic Coast States* (Special report #76). The request contained in this memo is consistent with many aspects of the Guidance document produced 15 years ago.

In Massachusetts, aquaculture has become a significant management responsibility of the MA Division of Marine Fisheries (DMF), in particular shellfish aquaculture. The growth in this industry has resulted in an increasing number of requests for the interstate transfer of shellfish seed. With this increased rate of movement comes an increased risk of spreading shellfish veterinary disease, pathogens and invasive species.

As you can see from the documents in the appendices, most Atlantic coast states have minimum requirements related to permitting and disease and pathogen testing of imported shellfish seed. Massachusetts is participating in a number of ongoing interstate efforts to create uniformity in the various disease and pathogen testing requirements and protocols. However, to-date, none of these efforts have focused on enhancing documentation of interstate seed sales and improving accountability with the existing protocols.

The Massachusetts shellfish industry and it aquaculturists support better controls and traceability of shellfish seed being placed in coastal waters as a means to prevent the spread of shellfish diseases and pathogens and to better understand the etiology of epizootic events. The Massachusetts aquaculture industry has experienced significant mortality associated with disease transmission in the past and sees it at a major threat to the industry. On the flipside, to ensure an adequate supply and diversity of seed choices for our growers, we believe restrictions on inter-state seed transplants need to be reasonable and achievable.

Under the Massachusetts aquaculture permitting system, DMF requires growers (permit applicants) to obtain approval for each seed source (hatcheries and other growers) prior to transplanting shellfish seed into MA coastal waters. DMF maintains a list of approved hatcheries (in-state and out-of-state) and issues approval to each source by species of shellfish, and in some cases by cohorts.

Like most other Atlantic states, we also have specific disease testing requirements that must be met in order to become an approved seed source in MA. Many of our approved seed sources are located in-state and are issued permits by DMF, with specific requirements that they may only sell to individuals holding a valid DMF permit or an equivalent authorization from the receiving state's relevant authority. However, many are located outside the Commonwealth and are not permitted by MA. These out-of-state sources must obtain approval from DMF in order to be listed as an approved source to sell seed into MA, but are not bound in any meaningful way to DMF's regulatory requirements.

In general, we have adopted the approach that it is the responsibility of the individuals receiving the seed to ensure they have met their state's import requirements. Recently we have come across a number of situations where individuals not authorized to possess and transplant shellfish in Massachusetts are obtaining shellfish seed from an out of state hatchery and operating unpermitted aquaculture operations, often in contaminated growing areas resulting in public health concern. Consequently the shellfish from the unpermitted operations were seized and destroyed, but they likely only represent a small number of such operations.

We considered mandating out-of-state hatcheries that sell into Massachusetts to obtain a Massachusetts permit, but the current permitting framework in MA would require these hatcheries to meet a number of environmental permitting requirements not germane to the topic at hand. Additionally such requirements would be difficult to enforce as the operations are not located under our jurisdiction.

In the event that an out-of-state hatchery (approved to sell seed into MA) provided seed to non-permitted individuals in MA, the only recourse currently available to DMF is to remove the hatchery from the approved source list. DMF's removal of the hatchery as an approved source would likely have a greater negative impact on our permitted (and compliant) in-state growers than the out-of-state hatchery that violated the conditions of approval and the unpermitted individuals who received the shellfish. This approach would also not deal with the numerous other out-of-state hatcheries that are not approved as seed sources for MA but could be (inappropriately) shipping seed into Massachusetts.

While we are working to better inform individuals receiving seed in Massachusetts of the permitting requirements to obtain and transplant seed into the Commonwealth, a multifaceted and multi-state cooperative approach that includes accountability on the part of all hatchery operators is likely needed to address this issue.

As this is an inter-state issue, we would like to explore the idea of developing a cooperative arrangement (fostered by ASMFC) between shellfish seed producing states to: (1) enable enhanced control over the inter-state sale of seed as a means to prevent the spread of shellfish disease and parasites; and (2) level the playing field for growers and seed sources operating in good faith with the existing requirements.

As part of this effort we would like your help to consult the ASMFC member states to determine:

1) If they currently require their in-state hatcheries to document all seed sales and the permit information of the recipient. If not, would the state be willing to do so through future rulemaking?
2) What states currently require hatcheries to deny an order if the recipients are not properly permitted. If not, would states be willing to do so through future rulemaking?
3) Do states require their hatcheries to furnish the list of seed recipients (by state if requested). If not, would the state be willing to do so through future rulemaking?
4) If the relevant state agencies would share information on out-of-state seed sales with the receiving states.

5) The willingness of states to enforce rules relevant to out-of-state permit verification prior to sale. If not, would the state be willing to do so through future rulemaking?

Should there be significant interest in developing a cooperative agreement, we hope ASMFC would provide the mechanism to support such an agreement. Thank you for your consideration of this matter.

Relevant links:

Partial list of East Coast hatcheries:
http://www.ecsga.org/Pages/Resources/EastCoastHatcheryNurseryList.pdf

Eastern United States Interstate Shellfish Seed Transport Workshop Proceedings
http://www.scseagrant.org/pdf_files/shellfish_abstracts.pdf

ASMFC Guidance document (2002) concerning responsible Aquaculture practices:
http://www.asmfc.org/uploads/file/sr76GuidanceRelativeToDevelopmentResponsibleAquaActNov02.pdf

California Current Integrated Ecosystem Assessment (CCIEA) California Current Ecosystem Status Report, 2017

A report of the NOAA CCIEA Team to the Pacific Fishery Management Council, March 8, 2017.
Editors: Dr. Chris Harvey (NWFSC) and Dr. Toby Garfield (SWFSC)

1. Introduction

Section 1.4 of the 2013 Fishery Ecosystem Plan (FEP) outlines a reporting process wherein NOAA provides the Council with a yearly update on the state of the California Current Ecosystem (CCE), as derived from environmental, biological and socio-economic indicators. NOAA's California Current Integrated Ecosystem Assessment (CCIEA) team is responsible for this report. This marks our 5th report, with prior reports in 2012 and 2014-2016.

The highlights of this report are summarized in Box 1.1. Sections below provide greater detail. In addition, Supplemental Materials are provided at the end of this document, in response to previous requests from Council members or the Scientific and Statistical Committee (SSC) to provide additional information, or to clarify details found within this short report.

Box 1.1: Highlights of this report

- Following the unprecedented warm anomaly of 2013-2016 and the major El Niño event of 2015-2016, most large-scale climate indices for the Northeast Pacific (ONI, PDO and NPGO) have returned to relatively neutral values.
- Coastal upwelling was relatively weak in the northern California Current throughout 2016; upwelling along the central coast was initially weak but strengthened by summer, while upwelling on southern coast was average to above-average.
- Snowpack rebounded from the extremely low 2015, although much of the 2016 snow melted rapidly, leading to low streamflows; so far, 2017 precipitation is well above average.
- Copepod biomass off Newport, OR remains dominated by relatively energy-poor species as of fall 2016.
- The spring/summer pelagic forage community was once again highly diverse in 2016. Surveys experienced poor catches of sardine, market squid and krill. However, surveys had high but patchy catches of juvenile rockfish, juvenile hake and anchovy.
- Chinook salmon escapements through 2014-2015 varied by region and life history type. We remain concerned about environmental conditions for Chinook and coho salmon that went to sea over the past several years.
- California sea lions at the San Miguel Island colony experienced very poor foraging conditions to support pups in the 2015 cohort, though preliminary evidence suggests better conditions for the 2016 pups.
- Commercial fishing landings and revenues declined markedly in 2015, driven mainly by drops in harvest of Pacific hake, coastal pelagic species, and crabs.

1.1 Notes on Interpreting Time Series Figures

Throughout this report, most time series figures follow common formats, illustrated in Figure 1.1; see captions for details. In coming years we will include model fits to time series data, derived from Multivariate Auto-Regressive State Space (MARSS) models as recommended by the SSC Ecosystem Subcommittee (SSCES; see advisory body reports, Agenda Item E.1.b., March 2015).

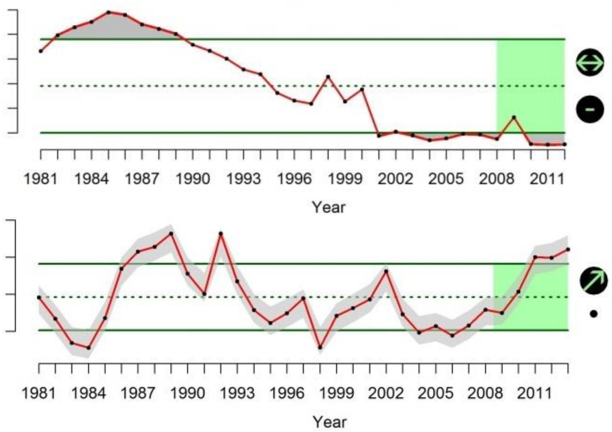

Figure 1.1a: Sample time series plots, with indicator data relative to mean (dashed line) and ± 1 s.d. (solid lines) of the full time series. Arrow at right indicates if the trend over the most recent 5 years (shaded green) is positive (↗), negative (↘) or neutral (↔). Symbol at lower right indicates if the recent mean was greater than (+), less than (–), or within 1 s.d. (•) of the long-term mean. When possible, time series include 95% confidence intervals (gray shading, lower panel).

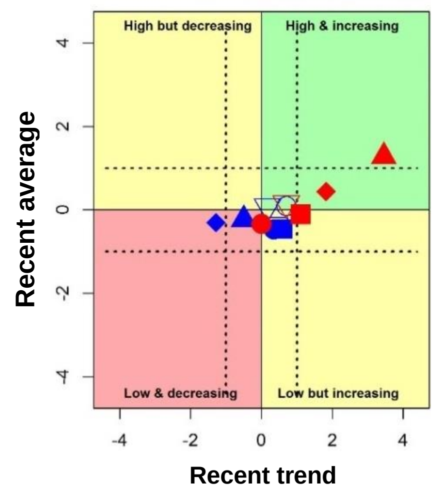

Figure 1.1b: Sample "quad plot." Each point represents one normalized time series. The position of a point indicates if the recent years of the time series are above or below the long-term average, and if they are increasing or decreasing; quadrants are "stoplight" colored to further indicate the indicator condition. Dashed lines represent ±1.0 s.d. of the full time series.

2. Sampling Locations

Figure 2.1a shows the CCE and major headlands that demarcate key biogeographic boundaries, in particular Cape Mendocino and Point Conception. We generally consider the region north of Cape Mendocino to be the "Northern CCE," the region between Cape Mendocino and Point Conception the "Central CCE," and the region south of Point Conception the "Southern CCE."

Figure 2.1a also shows sampling locations for much of the regional climate and oceanographic data (Section 3.2) presented in this report. In particular, much of our physical and chemical oceanographic data are collected on the Newport Line off Oregon and the CalCOFI grid off California. Physical oceanography sampling is further complemented by basin-scale observations and models.

Freshwater habitats worldwide can be spatially grouped into "ecoregions," according to the designations of Abell et al. (2008) (see also www.feow.org). The freshwater ecoregions in the CCE are shown in Figure 2.1b, and are the basis by which we summarize freshwater habitat indicators relating to streamflow and snowpack (Section 3.4).

The map in Figure 2.1c represents sampling for most biological indicators, including copepods (Section 4.1), forage species (Section 4.2), California sea lions (Section 4.5) and seabirds (Section 4.6). Not shown is groundfish bottom trawl sampling (see Section 4.4), which covers most trawlable habitat on the shelf and upper slope (55–1280 m depths) in US waters; the blue and green polygons in Figure 2.1c roughly approximate the areal extent of the bottom trawl survey.

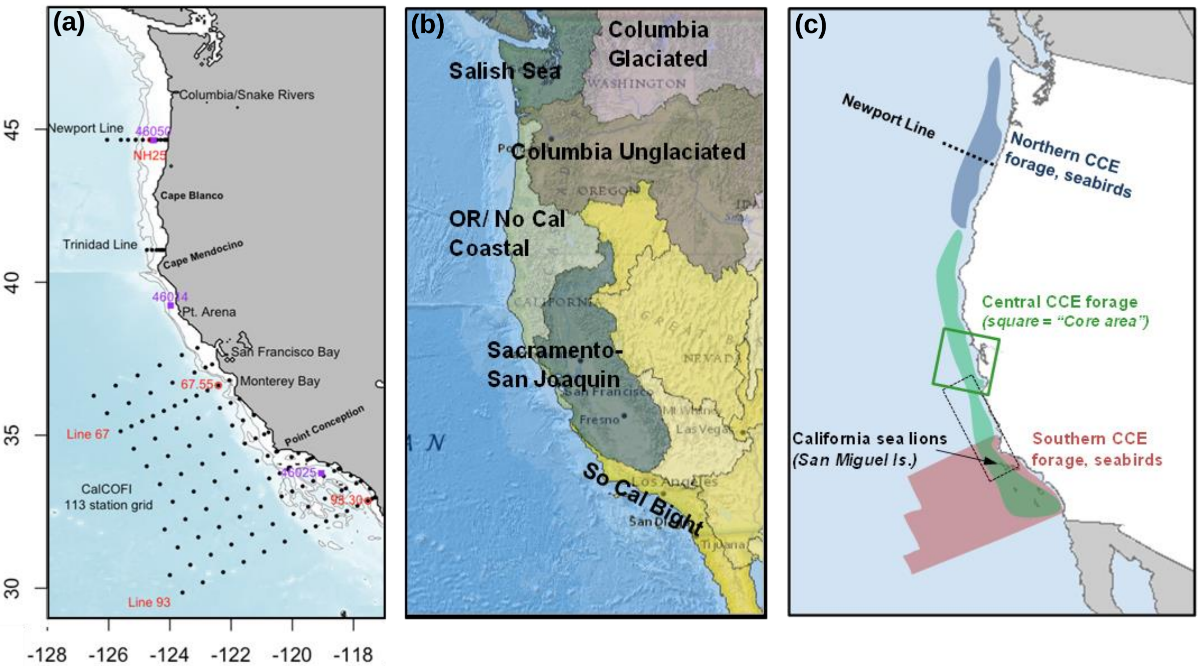

Figure 2.1. Maps of the California Current Ecosystem (CCE) and sampling areas: (a) key geographic features and oceanographic sampling locations; (b) freshwater ecoregions, where snowpack and streamflow indicators are measured, and (c) biological sampling areas for copepods (Newport Line), pelagic forage, seabirds, and California sea lions. Solid box = the "core" sampling area for forage in the Central CCE. Dotted box approximates the foraging area for adult female California sea lions from the San Miguel colony.

3. Climate and Ocean Drivers

The Northeast Pacific has experienced exceptional climate variability since 2013, reaching new extremes for many indicators. After a series of events that caused unprecedented warming in the CCE, conditions have changed since the summer of 2016 into the winter of 2016-2017, producing cooler coastal waters and a succession of winter storms with high precipitation. The strong El Niño event peaked in the tropical Pacific in the winter of 2015-2016, but its influence on the CCE was different than strong El Niño events of 1982-1983 and 1997-1998. Sea surface temperatures were exceptionally high, but the extent of heating into the water column was less than in past El Niño events (Fig. 3.1). Late winter upwelling was not as weak, and upwelling was much stronger leading into the spring.

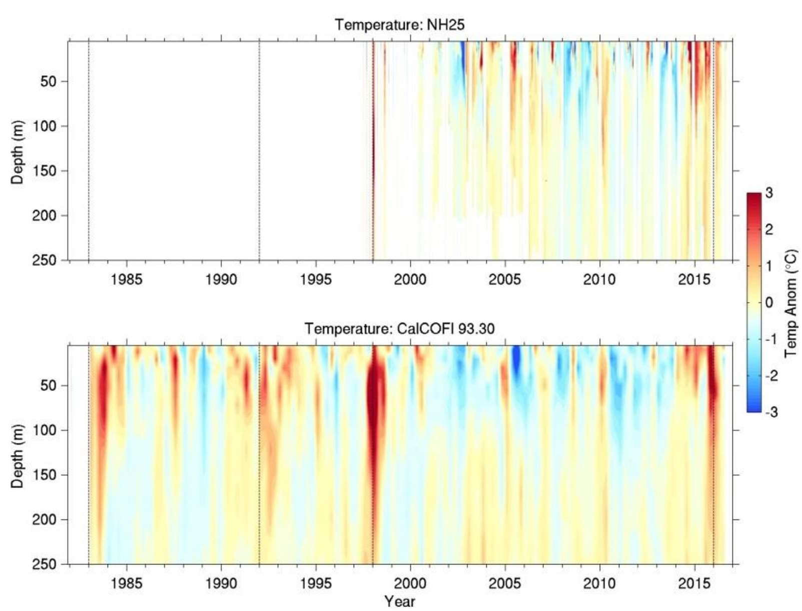

Figure 3.1. Time-depth temperature contours from nearshore stations NH25 and CalCOFI 93.30 (see Fig. 2.1a). Vertical lines mark El Niño events (1983, 1992, 1998, 2016). Anomalies in winter/spring of 2016 are less extreme at depth than prior major El Niño events.

3.1 BASIN-SCALE INDICATORS

The CCE is driven by atmosphere-ocean energy exchange that occurs on many temporal and spatial scales. To capture large-scale variability, the CCIEA team tracks three indices: the status of the equatorial El Niño Southern Oscillation (ENSO), described by the Oceanic Niño Index (ONI)[1]; the Pacific Decadal Oscillation (PDO); and the North Pacific Gyre Oscillation (NPGO). ENSO events impact the CCE by modifying the jet stream and storm tracks, deepening the nearshore thermocline, and generating coastal currents that enhance poleward transport of equatorial and subequatorial waters (and species). A positive ONI indicates El Niño conditions, which usually means more storms to the south, weaker upwelling, and lower primary productivity in the CCE. A negative ONI means La Niña conditions, which usually lead to higher productivity. The PDO is derived from sea surface temperature anomalies (SSTa) in the Northeast Pacific, which often persist in "regimes" that last for many years. In positive PDO regimes, coastal SSTa in the Gulf of Alaska and the CCE tend to be warmer, while those in the North Pacific Subtropical Gyre tend to be cooler. Positive PDOs are associated with lower productivity in the CCE. The NPGO is a low-frequency variation of sea surface height, indicating variations in the circulation of the North Pacific Subtropical Gyre and Alaskan Gyre, which in turn relate to the source waters for the CCE. Positive NPGO values are associated with increased equatorward flow, along with increased surface salinities, nutrients, and chlorophyll-*a*. Negative NPGO values are associated with decreases in such values, implying less subarctic source waters and generally lower productivity.

In summary the general trends are that positive MEI and PDO values and negative NPGO values usually denote conditions that lead to low CCE productivity and negative MEI and PDO values and positive NPGO values are associated with periods of high CCE productivity. These indices vary independently and so there is a wide range of observed variability in the CCE.

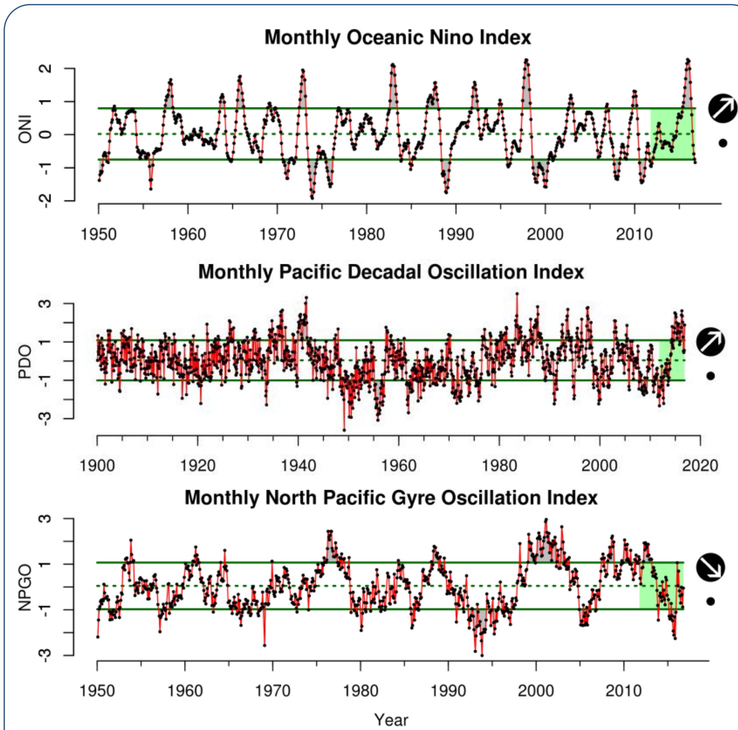

Figure 3.1.1. Monthly values of the Oceanic Niño Index (ONI; 1950-2016), Pacific Decadal Oscillation (PDO; 1900-2016), and the North Pacific Gyre Oscillation (NPGO; 1950-2016). Lines, colors, and symbols are as in Figure 1.1a.

3.1.1 BASIN-SCALE PROCESSES, 2014-2016

This past year saw the ONI shift from El Niño to neutral and even La Niña conditions, the PDO switch from strongly positive to neutral, and the NPGO move from strongly negative to neutral (Fig. 3.1.1). Each of these indices would suggest a return to conditions of higher productivity. However, the Northeast Pacific and the CCE still show the after effects of the very anomalous conditions experienced during 2013-2016. The large marine heat wave, a.k.a. "the Blob" (Bond et al. 2015) dissipated in fall of 2016 in the Northeast Pacific, but anomalously

[1]In previous reports, the reported El Niño Index was the Multivariate El Niño Oscillation Index (MEI). The numerical and trend values for ONI and MEI are very similar, and ONI is the index supported by the NOAA Climate Prediction Center. The CCIEA report adopts the ONI as the recommended index.

warm surface waters were present in the Gulf of Alaska and immediately along the North American west coast during the winter (Fig. 3.1.2). Summer SSTa showed no lasting influence of the El Niño event, with anomalies average to slightly below average along the coast from Vancouver to San Diego. Subsurface waters, measured by ARGO floats, in the Northeast Pacific are still warm, with anomalies >1° C down to 160 m and >0.5° C down to below 200 m (Appendix E, Fig. E.6). This deep warming is interpreted as a remnant effect of the marine heat wave.

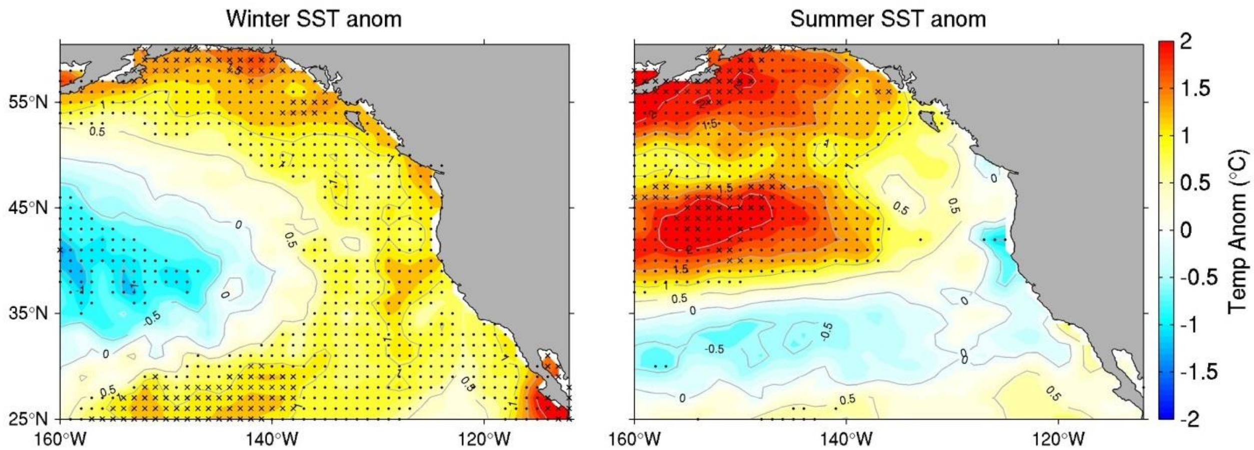

Figure 3.1.2. Sea surface temperature (SST) anomalies in winter (Jan-Mar; left) and summer (Jul-Sep; right), 2016. The time series at each grid point began in 1982. Positive anomalies of the marine heat wave and El Niño are seen in the Gulf of Alaska in winter and summer, and off Baja California in winter. Black circles mark cells where the anomaly was >1 s.d. above the long-term mean. Black x's mark cells where the anomaly was the highest of the time series.

Another marine heat wave formed off Baja California in 2014 and strengthened in 2015, keeping nearshore SSTs >0.5° C above normal. This event was likely caused by weaker atmospheric forcing in the Southern California Bight and along the Mexican coast (Leising et al. 2015, McClatchie et al. 2016). By summer 2016, SSTs of this region dropped to near average values (Fig. 3.1.2).

In summary, while the 2015-2016 El Niño was one of the largest recorded in terms of equatorial warming and the ONI, the large-scale environmental response of the CCE was dominated in the north by the lingering impacts of the marine heat wave, with only moderate influence from the El Niño, whereas in the south, the CCE was more strongly influenced by the El Niño. Thorough summaries of these dynamics are in Leising et al. (2015) and McClatchie et al. (2106). These large-scale forces will help explain the dynamics of biological indicators in Section 4 below.

3.2 Regional Climate Indicators

Seasonal high pressure over the Gulf of Alaska and low pressure over the US Southwest drive the upwelling-favorable winds that fuel the high spring-summer productivity of the CCE. Upwelling is a physical process of moving cold, nutrient-rich water from deep in the ocean up to the surface and is forced by strong northerly alongshore winds. Upwelling is critically important to productivity and ecosystem health in the CCE, as it is local coastal upwelling that allows the primary production at the base of the food web. The most common metric of upwelling is the Bakun Upwelling Index (UI), which is a measure of the magnitude of upwelling anywhere along the coast. The timing, strength, and duration of upwelling in the CCE are highly variable by region and by year. The cumulative upwelling index (CUI) is one way to display this variability. The CUI provides an estimate of the net influence of upwelling on ecosystem structure and productivity over the course of the year. The CUI integrates the onset date of upwelling favorable winds ("spring transition"), a general indication of the strength of upwelling, relaxation events and the end of the upwelling season.

3.2.1 REGIONAL-SCALE PROCESSES, 2012-2016

Upwelling strength displayed significant regional variability during 2016, with the least favorable conditions in the northern CCE (Appendix E, Fig. E.7). At 45° N, strong downwelling from January through March was followed by average upwelling from April to July; CUI at this latitude was much lower than the strong upwelling of 2015 (Fig. 3.2.1), and similar to the reduced upwelling of the 1998 El Niño event (McClatchie et al. 2016). At 39° N, the spring transition to upwelling began weakly in mid-March and strengthened in May, leading to above-average upwelling by July and comparable CUI to 2015 by August. In the Southern California Bight (~33° N), the CUI was close to the long term mean during the beginning of the season, and above average after June. This is in stark contrast to the reduced upwelling seen throughout the year in 1998 following that comparably large El Niño.

Although CUI was stronger in the south than the north in 2016, productivity did not increase concomitantly as one might expect. This is likely because of increased stratification and a deeper thermocline in this region, due to the lingering effects of the marine heat wave, plus the influence of the 2015-2016 El Niño event (McClatchie et al. 2016).

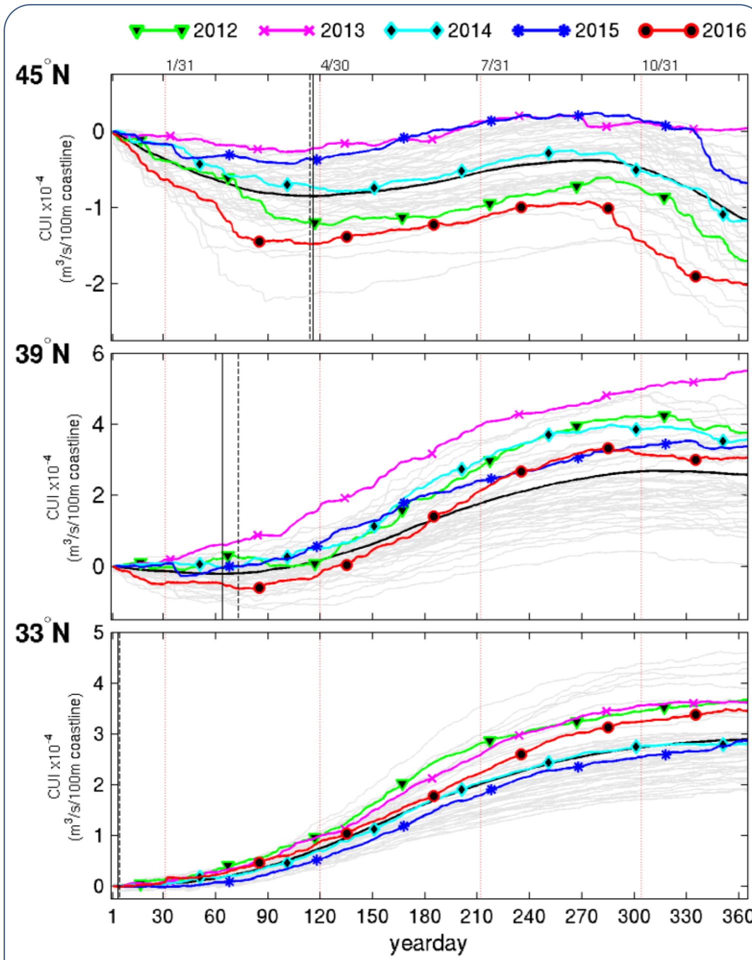

Figure 3.2.1. Cumulative Upwelling Index (CUI) at three latitudes, 1967-2016. Black trend = long-term mean; gray trends = 1967-2011; colored trends = 2012-2016. Black vertical lines mark the 2016 spring transition date (dashed) and long-term mean spring transition date (solid). Dotted red vertical lines mark the end of January, April, July and October.

3.3 HYPOXIA AND OCEAN ACIDIFICATION

Nearshore dissolved oxygen (DO) levels and ocean acidification (OA) are related to the strength of coastal upwelling. DO is required for organismal respiration, and DO levels are dependent on a number of physical and biological processes, including circulation, air-sea exchange, and community-level production and respiration. Waters with DO levels below 1.4 ml L^{-1} (2 mg L^{-1}) are considered to be hypoxic. Low DO can compress habitat and cause stress or even die-offs for sensitive species. OA is caused by increased levels of anthropogenic CO_2 in seawater, which impacts the chemical environment of marine organisms by reducing both pH and carbonate ion concentrations. A key indicator of OA effects is aragonite saturation state, a measure of how corrosive seawater is to organisms with shells made of aragonite (a form of calcium carbonate). Values <1.0 indicate corrosive conditions that have been shown to be stressful for many CCE species, including oysters, crabs, and pteropods. Upwelling, which drives primary production in the CCE, also transports hypoxic, acidified waters onto continental shelves, where increased community-level respiration can further reduce water column DO and exacerbate OA (Chan et al. 2008, Feely et al. 2008).

At the three stations shown here, DO was seasonally variable, with peaks in the winter, but all measurements were consistently above the hypoxia threshold of 1.4 ml/L in 2016 (Fig. 3.3.1). The 5-year annual trend at each site has been stable, but there is evidence of seasonal increases in DO; seasonal time series are presented in Appendix E.3 of the Supplement. Briefly: station NH25 off Oregon has experienced increasing winter DO over the past 5 years. At the nearshore station 93.90 off Southern California, DO has declined since 1984, driven mainly by winter values, and was ~1 s.d. below the mean in winter 2016. However, the recent trend is stable and possibly increasing based on seasonal averages. At the offshore station 90.90, summer DO has increased in recent years. Nearshore DO values are almost always lower than those offshore (93.30 vs. 90.90; see Fig. 3.3.1 and Appendix E.3).

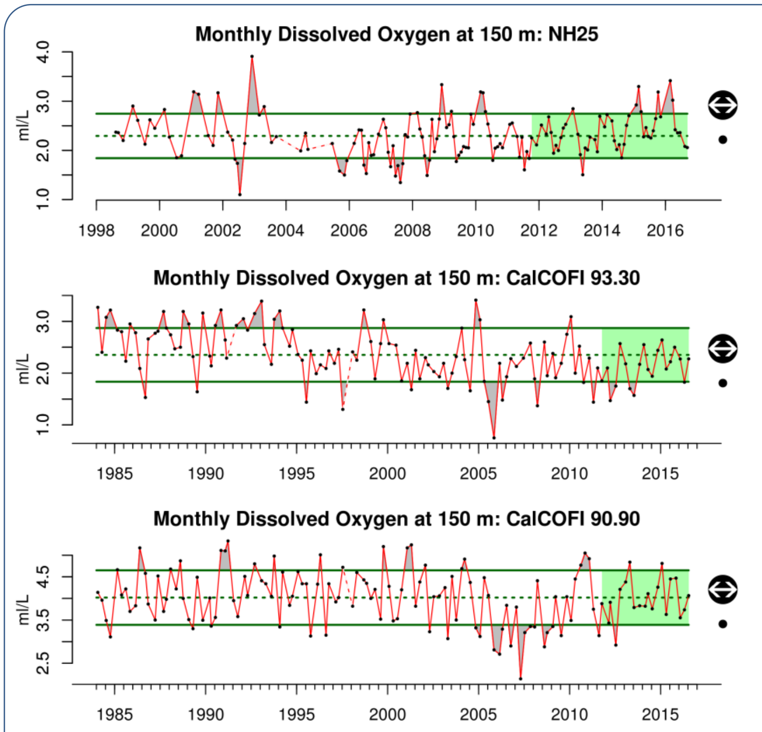

Figure 3.3.1: Dissolved oxygen at 150-m depths off Oregon and Southern California through 2016. Stations NH25 and 93.30 are <50 km from shore; station 90.90 is >300 km from shore. Lines, colors and symbols are as in Figure 1.1a; dashed red lines indicate data gaps >6 months.

In nearshore waters off Oregon (station NH5), aragonite levels at 40 m depth are typically saturated (>1.0) during the winter and spring, and then fall below 1.0 in the summer and fall; this was the case again in 2016 (Fig. 3.3.2). Further offshore (station NH25) and at 150 m depths, aragonite saturation state follows the same seasonal cycle but across a narrower range, and aragonite levels at this area and depth are almost always <1.0. However, aragonite levels have been elevated slightly in the anomalous conditions of the past two years. In fact, according to seasonal data, winter aragonite levels have increased over the past 5 years at both stations (Appendix E.3).

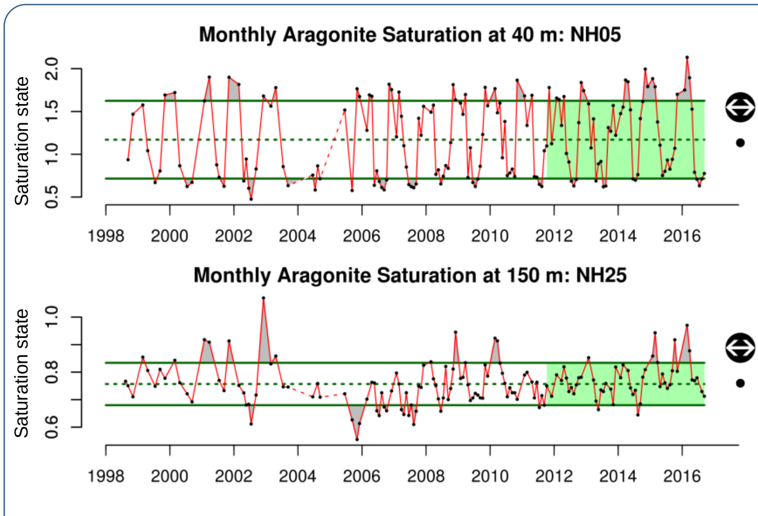

Figure 3.3.2: Monthly aragonite saturation values off of Newport, Oregon, 1998-2016. Lines, colors and symbols are as in Figure 1.1a; dashed red lines indicate data gaps >6 months.

3.4 HYDROLOGIC INDICATORS

Freshwater conditions are critical for salmon populations and for estuarine habitats that support many marine species (e.g., Appendix D). The freshwater indicators presented here focus on snowpack and streamflow, and are summarized by freshwater ecoregion (Fig. 2.1b). Snow-water equivalent (SWE) is the total water content in snowpack, which provides a steady source of freshwater into the summer months. Maximum streamflows in winter and spring are important for habitat formation, but can cause scouring of salmon nests. Minimum streamflows in summer and fall can restrict habitat for in-stream juveniles and migrating adults. All three indicators are influenced by climate and weather patterns and will be affected as climate change intensifies.

After years of steady declines and a historic low in 2015, SWE returned to average levels in all ecoregions in 2016 (Fig. 3.4.1). However, despite the rebound of SWE in early 2016, high spring and summer air temperatures resulted in rapid snowmelt. These factors led to an increase in maximum flows in 2016 (Appendix F), although not to levels considered dangerous to most salmon stocks. The early and rapid melt helped contribute to worsening trends in minimum flow in most of the ecoregions (see streamflow time series, Appendix F).

Following a series of winter storms, SWE in 2017 is on pace to exceed 2016 (see map in Appendix F, Fig. F.1) and may provide drought relief, although the official measure of SWE will not be until April 1, 2017.

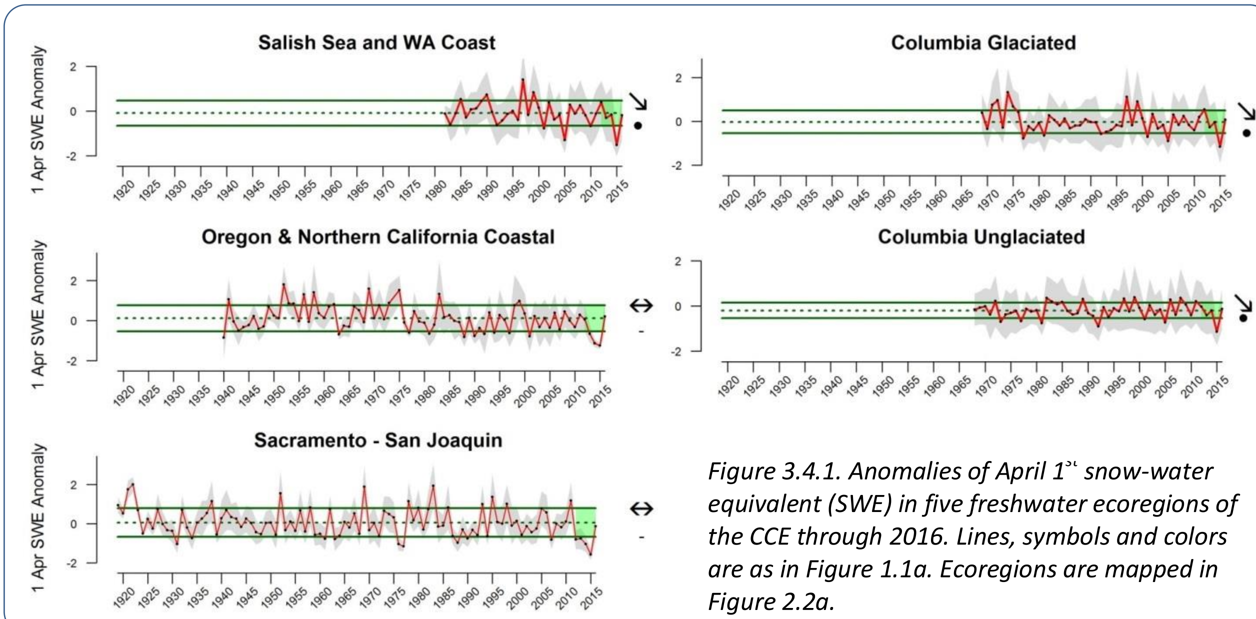

Figure 3.4.1. Anomalies of April 1st snow-water equivalent (SWE) in five freshwater ecoregions of the CCE through 2016. Lines, symbols and colors are as in Figure 1.1a. Ecoregions are mapped in Figure 2.2a.

We can also summarize streamflow using quad plots that summarize recent status and trends in flow anomalies at the finer spatial scale of individual Chinook salmon ESUs (Fig. 3.4.2). Here, high and increasing maximum flow is regarded as undesirable (i.e., the red quadrant of the max flow plot) due to the potential for scouring redds; low and decreasing minimum flow is also undesirable (the red quadrant of the min flow plot) because of potential for stress related to temperature, oxygen or space. The maximum flow events are within ±1 s.d. of long-term averages and generally lack signficant trends, although 4 ESUs indicate a recent increase (Fig 3.4.2, left). On the other hand, miminum flow anomalies have worsening trends for many ESUs, particularly those sensitive to low flow conditions, such as the Sacramento winter run and Klamath/Trinity ESUs. (Fig. 3.4.2, right).

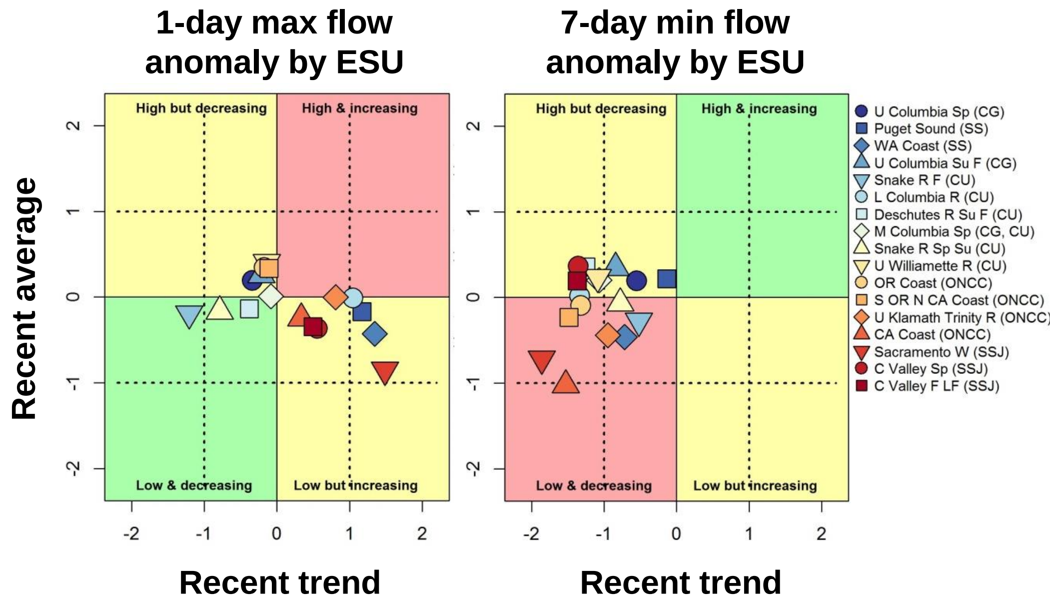

Figure 3.4.2. Quad plots of status and trends of maximum and minimum flow in 17 Chinook salmon evolutionary significant units (ESUs) in the CCE through 2016. The 5-year status and trends of flow for each ESU are divided into green ("good" conditions), yellow ("neutral"), and red ("poor"). Symbols of ESUs are color-coded from north (blue) to south (red). Quad plot lines and base colors are as in Figure 1.1b.

4 FOCAL COMPONENTS OF ECOLOGICAL INTEGRITY

The CCIEA team examines many indicators related to the abundance and condition of key species and the dynamics of community structure and ecological interactions. Many CCE species and processes respond very quickly to changes in ocean and climate drivers, while other responses may lag by many years. These dynamics are challenging to predict. Over the last several years, many ecological integrity metrics have indicated conditions of poor productivity at low trophic levels and poor foraging conditions for many predators. In 2016 we also continued to observe unexpected community structure in pelagic waters throughout the CCE. It remains to be seen how different populations have been affected, or whether 2017 will represent a shift away from the unproductive conditions observed since 2014.

4.1 NORTHERN COPEPOD BIOMASS ANOMALY

Copepod biomass anomalies represent interannual variation in biomass of two groups of copepod taxa: northern copepods, which are "cold-water" species rich in wax esters and fatty acids that appear to be essential for pelagic fishes; and southern copepods, which are "warm-water" species that are generally smaller and have lower lipid content and nutritional quality. In summer, northern copepods usually dominate the coastal zooplankton community represented by collections along the Newport Line (see Fig. 2.1a,c), while Southern copepods dominate the community during winter. This pattern is often altered during El Niño events and/or when the PDO is positive, leading to higher biomass of southern copepods (Keister et al. 2011, Fisher et al. 2015). Threshold values for the anomalies have not been set, but positive values of northern copepods in summer are correlated with stronger returns of Chinook salmon to Bonneville Dam, and values greater than 0.2 are associated with better survival of coho salmon (Peterson et al. 2014).

With the exception of a brief period during summer 2015, the northern copepod anomaly has remained >1 s.d. below the long-term mean since the autumn of 2014 (Fig. 4.1.1, top). During this same period, the southern copepod biomass anomaly increased significantly and was strongly positive in much of 2016 (Fig. 4.1.1, bottom). These anomaly patterns are consistent with warm surface waters and poor feeding conditions for pelagic fishes, and reflect a sustained departure from the generally productive ocean conditions for much of 2011-2014. Moreover, 17 species of copepods have been collected since autumn 2014 that had not been observed in these waters previously. It appears that many of these exotic copepod species were offshore, central Pacific species, not the typical southern species that are often transported northward to the Newport Line during major El Niño events.

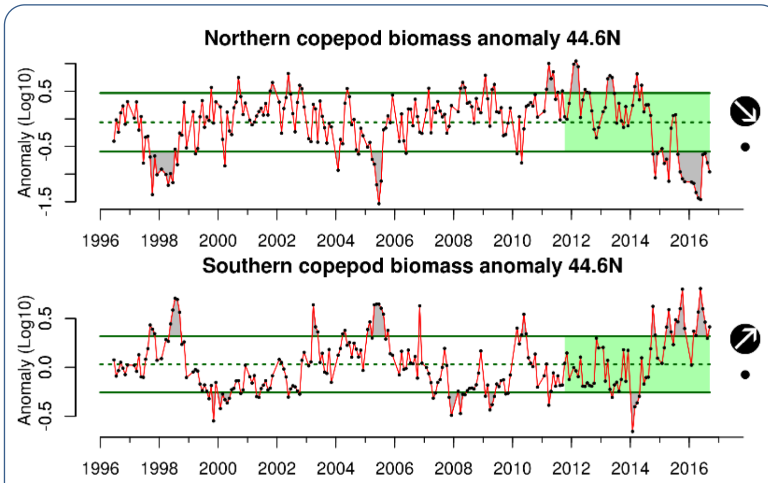

Figure 4.1.1. Monthly northern and southern copepod biomass anomalies from 1996-2016 in waters off Newport, OR. Lines, colors and symbols are as in Figure 1.1a.

4.2 Regional Forage Availability

This section describes trends in forage availability, based on research cruises throughout the CCE through spring/summer 2016. These species represent a substantial portion of the available forage in the regions sampled by the cruises (see Fig. 2.1c). *We consider these regional indices of relative forage availability and variability, <u>not</u> indices of absolute abundance of coastal pelagic species (CPS).* Absolute abundance estimates should come from stock assessments and comprehensive monitoring programs, which these surveys are not. Moreover, the regional surveys that produce these data use different methods (e.g., gear selectivity, timing, frequency, and survey objectives); thus the amplitudes of each time series are not necessarily comparable between regions.

The CCE forage community is a diverse portfolio of species and life history stages, varying in behavior, energy density, and availability to predators. Years with abundant pelagic fish, market squid and krill are generally associated with cooler waters, strong upwelling and higher productivity (Santora et al. 2014, McClatchie et al. 2016). For space considerations, we present the forage indicators as quad plots in the main report; time series plots for each species and region are available in Appendix G.

Northern CCE: The northern CCE survey targets juvenile salmon in June in surface waters, but also catches juvenile and adult pelagic fishes, market squid, and gelatinous zooplankton. Except for jack mackerel, recent average catch-per-unit-effort (CPUE) of most forage species, were within 1 s.d. of the long-term mean and showed no discernable short-term trends (Fig. 4.2.1). Sardine and anchovy CPUE remained near the lowest levels observed in the time series (Appendix G, Fig. G.1). The two main species of gelatinous

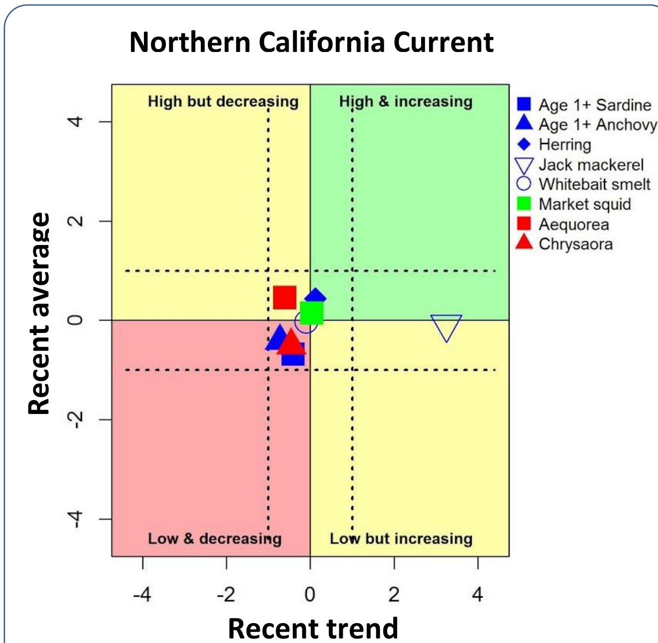

Figure 4.2.1: Means and trends of CPUE for key forage in the Northern CCE. Means and trends are from 2012-2016 and normalized relative to the full time series (1999-2016). Lines, colors and symbols are as in Figure 1.1b.

zooplankton were within the long-term mean range, although the small water jelly *Aequorea* sp. declined from 2015 and the large sea nettle *Chrysaora* was relatively uncommon. Anecdotally, a related survey in this region, which uses different methods and only began in 2011, caught many adult anchovy near the Columbia Plume, and saw evidence of anchovy spawning off Oregon in 2015 and 2016. This survey also showed a steep drop in krill in 2015 and 2016, concurrent with an increase in gelatinous salps. The survey also found young-of-the-year (YOY) rockfish and hake more abundant in 2016 than previous years.

Central CCE: Data presented here are from the "Core area" of a survey (see Fig. 2.1c) that targets YOY rockfishes, but also samples other forage fishes, market squid and zooplankton. The Central CCE forage community in 2016 exhibited many of the anomalous catch levels and trends observed in recent years. Adult sardine and anchovy CPUEs remained relatively low, whereas YOY rockfish CPUE was above average for the fourth year in a row (Fig. 4.2.2; see also Appendix G, Fig. G.2). YOY hake CPUE also maintained its recent increase, and YOY sanddabs remained above the long term mean. Krill and market squid CPUE have declined in recent years, particularly squid since 2014. *Chrysaora* jellyfish also declined, though that may be due to avoidance of sites where *Chrysaora* has fouled sampling gear in the past. However, salps were relatively abundant, as were warm-water species such as pelagic crabs (data not shown).

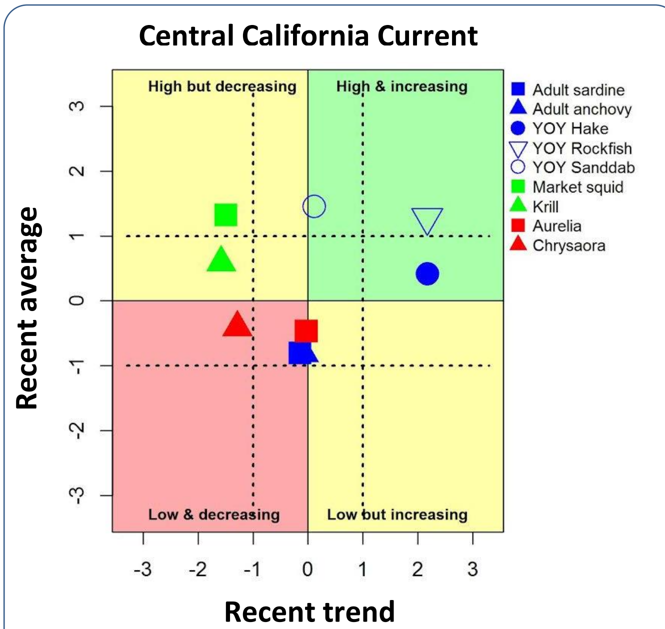

Figure 4.2.2 Means and trends of CPUE for key forage in the Central CCE (Core area). Means and trends are from 2012-2016 and normalized relative to the full time series (1990-2016).Lines, colors and symbols are as in Figure 1.1b.

Southern CCE: The forage abundance indicators for the Southern CCE come from larval fish surveys conducted by CalCOFI. The larval biomass is assumed to correlate with the spawning stock biomass of forage species such as sardine, anchovy, market squid, shortbelly rockfish, and some mesopelagic species. Recent CPUE for the four species that have been analyzed through 2016 were within ±1 s.d. of their long-term means, but anchovy showed a significant increasing trend while market squid show a recent decline (Fig. 4.2.3). The increase in larval anchovy CPUE in recent years (Appendix G, Fig. G.3) is consistent with anecdotal nearshore observations of large schools of adult anchovy.

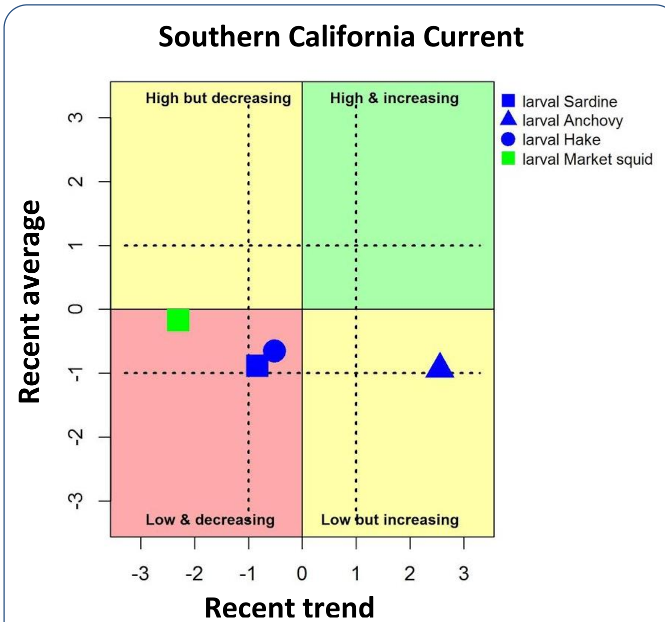

Figure 4.2.3 Means and trends of CPUE for key forage in the Southern CCE. Means and trends are from 2012-2016 and normalized relative to the full time series (1978-2016). Lines, colors and symbols are as in Figure 1.1b.

4.3 SALMON

For indicators of the abundance of Chinook salmon populations, we compare the trends in natural spawning escapement along the CCE to evaluate the coherence in production dynamics, and also to get a more complete perspective of their status across the greater portion of their range. When available, we use escapement time series back to the 1970s; however, some populations have shorter time series (for example, Central Valley Spring starts 1995, Central Valley Winter starts 2001, and Coastal California starts 1991). Here we present summary quad plots of escapements; full time series are available in Appendix H.

California Chinook salmon data are updated as of 2015. Generally, California Chinook salmon escapements were within 1 s.d. of their long-term averages (Fig. 4.3.1), although 2015 escapements were generally near the low end of the normal range (Appendix H, Fig. H.1). Most California stocks have neutral trends over the last decade, which is a noteworthy change from our last report: trends that had been positive for Central Valley Fall, Klamath Fall, California Coast and Northern CA/ Southern OR are now neutral after poor escapements in 2013, 2014 and/or 2015 (Appendix H, Fig. H.1). Central Valley Winter Run Chinook salmon have had relatively low escapements since 2007 following high escapements in 2005-2006, leading to the recent negative trend.

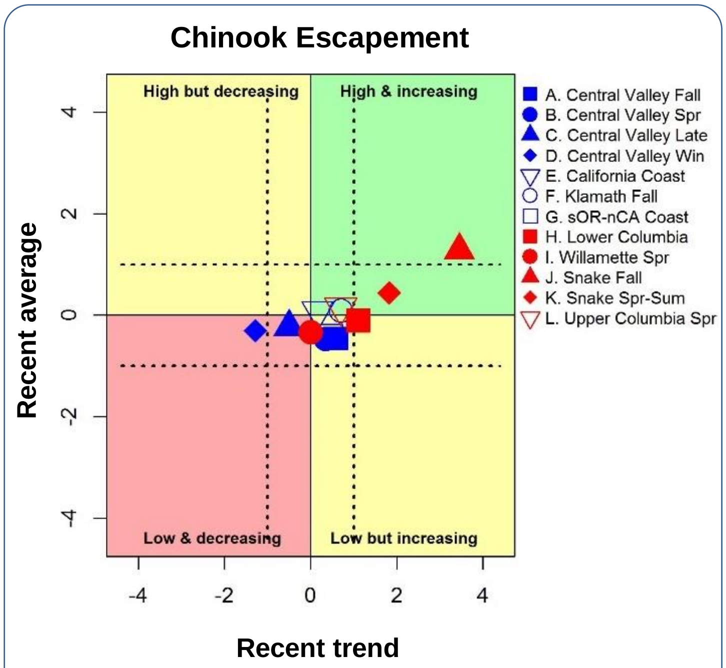

Figure 4.3.1. Chinook salmon escapement anomalies through 2015. "Recent average" is mean natural escapement (includes hatchery strays) from 2006-2015, relative to the mean of the full time series. "Recent trend" indicates the escapement trend from 2006-2015. Base colors and lines are as in Fig. 1.1b.

For Oregon, Washington and Idaho Chinook salmon stocks (updated through 2014), most recent escapements were close to average (Fig. 4.3.1). The exception is Snake River Fall Chinook after a series of large escapements since 2009 (Appendix H, Fig. H.2). Ten-year trends for northern stocks were either neutral or positive, with three (Lower Columbia, Snake River Fall and Snake River Spring) having significantly positive trends from 2005-2014.

Predicting exactly how the climate anomalies of 2013-2016 will affect different brood years of salmon from different parts of the CCE is difficult, despite concerted efforts by many researchers (e.g., Burke et al. 2013, Wells et al. 2016). However, many signs do suggest below-average returns may occur for Fall Chinook, Spring Chinook and coho stocks returning to the Columbia Basin. The poor hydrological conditions of 2015 (Section 3.4) were problematic for both juvenile and adult salmon. As noted above in Section 4.1, the Northern Copepod Biomass Anomaly is positively associated with Chinook and coho salmon returns in the Columbia River basin (Peterson et al. 2014), and its low levels in recent years do not portend well. The Northern Copepod Biomass Anomaly is just one part of a long-term effort by NOAA scientists to correlate oceanographic conditions and pelagic food web structure with salmon productivity (e.g., Burke et al. 2013). Their assessment is that physical and biological conditions for smolts that went to sea between 2013 and 2016 are generally consistent with poor returns of Chinook and coho salmon to much of the Columbia Basin in 2017, as depicted in the "stoplight chart" in Table 4.3.1.

Table 4.3.1. "Stoplight" table of basin-scale and local-regional conditions for smolt years 2013-2016 and likely adult returns in 2017 for coho and Chinook salmon that inhabit coastal Oregon and Washington waters in their marine phase. Green = "good," yellow = "intermediate," and red = "poor." Courtesy of Dr. Bill Peterson (NWFSC).

	Smolt year				Adult return outlook	
Scale of indicators	**2013**	**2014**	**2015**	**2016**	**Coho, 2017**	**Chinook, 2017**
Basin-scale						
PDO (May-Sept)	Yellow	Yellow	Red	Red	Red	Red
ONI (Jan-Jun)	Yellow	Yellow	Red	Red	Red	Red
Local and regional						
SST anomalies	Yellow	Yellow	Red	Red	Red	Red
Deep water temp	Red	Red	Red	Yellow	Yellow	Red
Deep water salinity	Red	Red	Yellow	Yellow	Yellow	Yellow
Copepod biodiversity	Green	Yellow	Red	Red	Red	Red
Northern copepod anomaly	Green	Green	Red	Red	Red	Red
Biological spring transition	Green	Red	Red	Red	Red	Red
Winter ichthyoplankton biomass	Yellow	Red	Green	Green	Green	Green
Winter ichthyoplankton community	Yellow	Yellow	Red	Red	Red	Red
Juvenile Chinook catch (Jun)	Green	Yellow	Red	Yellow	Red	Red
Juvenile coho catch (Jun)	Green	Yellow	Yellow	Yellow	Yellow	Yellow

4.4 Groundfish: Stock Abundance and Community Structure

The CCIEA team regularly presents the status of groundfish biomass and fishing pressure based on the most recent stock assessments. Because 2016 was not a groundfish assessment year, we have no update from last year's report. Most of the recently assessed groundfish are near or above the biomass limit reference point, and are thus not in an "overfished" status (Fig. 4.4.1). The only exceptions were yelloweye rockfish and Pacific ocean perch, both last assessed in 2011.

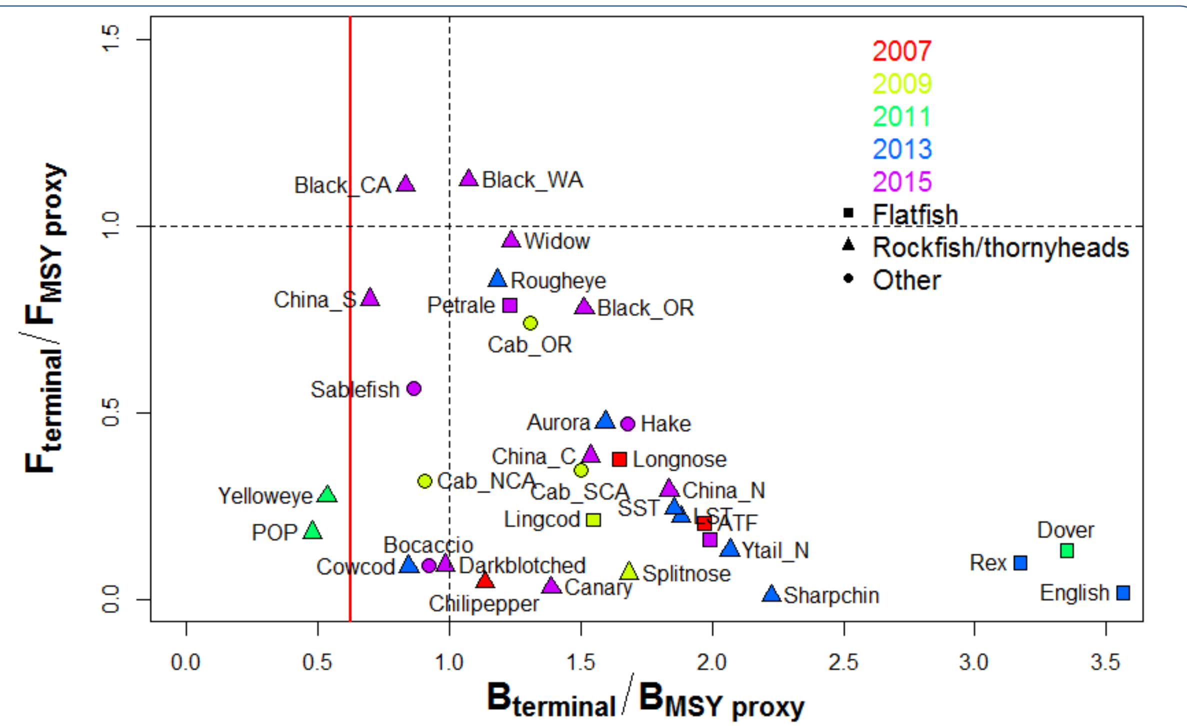

Figure 4.4.1. Stock status of CCE groundfish. Horizontal line = fishing rate reference. Vertical lines = biomass target reference point (dashed line) and limit reference point (solid line; left of this line indicates overfished status). Symbols indicate taxa; colors indicate year of most recent assessment.

"Overfishing" occurs when catches exceed overfishing limits (OFLs), but not all assessed stocks are managed by individual OFLs. Our best alternative is to compare fishing rates to proxy fishing rates at maximum sustainable yield (F_{MSY}), which are used to set OFL values. Only two stocks (black rockfish in California and Washington, both assessed in 2015) were being fished above F_{MSY} in their most recent assessments.

As noted in Section 4.2, YOY rockfish were highly abundant in the Central CCE in 2015 and 2016, and results from both shipboard and scuba surveys also revealed large numbers of pelagic and post-settled juvenile rockfish along the Washington coast in 2016. Given the anomalously warm and unproductive oceanographic conditions of 2013-2016, these findings run counter to what we might have expected from conceptual models linking climate and productivity conditions to groundfish populations (see Appendix D, Fig. D.2). It will be several years before these fish are large enough to be caught in bottom trawls; thus we will have to wait to determine how affect groundfish populations respond long-term to the recent climate anomalies.

We are also tracking the abundance of groundfish relative to Dungeness and Tanner crabs as a metric of seafloor community structure and trophic status. Due to space considerations, and because the time series are as yet short and difficult to interpret, we have moved these indicators from the main body to the Supplementary Materials, Appendix I.

4.5 Marine Mammals

California sea lions are permanent residents of the CCE, breeding on the Channel Islands and feeding throughout the CCE, and so are good indicators for the population status of pinnipeds in the system. California sea lions may also be sensitive indicators of prey availability in the central and southern CCE: sea lion pup count in the San Miguel Island breeding colony relates to prey availability for adult females during gestation (October-June), while pup growth is related to prey availability to adult females during the 11-month lactation period.

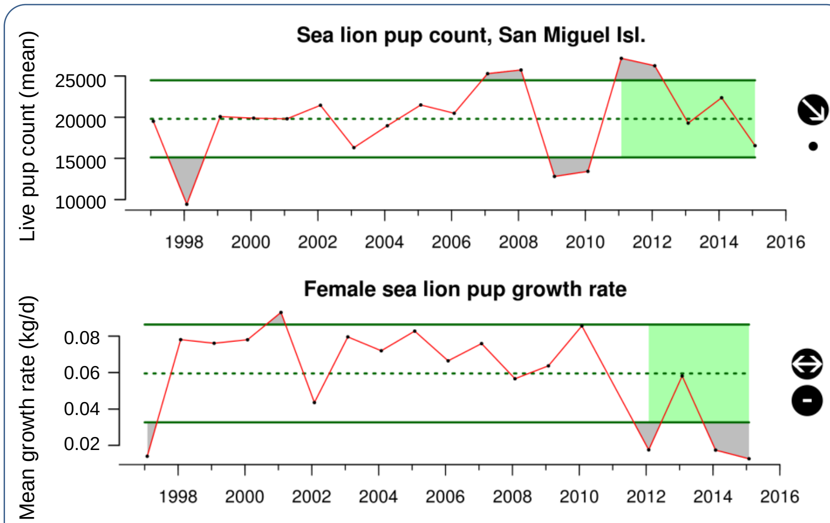

Figure 4.5.1. California sea lion pup counts at San Miguel Island and estimated mean daily growth rate of female pups between 4-7 months, for the 1997-2015 cohorts. Lines, colors and symbols are as in Fig. 1.1a.

Over recent years, California sea lion adult females experienced extremely poor feeding conditions (Fig. 4.5.1). Pup counts declined from 2011-2015, and pup growth was near historic lows in at least three of the last five cohorts. These results, coupled with high rates of springtime pup stranding and mortality in 2013-2016, reflects the extent of poor foraging conditions for pinnipeds in the central and southern CCE and may foretell a decrease in the California sea lion adult population. Other pinniped species that breed in this region but forage further offshore (Guadalupe fur seals and northern fur seals) also experienced poor pup growth in the same time period.

Preliminary results suggest that the 2016 cohort of California sea lion pups at San Miguel was more abundant and experienced better early growth than the preceding four cohorts, implying that foraging conditions may have improved over the past year.

4.6 Seabirds

Seabird species richness data were unavailable for this report, so we instead present regional time series for three key species. Sooty shearwaters migrate from the southern hemisphere to the CCE in spring and summer to prey on small fish and zooplankton near the shelf break. Common murres and Cassin's auklets are resident species that feed over the shelf; Cassin's auklets prey on zooplankton, while common murres target small fish.

In the northern sampling area (Fig. 2.1c), all three species exhibited temporal variability, particularly since the mid-2000s (Fig. 4.6.1). Sooty shearwaters have increased in recent years, while Cassin's auklets declined in 2016, possibly related to an exceptional mortality event in 2014-2015. Common murre counts showed no trend. (Note: no data were collected in 2013 or 2014.)

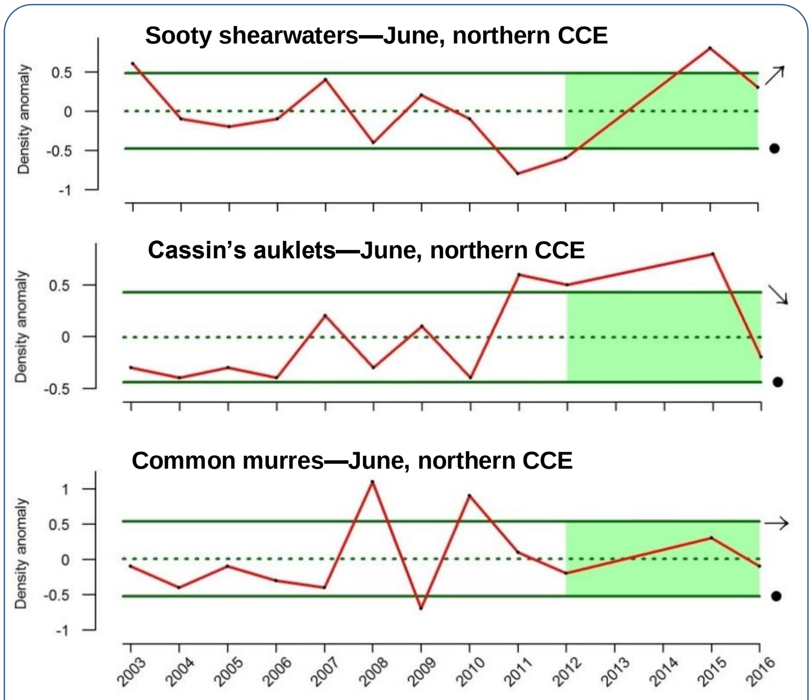

Figure 4.6.1. Anomalies in at-sea densities of sooty shearwaters, Cassin's auklets and common murres in June in the northern CCE through 2016. Lines, colors and symbols are as in Figure 1.1a.

In the longer southern time series, sooty shearwaters had increasing springtime density trends over the past five years (Fig. 4.6.2), which represents a return to densities observed in the late 1980s. Common murre densities had been minimal since data collection began in 1987 until an uptick in 2011, followed by strongly positive anomalies in 2015 and 2016. By contrast, Cassin's auklets in the southern CCE have been just below average density over the last 10 years.

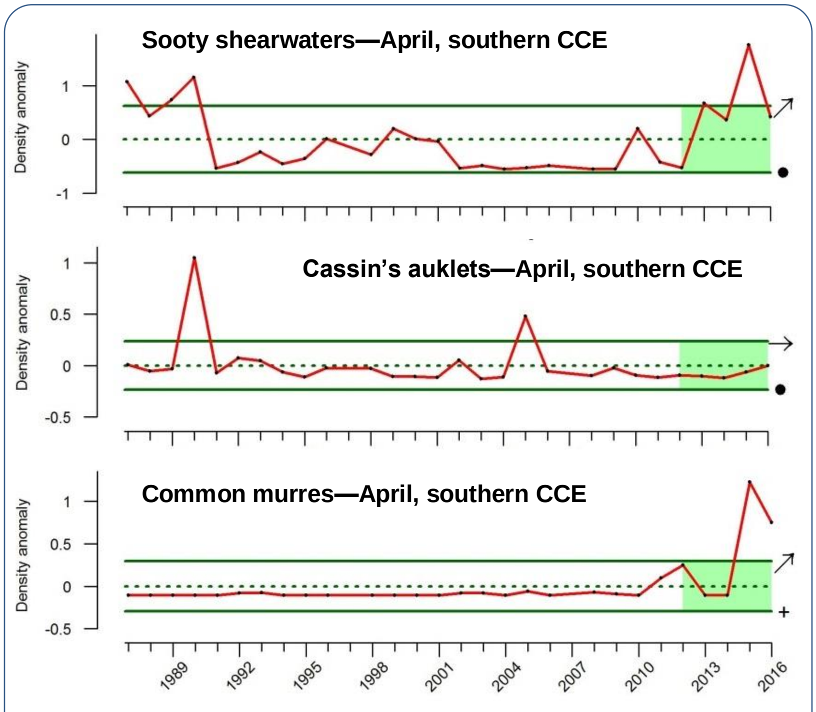

Figure 4.6.2. Anomalies in at-sea densities of sooty shearwaters, Cassin's auklets and common murres in April in the southern CCE through 2016. Lines, colors and symbols are as in Figure 1.1a.

The positive density anomalies in recent years are surprising, given the recent and persistent warm conditions; for example, sooty shearwaters increased despite their cold-water affinities. These are abundance indicators of long-lived birds, however, and we may need condition indicators like diet, hatching rates, fledgling success, or others to fully understand recent seabird dynamics. To illustrate this, in each of the past several years, at least one seabird species has experienced a "wreck"—anomalously large numbers of dead birds washing up on beaches throughout much of the CCE (e.g., Cassin's auklets in 2014, common murres in 2015). In the summer of 2016, rhinoceros auklets experienced a wreck, although it was largely confined to the northern CCE. The rhinoceros auklet wreck is described in Appendix J.

5. Human Activities

5.1 Coastwide Landings by Major Fisheries

Data for fishery landings are current through 2015. Overall, total landings decreased over the last five years, driven mainly by steep declines in landings of Pacific hake, CPS and crab in 2015 (Fig. 5.1.1). Landings of groundfish (excluding hake) were historically low from 2011-2015, while hake landings were highly variable. Landings of CPS fishes and market squid decreased over the last five years. Shrimp landings increased to historic highs, particularly from 2013-2015, whereas crab declined sharply from a peak in 2013. Salmon landings were highly variable, while highly migratory species (HMS) landings were relatively consistent; both were within ±1 s.d. of historic averages. Recreational landings were historically low from 2004-2015, and showed no recent trend. State-by-state commercial and recreational landings are summarized in Appendix K.

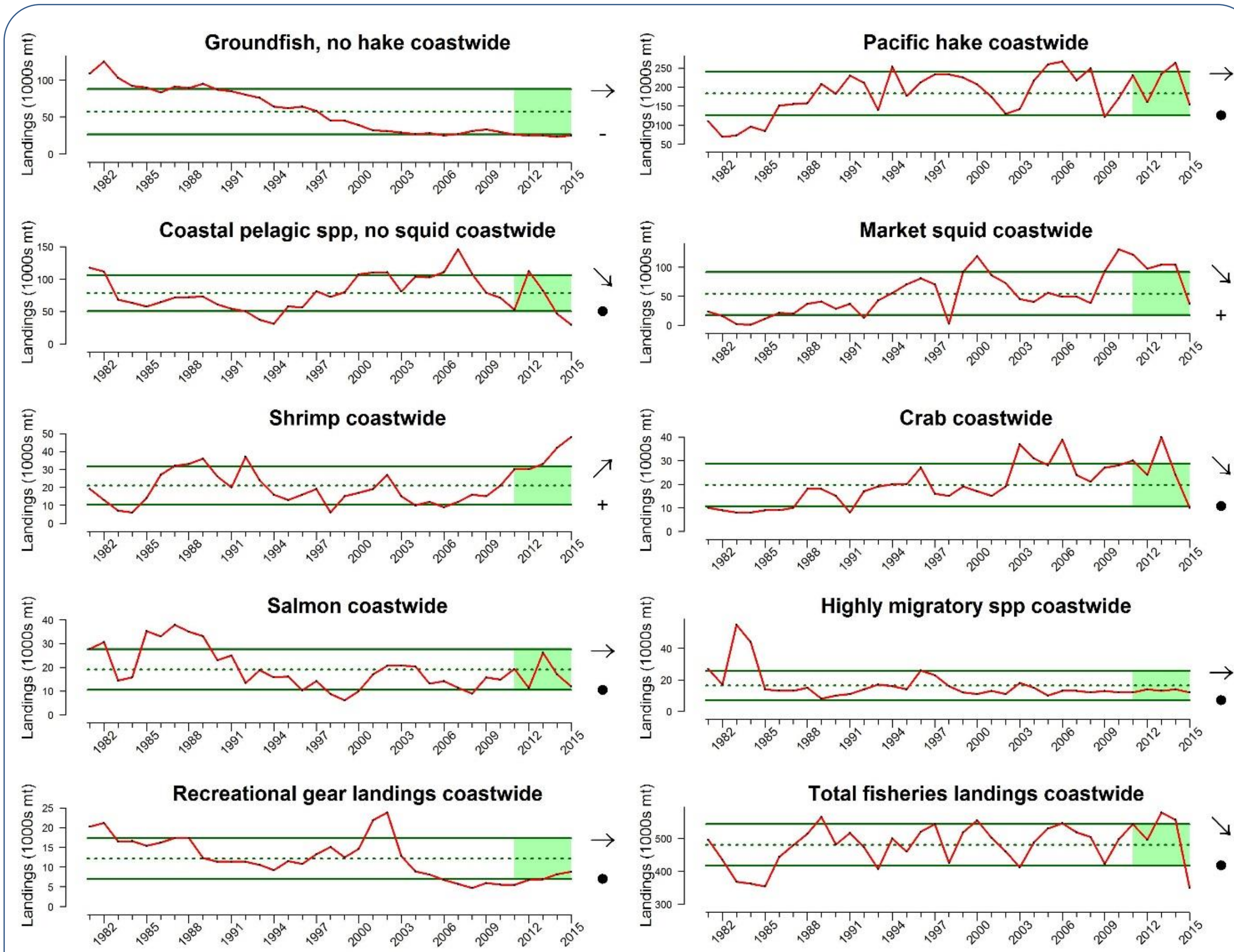

Figure 5.1.1: Annual landings of West Coast commercial (data from PacFIN) and recreational fisheries (data from RecFIN), including total landings across all fisheries from 1981-2015. Lines and symbols are as in Figure 1.1a.

Revenues from commercial fishing, broken out by state and FMP, are also presented in Appendix K. Total commercial fishery revenues (in adjusted 2015 dollars) have declined sharply since 2013, driven by declines in landings of crab, market squid and hake (Appendix K, Figs. K.5-K.8).

5.2 GEAR CONTACT WITH SEAFLOOR

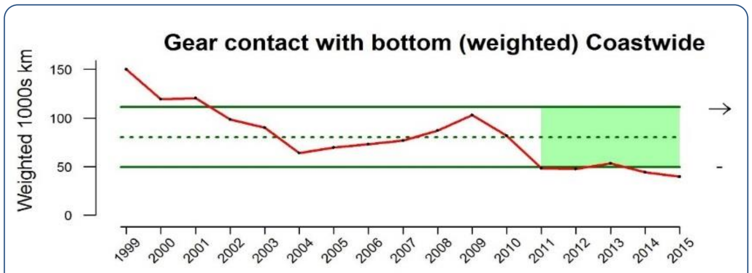

Figure 5.2.1. Cumulative weighted distance of fishing gear contact with bottom habitat across the entire CCE, 1999-2015. Lines, colors and symbols are as in Fig. 1.1a.

Benthic marine species, communities and habitats can be disturbed by natural processes as well as human activities (e.g., bottom contact fishing, mining, dredging). The impacts of fishing likely differ by gear and by habitat type, with hard, mixed and biogenic habitats needing longer to recover than soft sediments.

We compiled estimates of coast-wide distances affected by bottom-contact gear from 1999–2015. Estimates from 2002–2015 include bottom trawl and fixed gear, while 1999–2002 includes only bottom trawl data. We calculated trawling distances based on set and haul-back points, and fixed gear distances based on set and retrieval locations of pot, trap and longline gear. We weighted distances by gear and habitat type, according to sensitivity values described in Table A3a.2 of the 2013 Groundfish EFH Synthesis Report. Gear contact with the seafloor was at historically low levels over the most recent 5-year period (Fig. 5.2.1). The dominant signal is bottom trawl contact with soft sediments on the shelf and upper slope of the northern CCE (see Supplement, Appendix L). There is uncertainty in the estimation of bottom contact among fixed gear types (e.g. longline vs. pot and trap gear), but this uncertainty is minor compared to the signal from bottom trawl gear.

5.3 AQUACULTURE AND SEAFOOD DEMAND

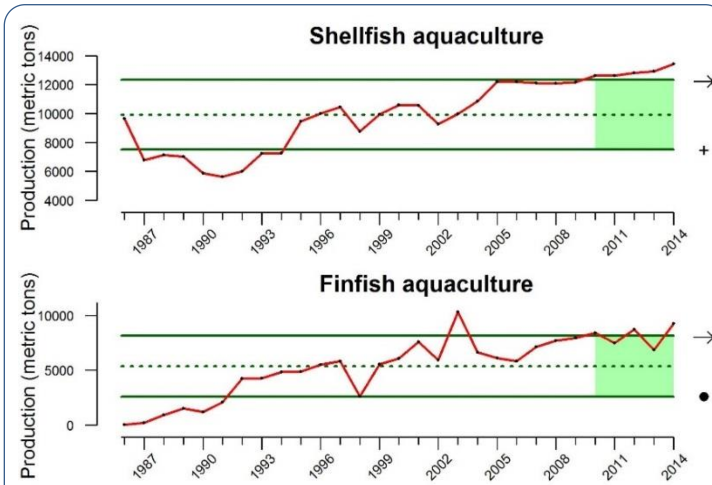

Figure 5.3.1. Aquaculture production of shellfish (clams, mussels, oysters) and finfish (Atlantic salmon) in CCE waters. Lines, symbols and shading are as in Figure 1.1a.

Aquaculture activities are indicators of seafood demand and also may be related to benefits (e.g., water filtration by bivalves, nutrition, income, employment) or impacts (e.g., habitat conversion, waste discharge, species introductions). Shellfish aquaculture production in the CCE has been at historically high levels in recent years (updated through 2014 as of this report), and finfish aquaculture has been near the upper limits of historical averages (Fig. 5.3.1). Demand for seafood products increasingly is being met by aquaculture and may be influencing the increases in production.

Seafood demand in the U.S. was relatively constant from 2011-2015, and had largely recovered from decline late in the previous decade (Fig. 5.3.2). The recent average total consumption was above historical averages, while per capita demand was within the historic range. With total demand already at historically high levels, increasing populations and recommendations in U.S. Dietary Guidelines to increase seafood intake, total demand for seafood products seems likely continue to increase for the next several years.

5.4 NON-FISHING ACTIVITIES

The CCIEA team compiles indicators of non-fisheries related human activities in the CCE, some of which may have effects on marine ecosystems, fisheries, and coastal communities. Among these activities are commercial shipping, nutrient inputs, and oil and gas activity. Since our last report in March 2016, we have received little new data for these three activities, and thus have placed information on them in the Supplementary Materials (Appendix M). It suffices to say that commercial shipping and oil and gas activity were at relatively low, stable levels through 2013-2015, while data on nutrient inputs are only available through 2012 and thus are not reliable for assessing present status and trends.

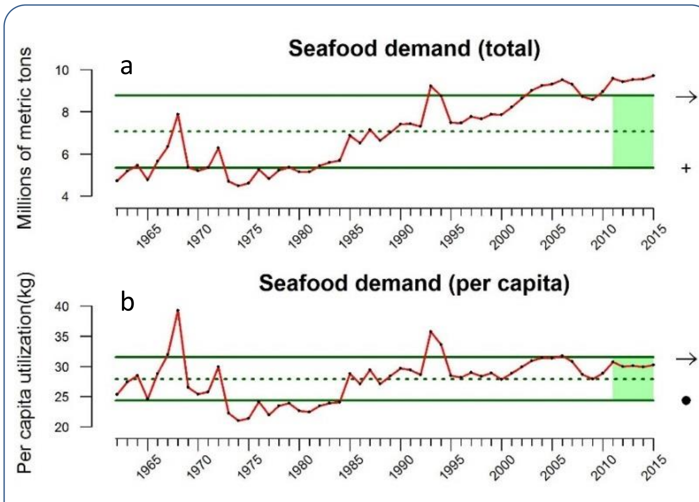

Figure 5.3.2. a) Total and b) per-capita use of fisheries products in the U.S., 1962-2015. Lines, symbols and shading are as in Figure 1.1a.

6. HUMAN WELLBEING

6.1. SOCIAL VULNERABILITY

Coastal community vulnerability indices are generalized socioeconomic vulnerability metrics for communities involved in commercial fishing. To assess social vulnerability in fishery-dependent communities, we use community-level social data, port-level fish ticket data, and a factor analysis approach to generate composite social vulnerability and commercial fishing indices for 1139 coastal communities. The Community Social Vulnerability Index (CSVI) is derived from social vulnerability data (demographics, personal disruption, poverty, housing characteristics, housing disruption, labor force structure, natural resource labor force, etc.). The fishing dependence composite index is based on commercial fishing engagement in a community (including fishery landings, revenues, permits, and processing) and commercial fishing reliance (per capita enagagement). Figure 6.1.1 shows both indices for 25 highly fishing-dependent communities in five regions of the West Coast. Scores are relative to the entire CCE; for example, in 2014 the commercial fishing dependence of Moss Landing was ~33 standard deviations greater than the average community. The ten most fishery-dependent communities and their vulnerability scores are presented in Appendix N.

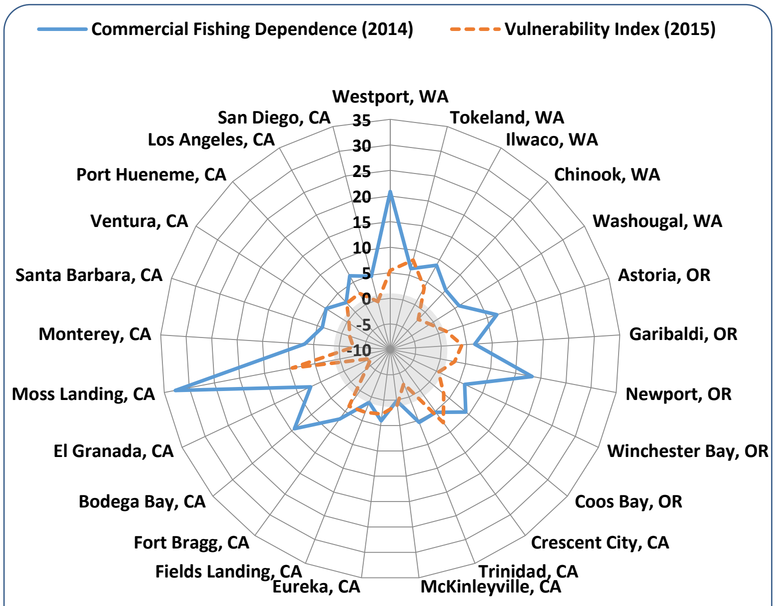

Figure 6.1.1. Commercial fishing dependence in 2014 (solid) and social vulnerability index in 2015 (dashed) for the five most fishing-dependent communities in Washington, Oregon, and northern, central and southern California, expressed as standard deviations relative to all CCE communities. Shaded region is ≤1 s.d.

Figure 6.1.2 shows the two indices in x-y space, allowing us to readily identify fishing-dependent communities with high social vulnerability. Of note are communities like Moss Landing and Westport, which have relatively high commercial fishing dependence (~33 and 21 s.d. above average) and also a high CSVI (~10 and 5 s.d. above average). Communities that are strong outliers in both indices may be particularly socioeconomically vulnerable to a downturn in commercial fishing. Exogenous shocks of a management-related or ecosystem-related nature may produce especially high individual and community-level social stress in these communities.

We now have enough data from the US Census and the American Community Survey for a 2000-2015 time series of community vulnerability in relation to commercial fishery dependence. This time series focuses on ten commercial fishing-dependent communities that consistently scored among the most socially vulnerable in all years. Because this time series has only four data points, it remains volatile and difficult to interpret, and is thus in the Supplement (Appendix N). We will further develop this time series, although doing so is constrained by the fact that census data are only collected every five years.

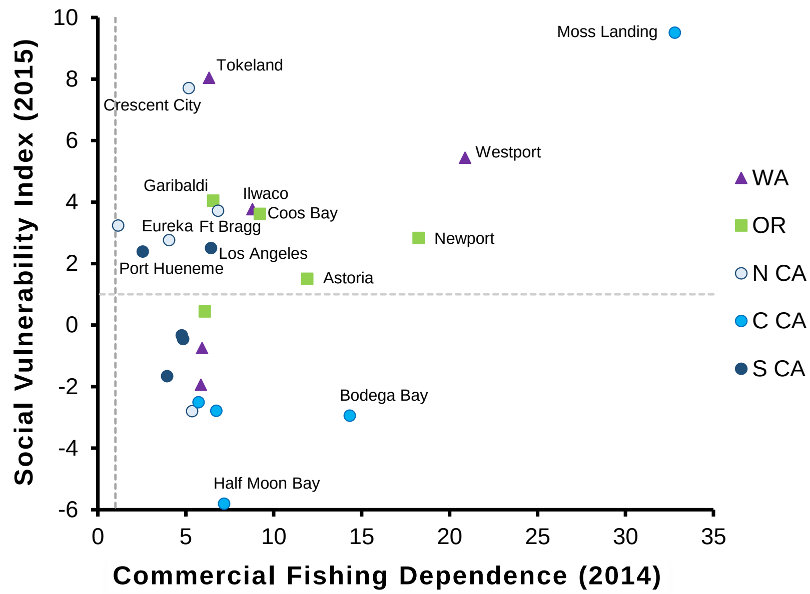

Figure 6.1.2. Social vulnerability and commercial fishing dependence data for the same communities and time periods as in Figure 6.1.1, but as x-y data color-coded by region. Dashed lines indicate 1 s.d. above the coastwide means, i.e., communities above and right of the two dashed lines have significantly greater social vulnerability and commercial fishing dependence than average communities in the CCE.

6.2 Fleet Diversity Indices

Catches and prices from many fisheries exhibit high interannual variability, leading to high variability in fishers' income. Variability in annual revenue can be reduced by diversifying fishing activities across multiple fisheries or regions (Kasperski and Holland 2013). There may be good reasons for individuals to specialize, however, including reduced costs or greater efficiency. Thus, while diversification may reduce income variation, it does not necessarily promote higher average profitability. We measure diversification with the Effective Shannon Index (ESI). ESI = 1 when revenues are all from a single species group and region. It increases both as revenues are spread across *more* fisheries and as revenues are spread more *evenly* across fisheries. The index has an intuitive meaning: ESI = 2 if fishery revenues are spread evenly across 2 fisheries; ESI = 3 if revenues are spread evenly across 3 fisheries; and so on. If revenue is not evenly distributed across multiple fisheries, the ESI value is lower than the number of fisheries. As of 2015, the fleet of vessels fishing on the US West Coast and in Alaska is less diverse on average than at any point in the past 35 years (Fig. 6.2.1). Between 2014 and 2015, some categories of vessels showed a small increase in ESI, while others decreased, but absolute changes were minor. The only fleet to change by >2 s.d. were vessels 81-125 feet, for which ESI increased by about 5%; this change appears to be due to non-participation of some less-diversified vessels from West Coast fisheries in 2015. The long-term decrease in ESI over the last 35 years is due both to entry and exit of vessels and changes for

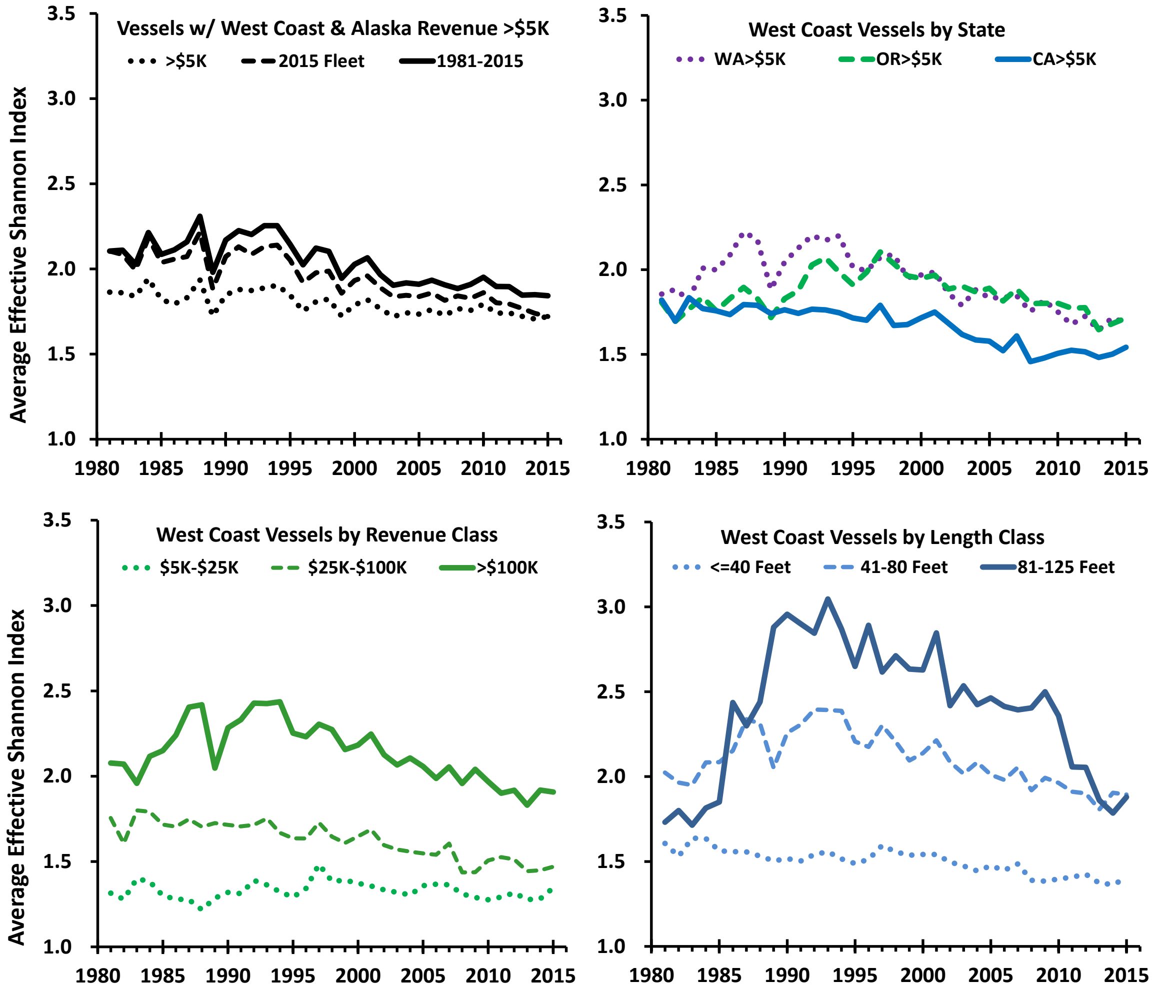

Figure 6.2.1. Average fishing vessel diversification for US West Coast and Alaskan fishing vessels with over $5K in average revenues (top left) and for vessels in the 2015 West Coast Fleet, broken out by state (top right), average gross revenue (bottom left) and vessel length (bottom right).

individual vessels. Over time, less-diversified vessels have been more likely to exit, which increases average diversification. However, vessels that remain in the fishery have also become less diversified, at least since the mid-1990s, and newer entrants have generally been less diversified than earlier entrants. The overall result is a moderate decline in ESI since the mid-1990s or earlier for most vessel groupings. Notwithstanding these average trends, there are wide ranges of diversification levels and strategies within as well as across vessel classes, and some vessels remain highly diversified. It should be noted that increases in diversification from one year to the next may not always indicate a positive improvement. For example, if a class of vessels was heavily dependent on a single fishery with highly variably revenues, such as Dungeness crab, an overall decline in the Dungeness crab fishery might cause ESI to increase. Also an increase in ESI may be due to the exit of less diversified vessels. Additional break-downs of diversification are in Appendix O of the Supplement.

7. Research Recommendations

In March 2015, the Council approved FEP Initiative 2, "Coordinated Ecosystem Indicator Review" (Agenda Item E.2.b), by which the Council, advisory bodies, the public, and the CCIEA team would work jointly to refine the indicators in the annual CCIEA Ecosystem Status Report to better meet Council objectives. The Initiative was implemented by an ad-hoc Ecosystem Working Group (EWG).

The EWG asked the CCIEA team to include a short section of "Research Recommendations" in the 2017 report. The Recommendations below reflect our collective assessment of science products that we believe are important; that we could provide to the Council in a reasonable time frame (e.g., 1-3 years, including technical review by the SSC Ecosystem Subcommitte); that fit with developing NOAA Ecosystem-Based Fisheries Management (EBFM) Road Map; and that would provide added value to the indicators as they relate to management of FMP stocks and protected species.

7.1 Continue an Ongoing Scoping Process Between the Council and the CCIEA

The CCIEA team recognizes the necessity to partner directly with the Council on these Research Recommendations, in order for them to be effective and directly applicable to management. We greatly appreciated the time and effort the Council gave to scoping the contents of this annual report under FEP Initiative 2. An ongoing scoping process could give the CCIEA team clear direction on Council needs, and give the Council a clear sense of CCIEA capabilities and capacity. Therefore:

- *The Research Recommendations below are based on our current work and interests, but we would appreciate an opportunity to further scope CCIEA work with the Council and its advisory bodies, to ensure that our work is aligned with the Council's ecosystem science needs.*

7.2 Continue Making Improvements to Indicator Analysis

The CCIEA team has benefited greatly from working with the EWG on the Initiative, and from the complementary support of the SSC in providing technical review of CCIEA indicators and activities. The CCIEA team recommends that this partnership continue, with emphasis on:

- *Continued refining of the existing indicators in this report, to better meet Council needs;*
- *Identifying and prioritizing indicator gaps, such as CPS, HMS, groundfish, diet information, chlorophyll, harmful algal blooms, and socioeconomic data from underreported communities;*
- *Using multivariate autoregressive state-space (MARSS) models to estimate trends in our indicators, separate from the observation error inherent in field sampling;*
- *Analyzing time series to (1) determine if threshold relationships exist between stressors and indicators, to inform risk assessments; and (2) to detect early warning indicators of major shifts in ecosystem structure or function.*

7.3 Assess Dynamics of Fisheries Adaptation to Short-Term Climate Variability

The CCE is highly variable, driven by annual or decadal variations such as El Niño events, PDO shifts, and marine heat waves. The livelihoods of fishers in the CCE are heavily influenced by such variability. As fishers attempt to adapt to variability by switching among fisheries, their actions impact other fishers and fishing communities, and may actively influence ecosystem dynamics. This project will investigate how fisheries management and fishers' fishing strategies combine to effect social and ecological resilience to the short-term climate variability inherent to the CCE. We plan to:

- *Analyze how productivity of key species varies with climate/ocean conditions;*
- *Survey CCE fishers to determine motivations for fishery participation, and use the data from the survey and fish tickets to fit statistical models of individual fishing participation choices;*
- *Construct an integrated model of several CCE fisheries (e.g., salmon, Dungeness crab, albacore, groundfish, shrimp) that determines participation and effort in each fishery;*

- *Model how climate variability affects fisheries both directly via environmental effects and indirectly via participation decisions, and explore what types of fishing portfolios, for individuals or ports, result in lower variation in income and higher quality of life.*

7.4 Assess Vulnerability of "Communities At Sea" to Long-Term Climate Change

Long-term climate change has already shifted distributions of marine species in the CCE, but the socio-ecological impacts of climate change on fishing communities over the next several decades are difficult to anticipate. A major challenge remains linking vulnerability to predicted long-term changes in the marine seascape upon which each community depends, particularly because both target species and fleets from different ports form spatially and temporally dynamic "communities at sea" (e.g., Colburn et al. 2016). We plan to:

- *Develop a composite index of vulnerability for each community at sea as a function of its exposure (changes in target species biomass) and sensitivity (dependence on each target species) to long-term climate change;*
- *Assess each community at sea's adaptive capacity (e.g., mobility, target switching);*
- *Set up Environmental Competency Groups throughout the CCE, so that scientists, fishers and managers can together interrogate information about climate vulnerabilities and impacts, co-develop adaptation strategies, and proactively reveal barriers to adaptation.*

7.5 "Dynamic Ocean Management" to Reduce Bycatch in HMS Fisheries

Traditional management measures for bycatch reduction are static in space and time, despite the fact that both marine species and human users rely on dynamic environmental features. Dynamic Ocean Management (DOM) offers an ecosystem-based management approach toward addressing these dynamic issues (Lewison et al. 2015). We define DOM as management of marine systems that can change in space and time with the shifting nature of the ocean and its users. We are exploring DOM for HMS, specifically to maximize swordfish catch in the California drift gillnet fishery while minimizing bycatch of key species including leatherback sea turtles, blue sharks, and California sea lions; we will extend this to include marine mammals that are hard cap species. Our approach is to:

- *Use species-specific bycatch risk profiles to create risk-reward ratios for swordfish vessels;*
- *Track spatiotemporal changes in risk ratios as a function of management strategies and dynamic environmental conditions in the area of the drift gillnet fishery.*

7.6 Assess Ecological and Economic Impacts of Ocean Acidification

The CCE is characterized by upwelling of deep, cold, nutrient-rich waters that support fish stocks and the human communities that rely on them, but that also make the area particularly at risk of OA. The CCIEA team is leading focused research to identify the species, fisheries, and ports most vulnerable to OA. This will address needs identified in PFMC Fishery Ecosystem Plan Initiative A.2.8, by the Ecosystem Advisory Subpanel, and in the NOAA Fisheries Climate Science Strategy Western Regional Action Plan (WRAP). Specifically, we will:

- *Apply an Atlantis ecosystem model, which was formally reviewed by the SSC in July 2014, and presented to the full Council in November 2014 (Kaplan and Marshall 2016);*
- *Link the Atlantis model to 1) ensembles of future scenarios for OA, warming, and species range shifts, and 2) updated information about species exposure and sensitivity to OA;*
- *Identify FMPs, ecoregions, and ports most likely affected by OA, warming, and subsequent range shifts, including both direct and indirect (e.g. food web) effects;*
- *Consider impacts on FMPs that result from changes in prey productivity, for instance impacts on rebuilding rockfish stocks.*

MRIP SURVEY SPECIFICATION / STATE CONDUCT INVESTIGATION
May 2018

Based on the success of conducting the APAIS through a cooperative approach between the Atlantic states, MRIP, and ACCSP, NOAA expressed interest in collecting more data through state conduct (Goal 5 of the 2017-2022 MRIP Strategic Plan). MRIP has expressed interest in state conduct of the for-hire telephone survey, and this document contains a brief overview of tasks and estimated staff time to conduct four MRIP surveys: FHTS, LPTS, LPIS, and LPBS. If state conduct is pursued for one or more surveys, then state conduct would include ACCSP centralized coordination, with data distribution, storage, editing, delivery and other administrative tasks handled through the ACCSP's existing online Assignment Tracking Application (ATA). In all cases, MRIP maintains responsibility for survey design and generation of estimates.

For Hire Telephone Survey (FHTS) (Annual cost unknown)
Developed to measure charter and party boat angler effort. The FHTS was implemented for Gulf Coast states in 2000 (charter boat only), and all Atlantic Coast states in January 2005.

Overview of State Tasks:

- Staff Management: Hiring, training, supervision of interviewers. (Note: not in time estimates below)
- Notification Letter: Mailing letters to each captain 2 weeks prior to the sampling week to inform that their vessel has been selected for the FHTS and they will be called after their fishing week is complete.
- Telephone Calls: Weekly telephone calls made to charter/headboat captains to determine fishing activity for the previous week.
- LPTS Add-on: Vessels selected for the FHTS in Maine through Virginia who have a current HMS permit are asked additional questions associated with the Large Pelagic Telephone Survey (LPTS).
- Vessel Directory: Updates to the online Vessel Directory are performed to ensure vessel records have the most current information. (Note: task partially performed under APAIS)

Staff time estimate per wave:

Estimated staff time to conduct telephone calls and mailings for the FHTS with LPTS Add-on (hours/wave)

State	Wave 1 (JAN/FEB)	Wave 2 (MAR/APR)	Wave 3 (MAY/JUN)	Wave 4 (JUL/AUG)	Wave 5 (SEP/OCT)	Wave 6 (NOV/DEC)	Yearly Total	Avg Weekly Sampling Hours
ME *	-	-	31	50	42	-	123	5
NH	-	-	34	37	33	-	104	4
MA	-	189	275	278	247	259	1248	29
RI	-	47	58	60	54	58	277	7
CT	-	37	42	39	35	39	192	5
NY	-	107	136	139	123	136	641	15
NJ	-	165	189	173	156	165	848	20
DE	-	24	34	34	30	37	159	4
MD	-	128	141	144	144	152	709	17
VA	-	39	45	47	40	45	216	5
NC *	147	173	189	207	158	178	1052	21
SC	-	89	94	94	86	86	449	11
GA *	-	52	45	45	40	45	227	6

* **State currently conducts FHTS** BLACK text = FHTS only RED text = FHTS with LPTS Add-on

Recommended approach: State Conduct

<u>Large Pelagic Telephone Survey (ME-VA) – PRIVATE ANGLERS (Annual contract cost ~ $ 225,000)</u>
Telephone interviews with randomly selected private recreational anglers who hold HMS permits. Used to determine fishing effort and trips for HMS.

Overview of Tasks:

- <u>Staff Management:</u> Hiring, training, supervision of interviewers. (Note: not in time estimates below)
- <u>Notification Letter:</u> Mailing letters to each captain 2 weeks prior to the sampling week to inform them that their vessel has been selected for the FHTS and that they will be called after their fishing week is complete.
- <u>Telephone Calls:</u> Bi-weekly telephone calls made to charter/headboat captains to determine fishing activity for the previous 2 weeks.
- <u>LPTS Vessel Directory:</u> Updates to the private LPTS Vessel Directory (list of vessels with HMS Angling and Atlantic Tunas General category permits) are performed to ensure vessel records have the most current information. (Note not in time estimates below - minimal time expected)

Staff time estimate per wave:

Estimated staff time to conduct telephone calls and mailings for the private LPTS (hours/wave)

State	Wave 1 (JAN/FEB)	Wave 2 (MAR/APR)	Wave 3 (MAY/JUN)	Wave 4 (JUL/AUG)	Wave 5 (SEP/OCT)	Wave 6 (NOV/DEC)	Yearly Total	Avg Bi-weekly Sampling Hours
ME*	-	-	-	48	39	-	87	10
NH	-	-	-	75	60	-	135	15
MA	-	-	64	179	134	-	377	34
RI	-	-	34	91	71	-	196	18
CT	-	-	21	55	43	-	119	11
NY	-	-	73	146	116	-	335	30
NJ	-	-	73	182	140	-	395	36
DE	-	-	26	72	53	-	151	14
MD	-	-	43	118	87	-	248	23
VA	-	-	49	124	99	-	272	25
NC	-	-	-	-	-	-	-	-
SC	-	-	-	-	-	-	-	-
GA	-	-	-	-	-	-	-	-

* State currently conducts private LPTS

Bi-weekly nature of survey causes unequal distribution of hours from week to week

Recommended approach: Unknown – Staffing logistics for sampling every other week creates challenges

<u>Large Pelagic Intercept Survey (ME-VA) (Annual contract cost ~ $675,000)</u>

Dockside interviews with captains of private and for-hire vessels returning from fishing trips targeting large pelagic species (e.g. tunas, billfishes, swordfish, sharks, wahoo, dolphinfish, and amberjack) in the offshore waters. Locations are selected from a registry of LPS sites and tournaments.

Overview of State Tasks

- <u>Staff Management:</u> Hiring, supplemental training, and supervision of interviewers. (Note: not in time estimates below)
- <u>Assignment Completion:</u> Proper conduct of dockside interviews at assigned sites/times with captains, anglers, and/or crew members to collection specified data elements.
- <u>Editing Data:</u> Work with ACCSP staff to correct coding or data-entry errors.
- <u>Delivery:</u> Send data to ACCSP for further processing and delivery to MRIP.
- <u>Validation Phone Calls:</u> Validation of 10% of all dockside intercepts through telephone interviews.
- <u>Quality Control:</u> Conduct quality control field supervisor visits of 5% of all interviewer assignments.

Staff time estimate per month?

Estimated staff time to conduct LPIS (hours/month)

State	June	July	August	September	October	Yearly Total	Avg Weekly Sampling Hours
ME*	-	186	207	143	164	700	39
NH	-	307	322	157	172	958	53
MA	1173	1201	1173	658	694	4899	223
RI	-	243	172	179	143	737	41
CT	-	143	129	143	215	630	35
NY	472	493	458	422	186	2031	92
NJ	408	679	765	400	608	2860	130
DE	129	186	179	172	164	830	38
MD	1173	1201	1173	658	694	4899	223
VA	343	379	415	222	229	1588	72
NC	-	-	-	-	-	-	-
SC	-	-	-	-	-	-	-
GA	-	-	-	-	-	-	-

*State currently conducts LPIS

Recommended approach: State Conduct

Large Pelagic Biological Survey (MA-NC) (Annual contract cost ~ $100,000)

Biological samples from sharks, dolphin, wahoo, little tunny, and Atlantic bonito are not currently collected on the LPBS. Nearly 100% of the LPBS assignments are opportunistic. When a bluefin tuna is available for sampling, an opportunistic assignment is triggered. Additional species, including but not limited to sharks, could be designated to trigger opportunistic assignments.

Overview of State Tasks:

- Staff Management: Hiring, supplemental training, and supervision of interviewers. (Note: not in time estimates below)
- Maintain Contacts/Outreach: Make contacts with site managers and fish cleaners prior to start of season and maintain a list of cooperative captains/anglers who target Bluefin tuna.
- Assignment Completion:
    - Opportunistic - Perform opportunistic assignments when Bluefin tuna are landed and available for sampling. Interviews and biological samples are collected. ~145 ASSIGNMENTS
    - Tournament – Perform fixed date/fixed site assignments when MRIP specifies HMS tournaments to be sampled. Interviews and biological samples are collected. ~5 ASSIGNMENTS
- Collect Biological Samples: Record lengths and weights, and obtain otoliths, caudal peduncle, first dorsal spine, and gonads from Bluefin tuna and other high priority large pelagic species as determined by MRIP. Prepare, preserve, and store collected samples.
- Delivery: Send assignment summary data to ACCSP for further processing and delivery to MRIP.
- Shipping: Ship all samples as required by MRIP.

Staff time estimate per month?

Estimated staff time to conduct LPBS (hours/month)

State	June	July	August	September	October	Yearly Total
ME	-	-	-	-	-	-
NH	-	-	-	-	-	-
MA	-	-	80	80	40	200
RI	-	-	40	40	24	104
CT	-	24	40	32	8	104
NY	-	48	80	56	-	184
NJ	16	40	56	-	-	112
DE	24	40	56	-	-	120
MD	40	96	56	-	-	192
VA	48	72	40	-	-	160
NC *	-	-	-	-	-	300
SC	-	-	-	-	-	-
GA	-	-	-	-	-	-

***State currently conducts LPBS January through May**

The opportunistic nature of sampling means hours will change depending on fish availability

Recommended approach: State Conduct