CALIFORNIA WETFISH PRODUCERS ASSOCIATION
PO Box 1951 • Buellton, CA 93427 • Office: (805) 693-5430 • Mobile: (805) 350-3231 • Fax: (805) 686-9312 • www.californiawetfish.org

February 9, 2015

Ms. Dorothy Lowman, Chair
And Members of the Pacific Fishery Management Council
7700 NE Ambassador Place #200
Portland OR 97220-1384

RE: Agenda Item E.2 Review of Fishery Ecosystem Plan Initiatives

Dear Ms. Lowman and Council members,

The California Wetfish Producers Association (CWPA) represents the majority of coastal pelagic species 'wetfish' fishermen and processors in California. We appreciate your consideration of the following comments and recommendations relative to Agenda Item E.2 – Review of Fishery Ecosystem Plan Initiatives.

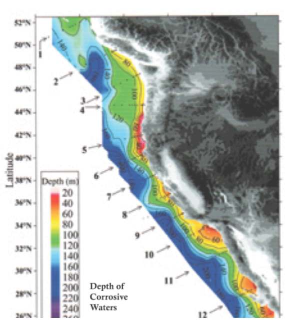
The March meeting agenda calls for Council action to prioritize potential Fishery Ecosystem Plan Initiatives and provide guidance on scheduling, now that work is nearing completion on the unmanaged forage fish initiative. Potential initiatives important for CPS fisheries include, for example:

- A.2.1 – assessing the potential long-term effects of Council harvest policies on Age and Size Distribution,
- A.2.6 – how to provide for sustained participation in fisheries, in light of the 'graying' of the fleet and
- A.2.7 – investigating the socio-economic effects of fishery management

However, the overarching challenge of our time is embodied in Initiative A.2.8 – Cross FMP effects of Climate Change/Shift.

Climate change and increasing ocean acidification (OA) have mobilized activity on the west coast, triggered in part by shellfish growers in the Pacific Northwest who began suffering mortality to oyster seed stocks approaching 80 percent a few years ago, the cause attributed to corrosive water entering hatcheries at a critical period in early shell development (Barton et al 2012).

A NOAA research cruise first measured evidence of acidified seawater off the Pacific coast in 2007. Corrosive water, undersaturated with respect to aragonite, a soluble form of calcium carbonate that shellfish need to build shell, has been found expanding toward the surface and shoreward at a rate of 1-2 meters per year in the North Pacific. (Feely et al 2008, *Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf)*



Labratory studies have demonstrated that undersaturated, low pH water can dissolve the shells of certain shellfish. In 2011, new NOAA research discovered the first evidence that acidity of continental shelf waters off the west coast during upwelling season from April to September is dissolving the shells of pteropods, important food for several marine fishes including salmon. (N. Bednarsek, R. A. Feely, et al. *Proceedings of the Royal Society B: Biological Sciences*, 2014)

The rate of change in ocean chemistry is unprecedented. One such event, the Paleo-Eocene Thermal Maximum (PETM), which occurred 56 million years ago, is likely our closest analog to modern ocean acidification. However, today's surface ocean is acidifying ten times faster than it did during the PETM. The findings were published in *Paleoceanography* in June, 2014.

On the west coast, shellfish fisheries provide enormous socioeconomic and recreational benefits, the cornerstone of the economy of many coastal communities. Shellfish contribute about 50 percent of total commercial fishery ex-vessel value in Washington and Oregon, and more than 60 percent of value in California (in 2013, Dungeness crab in northern California and market squid in both the Monterey area and southern California generated $162.7 million ex vessel, more than 63 percent of total ex vessel value statewide. CDFW Table 15).

In addition, scientists predict that the combined threat of climate change, including ocean warming, hypoxia and ocean acidification, "causing waters to become undersaturated with regard to aragonite along large stretches of the US West Coast in the next few decades," is likely to alter ecosystems and fisheries. (C. Hauri, N. Gruber et al, *Oceanography* Vol.22, No.4, December 2009)

It is critically important that the Council family not only be aware of these impending changes, but take an active role in guiding research and, ultimately, policy decisions. Initiative A.2.8 is the first step to engage in this process.

Please review the attachments included with this comment letter:
Attachment 1 – The West Coast Governors Alliance on Ocean Health – provides a synopsis on OA and lists several groups now actively working to address these issues, including the West Coast Ocean Acidification and Hypoxia Panel (http://westcoastoah.org/), Integrated Ocean Observing System Pacific Region Ocean Acidification Portal -- (http://www2.ipacoa.org/Explorer?action=oiw:fixed_platform:CARLSBD_Aquafarm1) and California Current Acidification Network (C-CAN) (http://c-can.msi.ucsb.edu), a group that I'm involved with in my 'spare' time.

Attachment 2 is a Science Daily article on NOAA research that found … "first evidence that a large fraction of the West Coast pteropod population is being affected by ocean acidification," according to Nina Bednarsek, Ph.D., of NOAA's Pacific Marine Environmental Laboratory. Pteropods are an important component of the food web (also not fished).

Attachment 3 is a press release from Ocean Science Trust announcing a session at the upcoming American Association for the Advancement of Science (AAAS) meeting to discuss work of the Ocean Acidification and Hypoxia Panel: "OA and Hypoxia, planning for regional action".

We support designating an ad hoc Climate Change-OA working group, perhaps including a subset of the Ecosystem Working Group and also involving members of the other advisory bodies, to interact with the OA Hypoxia Panel and other relevant groups as part of this Initiative.

Thank you for your attention to these comments.

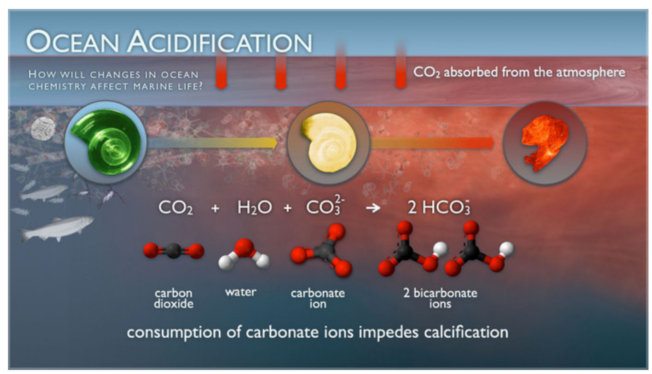
Best regards,

Diane Pleschner-Steele

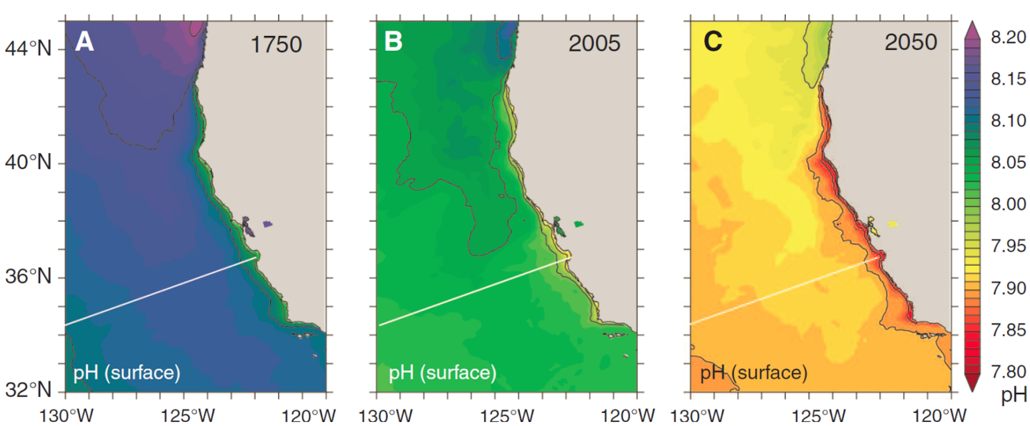
Diane Pleschner-Steele
Executive Director

Attachment 1: West Coast Governors Alliance on Ocean Health – What is Ocean Acidification?
Attachment 2: Science Daily – Ocean aciditidy is dissolving shells of tiny snails off the west coast
Date: April 30, 2014 Source: National Oceanic and Atmospheric Administration
Attachment 3: New Approach to Address Silent Threats to Ocean Health on the West Coast
Ocean Acidification and Hypoxia Science Panel Explores Ocean Stressors at a Regional Scale

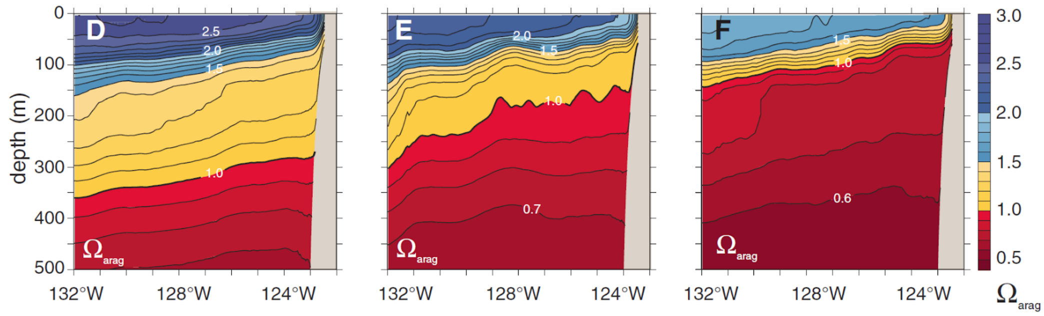
What is ocean acidification?



Ocean acidification refers to the process of seawater pH decreasing ("increased acidity") as the ocean absorbs CO2. As atmospheric CO2 levels have increased since pre-Industrial times (the mid-1700s), the oceans have absorbed approximately 30% of anthropogenically-produced CO2. As a consequence, ocean pH has dropped from 8.2 to 8.1. While this may not seem like a major change, the logarithmic scale of pH means that this change actually represents a 30% increase in acidity.



A graphic representation of the chemical changes produced by adding CO2 to water to cause ocean acidification (decreasing ocean pH). The top row represents the effects of ocean acidification on a pteropod, a typical shelled organism that will have trouble building its shell under lower pH (Image produced by the NOAA Pacific Marine Environmental Laboratory).



(Top row) Past, current and future modeling of ocean surface pH along the California Current System for 1750, 2005 and 2050. Warmer colors represent lower pH values. (Bottom row) Aragonite saturation values at a depth transect off Central California, indicated by the white line in A-C for 1750, 2005 and 2050. Warmer colors represent lower aragonite saturation values, which have been found to correlate directly to decreased capacity to build calcium carbonate shells (Graphics reproduced from: Gruber, Nicolas, et al. (2012). Rapid progression of ocean acidification in the California Current System. Science 337.6091: 220-223).

Additional drivers

Ocean acidification due to increasing CO2 uptake by the oceans is compounded by additional localized drivers. These include:

1. Increased regional-scale upwelling of high-nutrient, high-CO2 waters with increasing winds. Wind strength has increased in recent years, driving more persistent upwelling. The deep water that surfaces also contains CO2 absorbed by the oceans 30-50 years ago, meaning that our current CO2 production will have an effect for years to come.
2. Nutrient inputs from land-based run-off. These inputs drive biological respiration, which in turn decreases O2 in the water.
3. Nitrogen oxide and sulfur oxide production from motor vehicles, ships and electrical utilities. These gases produce similar acidifying effects to CO2.

(Information from the Washington State Blue Ribbon Panel on Ocean Acidification document Ocean Acidification: From Knowledge to Action).

Impacts of Ocean Acidification along the West Coast

In the mid-2000s, shellfish farmers in Oregon and Washington began to notice the effects of ocean acidification as they watched their shellfish larvae struggle to grow and form sufficient calcium carbonate shells. After several summers of die-offs, the farmers, along with scientists at the NOAA Pacific Marine Environmental Laboratory, identified increasingly low-pH waters as a major deterrent to shellfish growth (Barton et al., 2012).

Shellfish hatcheries can now buffer their incoming seawater to produce pH levels optimal for larval growth, allowing them to combat acidic upwelling events in order to stay in business. Adult shellfish that are transplanted to open bays may be at increasing risk, however, as pH levels in upwelled waters continue to decrease to levels at which even tougher, fully-grown adult shellfish cannot handle.

In the meantime, West Coast agencies, including the WCGA, are continuing to help link shellfish farmers to available science and resources, to monitor these changes and to make decisions about how to mitigate the effects of ocean acidification.

Links to resources

- NOAA PMEL OA - http://www.pmel.noaa.gov/co2/story/Ocean+Acidification
- Washington Sea Grant "Ocean Acidification in the Pacific Northwest" - http://wsg.washington.edu/admin/pdfs/ocean-acidification/OAFAQ-PacNW.pdf
- California Current Acidification Network (C-CAN) - http://c-can.msi.ucsb.edu/articles-of-interest
- West Coast Ocean Acidification and Hypoxia Panel - http://westcoastoah.org/
- Integrated Ocean Observing System Pacific Region Ocean Acidification Portal - http://www2.ipacoa.org/Explorer?action=oiw:fixed_platform:CARLSBD_Aquafarm1
- Seattle Times "Sea Change" series: http://apps.seattletimes.com/reports/sea-change/2013/sep/11/pacific-ocean-perilous-turn-overview/
- IOOS Ocean Acidification video: http://www.ioos.noaa.gov/ocean_acidification/welcome.html

CONTACT INFORMATION

Kim@Westcoastoceans.org

858-754-8826

West Coast Ocean Data Portal
Ocean Acidification
Climate Change ACT

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Ocean acidity is dissolving shells of tiny snails off U.S. West Coast

Date: April 30, 2014

Source: National Oceanic and Atmospheric Administration

First evidence of marine snails from the natural environment along the U.S. West Coast with signs that shells are dissolving.

Credit: NOAA

A NOAA-led research team has found the first evidence that acidity of continental shelf waters off the West Coast is dissolving the shells of tiny free-swimming marine snails, called pteropods, which provide food for pink salmon, mackerel and herring, according to a new paper published in Proceedings of the Royal Society B.

Researchers estimate that the percentage of pteropods in this region with dissolving shells due to ocean acidification has doubled in the nearshore habitat since the pre-industrial era and is on track to triple by 2050 when coastal waters become 70 percent more corrosive than in the pre-industrial era due to human-caused ocean acidification.

The new research documents the movement of corrosive waters onto the continental shelf from April to September during the upwelling season, when winds bring water rich in carbon dioxide up from depths of about 400-600 feet to the surface and onto the continental shelf.

"Our findings are the first evidence that a large fraction of the West Coast pteropod population is being affected by ocean acidification," said Nina Bednarsek, Ph.D., of NOAA's Pacific Marine Environmental Laboratory in Seattle, the lead author of the paper. "Dissolving coastal pteropod shells point to the need to study how acidification may be affecting the larger marine ecosystem. These nearshore waters provide essential habitat to a great diversity of marine species, including many economically important fish that support coastal economies and provide us with food."

The term "ocean acidification" describes the process of ocean water becoming corrosive as a result of absorbing nearly a third of the carbon dioxide released into the atmosphere from human sources. This change in ocean chemistry is affecting marine life, particularly organisms with calcium carbonate skeletons or shells, such as corals, oysters, mussels, and small creatures in the early stages of the food chain such as pteropods. The pteropod is a free-swimming snail found in oceans around the world that grows to a size of about one-eighth to one-half inch.

The research team, which also included scientists from NOAA's Northwest Fisheries Science Center and Oregon State University, found that the highest percentage of sampled pteropods with dissolving shells were along a stretch of the continental shelf from northern Washington to central California, where 53 percent of pteropods sampled using a fine mesh net had severely dissolved shells. The ocean's absorption of human-caused carbon dioxide emissions is also increasing the level of corrosive waters near the ocean's surface where pteropods live.

"We did not expect to see pteropods being affected to this extent in our coastal region for several decades," said William

Peterson, Ph.D., an oceanographer at NOAA's Northwest Fisheries Science Center and one of the paper's co-authors. "This study will help us as we compare these results with future observations to analyze how the chemical and physical processes of ocean acidification are affecting marine organisms."

Richard Feely, senior scientist from NOAA's Pacific Marine Environmental Lab and co-author of the research article, said that more research is needed to study how corrosive waters may be affecting other species in the ecosystem. "We do know that organisms like oyster larvae and pteropods are affected by water enriched with carbon dioxide. The impacts on other species, such as other shellfish and larval or juvenile fish that have economic significance, are not yet fully understood."

"Acidification of our oceans may impact marine ecosystems in a way that threatens the sustainability of the marine resources we depend on," said Libby Jewett, Director of the NOAA Ocean Acidification Program. "Research on the progression and impacts of ocean acidification is vital to understanding the consequences of our burning of fossil fuels."

The research drew upon a West Coast survey by the NOAA Ocean Acidification Program in August 2011, that was conducted onboard the R/V *Wecoma*, owned by the National Science Foundation and operated by Oregon State University.

Story Source:

The above story is based on materials provided by **National Oceanic and Atmospheric Administration**. *Note: Materials may be edited for content and length.*

Journal Reference:

1. N. Bednar ek, R. A. Feely, J. C. P. Reum, B. Peterson, J. Menkel, S. R. Alin, B. Hales. **Limacina helicina shell dissolution as an indicator of declining habitat suitability owing to ocean acidification in the California Current Ecosystem**. *Proceedings of the Royal Society B: Biological Sciences*, 2014; 281 (1785): 20140123 DOI: 10.1098/rspb.2014.0123

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National Oceanic and Atmospheric Administration. "Ocean acidity is dissolving shells of tiny snails off U.S. West Coast." ScienceDaily. ScienceDaily, 30 April 2014. <www.sciencedaily.com/releases/2014/04/140430101914.htm>.

FOR IMMEDIATE RELEASE
February 9, 2015

MEDIA CONTACT:
Laurel Kellner
(510) 350-1892
laurel.kellner@calost.org
@LaurelKell

CALIFORNIA OST Ocean Science Trust
Connecting Science to Ocean Management

New Approach to Address Silent Threats to Ocean Health on the West Coast
Ocean Acidification and Hypoxia Science Panel Explores Ocean Stressors at a Regional Scale

Oakland, CA -- State leaders and esteemed scientists have teamed up to create an unprecedented coalition spanning the West Coast to address a global threat--ocean acidification. The West Coast Ocean Acidification and Hypoxia Science Panel (the Panel), convened by Ocean Science Trust, includes bi-national, cross jurisdictional support from leadership spanning thousands of miles of coastline from California to British Columbia. In addition to this political partnership, Panel scientists are taking a comprehensive look at impacts, from large-scale oceanographic shifts to physiological changes to fish and other important marine species. The Panel is providing scientific guidance to state and federal decision makers, including water quality regulators and marine resource managers.

Given the scientific complexity, there is no easy answer to addressing ocean acidification. The coast-wide approach of the Panel creates an opportunity to provide scientific guidance that informs better management of entire ecosystems across state and national boundaries. Panelists Tessa Hill (UC Davis), Francis Chan (Oregon State University), and Richard Feely (NOAA/PMEL) are teaming up to combine multiple measurements of ocean chemistry from across the West Coast region, from ocean depths to rocky shores, in an effort to spot broad-scale patterns. “The West Coast is a special place to study these processes,” says Dr. Hill. “The oceanography of this region, with low pH and low oxygen waters being upwelled to the surface, makes it uniquely susceptible to future changes in pH and oxygen.”

Emerging scientific insights from the Panel reveal that ocean acidification cannot be considered in isolation; it should be managed together with other stressors including decreases in ocean oxygen levels (hypoxia) and increasing sea surface temperatures. This multi-stressor approach is part of a new push by California to lead thinking nationwide about ocean health and the future of coastal communities. “The challenges ocean acidification poses to marine ecosystems extend beyond shellfish; it has the potential to affect entire ecosystems. The West Coast is home to some of the most diverse and productive ecosystems on earth. We need to think about the whole picture,” says Cat Kuhlman, California’s Deputy Secretary for Ocean and Coastal Policy.

The Panel’s work highlights the need to bolster ecosystem resilience in the face of uncertainty, and is sparking a broader dialogue about how to incorporate ocean acidification and hypoxia into existing management and policy frameworks. “These issues really touch on the mandates of many state agencies. We are asking managers and regulators to look at where they are already bolstering ecosystem resilience, and strengthen those,” says Ms. Kuhlman.

Building resilience into ocean and coastal ecosystems to withstand future changes is a buffering approach that can buy time to evaluate and test solutions. There are opportunities for strategic action, and the West Coast is working towards finding a solution to these combined stressors at a regional scale. The existing network of marine protected areas in California, and the newly created reserves along Oregon’s coast provide ready-made ecosystem-based management tools. "Reserves provide a built-in buffer against ocean acidification and hypoxia. Rather than viewing these threats as the achilles heel of reserves, we can instead think about how reserves can work to stave off impacts," says panelist Francis Chan, a marine hypoxia scientist of the Department of Zoology at Oregon State University.

Ocean Science Trust convened the West Coast Ocean Acidification and Hypoxia Panel, at the request of the Ocean Protection Council and in collaboration with Oregon's Institute for Natural Resources. "We're aggressively linking science to management and regulatory decisions. We are figuring out how to get really good at that in the face of a changing climate and multiple threats impacting ocean health," says Ms. Kuhlman.

Kuhlman, Hill, and Chan will host a session to discuss *Ocean Acidification and Hypoxia: Planning for Regional Action* on February 15, at the American Association for the Advancement of Science (AAAS) meeting in San Jose, California.

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About Ocean Science Trust: Ocean Science Trust is a team of natural and social scientists, policy experts, technologists and communications professionals working together for healthy, resilient and productive oceans in California. We believe that science is an important foundation of resource management and conservation decisions. We work across traditional boundaries between governments, scientists and citizens to build understanding and trust in science and empower participation in the decisions that are shaping the future of our oceans. For more information please visit us at www.oceansciencetrust.org on Twitter or Facebook, or call (510) 350-1892.

February 12, 2015

Ms. Dorothy Lowman, Chair
Pacific Fishery Management Council
70 NE Ambassador Place, Suite 101
Portland, OR 97220

via email: pfmc.comments@noaa.gov

Re: Agenda Item E.2 – Review of Fishery Ecosystem Plan Initiatives

Dear Chair Lowman and Council Members:

Wild Oceans is an independent, non-profit group of anglers dedicated to protecting the ocean's top predators – the billfish, tunas, swordfish and sharks – while preserving healthy ocean food webs and critical habitats. We have long supported ecosystem based fisheries management (EBFM) focusing on maintaining resilient food webs and abundant forage stocks critical to maintaining healthy populations of commercially and recreationally important predator species, marine mammals, sea turtles, and seabirds.

We have encouraged the Pacific Fishery Management Council's (council) adoption of EBMF, including the council's creation of the Fishery Ecosystem Plan for the U.S. Portion of the California Current Large Marine Ecosystem (FEP), and development of the Comprehensive Ecosystem-Based Amendment 1 (CEBA 1) to protect unmanaged and unfished forage fish. Now, is the time to take the next step in the evolution of the FEP and **choose to develop *Ecosystem Indicators* as Initiative 2, beginning with a *Forage Status Indicator.***

Ecosystem Indicators are the Linchpins in the Fishery Ecosystem Plan

EBFM is widely accepted as the most appropriate framework for achieving sustainability in fisheries, both in terms of ecological and human well being. In ecosystem-based fishery management, everything is linked. To be functional, the

P.O. Box 258 • WATERFORD, VA 20197 • (703)777-0037
WWW.WILDOCEANS.ORG

council must support the FEP's broad conceptual goals with operational objectives and a framework of Ecosystem Indicators. The Ecosystem Indicators, including reference points and performance measures, will help illustrate specific objectives for ecosystem health, including a description of unhealthy states to be avoided. The Ecosystem Indicators will help the council assess ecosystem health and performance of the fishery and determine whether or not management effectively achieves the council's ecosystem goals.

The council identified the development of Ecosystem Indicators as one of the objectives of the FEP[1] and considered the development of Ecosystem Status Indicators as a natural progression of the Annual State of the California Current Ecosystem Report (Annual CCE Report) prepared by the National Marine Fisheries Service Northwest and Southwest Fisheries Science Centers.[2] More specifically, in September 2013, the council expressed support for the development of a Forage Status Indicator, and decided to host a Forage Status Indicator workshop in November 2013. The workshop was postponed due to the 2013 federal furlough and has not been rescheduled. Now, the council has the opportunity to build the framework of its FEP by selecting Ecosystem Indicators as Initiative 2, and develop linchpin indicators of ecosystem health as targets for management, beginning with a Forage Status Indicator.

A Forage Status Indicator is a Linchpin Indicator of Ecosystem Health

The council's FEP emphasizes the importance of biodiversity for ecosystem and fisheries stability and the relationship between conserving forage species to the health of the CCE. Further, the council realizes that the status of individual species should be considered in the context of monitoring and protecting the forage base as a whole, since the broad field of predators depends on a diversity of prey, an abundance of diversity, and availability of prey throughout the CCE.

A Forage Status Indicator is a logical conclusion to the council's pending final action on CEBA 1 - to protect unmanaged and unfished forage fish. Failed salmon runs[3], declines in seabird populations[4], and marine mammal mortality events[5] that have defined recent history have been linked to the lack of available

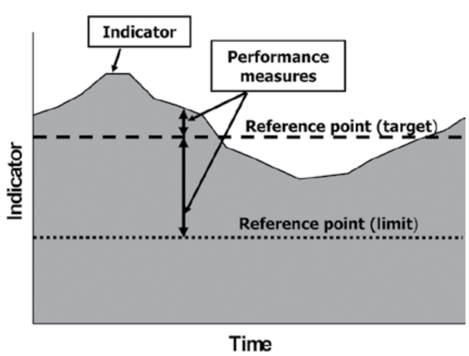
[1] Pacific Coast Fishery Ecosystem Plan for the U.S. Portion of the California Current Large Marine Ecosystem, p. 4.
[2] Ecosystem Initiatives Appendix to the Pacific Coast Fishery Ecosystem Plan for the U.S. Portion of the California Current Large Marine Ecosystem, Appendix A, p. A-23.
[3] Thayer et al. 2010. Collaborative Fisheries Research in Support of Ecosystem-Based Salmon Management in Northern California. Final Report, California Sea Grant Project R/FISH-212PD.
[4] Warzybok, P.M and R.W. Bradley. 2009. Status of Seabirds on Southeast Farallon Island During the 2009 Breeding Season. Unpublished report to the US Fish and Wildlife Service. PRBO Conservation Science, Petaluma, California. PRBO Contribution Number 1707.
[5] Melin et al. 2010. Unprecedented Mortality of California Sea Lion Pups Associated with Anomalous Oceanographic Conditions Along the Central California Coast in 2009. CalCOFI Report, Volume 51, 2010.

forage. These events make it clear that in order to achieve the conceptual goal of maintaining a resilient food web in the CCE we need more than a moratorium on fishing unmanaged forage. Through development of a Forage Status Indicator the Council and stakeholders will identify the healthy ecological forage state that we strive to achieve and use this to evaluate whether and when we can maintain or increase the removal of forage fish from the CCE.

A Forage Status Indicator, in conjunction with the established benchmarks, can be used quantitatively (Q1) and/or qualitatively (Q2) to develop management measures and terms of reference that help ensure sufficient abundance of forage species while providing appropriate opportunities for sustainable management of existing forage species fisheries.

Q1	Biomass Numbers of Fish Age Structure of the Population (relative to a "natural" state)
Q2	Relative Value to Keystone Predators or Indicator Species 2a – Primary Prey (preferred or staple) 2b – Secondary Prey (alternate, of secondary importance as a food source)

Following the diagram below, a Forage Status Indicator could be modeled after the reference points currently used in single-species management. For example, this familiar way of measuring status over time could be used to implement the National SSC Workshop's recommendation of a system- or trophic-level optimum yield (Seagraves 2012). Because the ecological value of the CCE forage base is greater than the sum of its component parts, it would be logical to set a goal of adopting a Forage Status Indicator that incorporates the emerging standard of Target = $B_{75\%}$ and Threshold = $B_{40\%}$ to **both** individual forage species and the forage base as a whole.



A Forage Status Indicator could also use qualitative data including predator prey relationships, geographic abundance, and other ecological relationships to create a more robust assessment of forage health, from an ecological standpoint. Fishery ecologists studying conservation of important prey fish for their ecosystem services in other regions are investigating alternative indicators which might be used to inform single species management decisions, including biomass size spectra which depict the abundance and distribution of organisms at each level of the food chain and prey-predator ratios to index availability and probable vulnerability of prey to predators and serve as an indicator of expected prey mortality and predator abundance.[6]

Next Step in the Evolution of Ecosystem Indicators

Ecosystem Indicators will only be useful if they translate ecosystem information into decision criteria that foster our conceptual ecosystem goals. It is the council's responsibility at this juncture to endorse the use of Ecosystem Indicators and begin construction of a Forage Status Indicator. From there, the challenge to the council, advisory bodies and interested stakeholders will be to select a suite of additional Ecosystem Indicators that will create a framework that supports the conceptual goals of the FEP.

The council is already off to a running start. The Annual CCE Report produced by NOAA's Integrated Ecosystem Assessment team includes indicators of ecological integrity that relate either directly or indirectly to the productivity or condition of ecologically important, managed, or protected species and assemblages. According to the 2014 Annual CCE Report, "the data included should offer some perspective on the relative condition of species, species assemblages, or communities that might not be reflected in single-species metrics."[7] But, an Ecosystem Indicator is "something that is measured (not necessarily numerically) and used to track an operational objective."[8] The focal components of ecological integrity in the Annual CCE Report do not yet track the operational objectives of the FEP, but that is where we are headed with Ecosystem Indicators.

Indicators are not an end in themselves, but fit within a hierarchical framework. The process of selecting Ecosystem Indicators to develop will require creativity and a values-based review that clarifies the conceptual ecosystem goals of the FEP and identifies concrete operational objectives that qualitatively or quantitatively describe ecological, economic and social outcomes of management consistent with guidelines for National Standard 1 (NS1) of the Magnuson-Stevens Fishery Conservation and Management Act.

Once the council chooses which Ecosystem Indicators to develop, the council, together with the Integrated Ecosystem Assessment Team, advisory bodies and stakeholders will develop the indicators, reference points, performance measures

[6] Jung, S. and E.D. Houde. 2005. Fish biomass size spectra in Chesapeake Bay. Estuaries 28(2): 226-240; Uphoff, J. and C. Jones and R.M. Johnson. 2006. Predation on Menhaden. Menhaden Species Team Background and Issue Briefs. Ecosystem Based Management for Chesapeake Bay.
[7] Annual State of the California Current Ecosystem Report, March 2014, p. 6.
[8] FAO Expert Workshop on the Development and Use of Indicators for an Ecosystem Approach to Fisheries. 2009.

and decision rules for assessing and enforcing the performance of the fishery. Finally, the council will use this data to track the operational objectives of the FEP to help make decisions about managing our fisheries to achieve the goals of the FEP.

Ultimately, Ecosystem Indicators will reduce the complexity of the ecosystem but depend on careful selection in order to represent critical aspects for a functioning ecosystem. We look forward to working with you as we take the lead on developing indicators of ecosystem health that will help us to achieve our vision of a robust, productive California Current Ecosystem.

Sincerely,

Theresa Labriola
West Coast Fisheries Project Director