California Current Ecosystem

FORAGE STATUS INDICATOR

***Need and Purpose Statement*:** The Pacific Fishery Management Council's new Fishery Ecosystem Plan emphasizes the importance of biodiversity for ecosystem and fisheries stability. In taking an ecosystems approach to fisheries management, we acknowledge that overfishing single, targeted species alters or disturbs marine communities. The council recognizes the importance of conserving forage species to the health of the California Current Ecosystem. 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.

I. Forage

Defining the Forage Base: Managed and unmanaged, fished and un-fished species should be included when assessing the health of the CCE forage base. The most practical way to define the forage base, at least initially, is to include species "managed" (actively managed and monitored) under the council's Coastal Pelagic Species Fishery Management Plan, plus those "unmanaged" species listed for protection under Initiative 1 of the FEP[1].

II. Status

Determining the Metrics: The status of the forage base as a whole, as well as of individual species, may be measured quantitatively (Q1) and/or qualitatively (Q2):

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

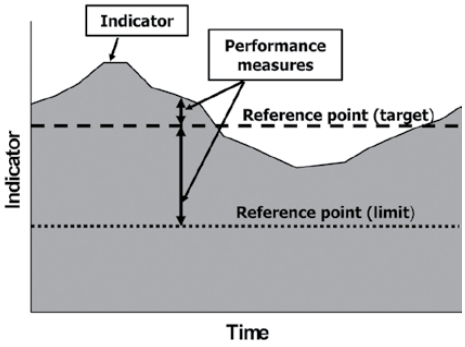
[1] Round and thread herring, mesopelagic fishes, Pacific sandlance, Pacific saury, Silversides, Osmerid smelts, and Pelagic squids.

III. Indicators

Establishing Benchmarks and Triggers: The major challenge of developing a Forage Status Indicator is identifying and cultivating a reliable index or indices of forage abundance and availability. Because the FEP is initially a non-regulatory, guidance document, benchmarks (targets and thresholds) for individual managed/fished forage species will be established through the CPS FMP. But as participants at the 4th National SSC Workshop agreed, it is equally or more important to identify an overall forage base cutoff or biomass threshold to augment species-specific goals. Ecological conditions that result in poor survival across species can have broader and greater impacts on the system than fluctuations in a single species' population level and this aggregated treatment of forage could better mitigate such fluctuations.[2]

Livingston *et al* suggest indicators to assess the ecosystem-level impacts of fishing and predict possible future trends in these indicators. Considering the ecosystem goal of maintaining predator-prey relationships, energy flow and balance within the system and species diversity, the authors recommend a quantitative index of forage biomass, with a threshold for action, as an indicator for maintaining pelagic forage availability.[3]

As in the FAO (2003) diagram to the right, a forage abundance 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 OY. (Seagraves 2012).



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. Among these are:

- Biomass Size Spectra (BBS), which depict the abundance and distribution of organisms at each level of the food chain. BSS models potentially can serve as ecological indicators, as constituents of a trophic level respond to natural or

[2] Seagraves, R. and K. Collins (editors). 2012. Fourth National Meeting of the Regional Fishery Management Council's Scientific and Statistical Committees. *Report of a National SSC Workshop on Scientific Advice on Ecosystem and Social Science Considerations in U.S. Federal Fishery Management*. Mid-Atlantic Fishery Management Council, Williamsburg, VA.

[3] Livingston, P.A., Aydin, K., Boldt, J., Ianelli, J., and Jurado-Molina, J. 2005. *A framework for ecosystem impacts assessment using an indicator approach.* ICES Journal of Marine Science, 62: 592-597

human-induced stresses.[4]

- 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.[5]

- Select indicator species whose abundance is readily monitored and is highly-dependent on prey availability throughout a wide range of habitats.

Applying the Precautionary Approach: Finally, it is important to acknowledge that, because of the many components, variables, uncertainties and trade-offs involved, "ecological reference points" do not become apparent from even the most rigorous study. They are ultimately a policy decision. Consequently, in the quest to develop ecological reference points for forage species, an overwhelming consensus has emerged around setting a minimum biomass threshold of 40% of an un-fished population (approximating the MSY level) and a target level of 75% of an un-fished population, a level thought to most fairly balance the needs of fisheries with those of the ecosystem.[6]

Because the ecological value of the CCE forage base is greater than the sum of its component parts, it would be logical to apply the emerging standard of Target = $B_{75\%}$ and Threshold = $B_{40\%}$ to both individual forage species *and* the forage base as a whole.

This briefing paper was prepared by ***Wild Oceans***, 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 essential to the survival of all fish, marine mammals, sea turtles and seabirds. For more information visit wildoceans.org.

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[4] Jung, S. and E.D. Houde. 2005. Fish biomass size spectra in Chesapeake Bay. *Estuaries* 28(2): 226-240.

[5] 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.

[6] Constable, A.J., de la Mare, W.K., Agnew, D.J., Everson, I., and Miller, D. 2000. Managing fisheries to conserve the Antarctic marine ecosystem: practical implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). ICES Journal of Marine Science, 57: 778-791; and *The ecosystem approach to fisheries.* FAO Technical Guidelines for Responsible Fisheries. Food and Agriculture Organization of the United Nations. Rome 2003; and National Marine Fisheries Service. National Standard 1 Guidelines. 2009. 50 CFR Part 600.310(e)(3)(iv)(C); and Marine Stewardship Council. 2011. Technical Advisory Board D-036: Assessment of Low Trophic Level (LTL) Fisheries. 15 August 2011; and Pikitch, E., Boersma, P.D., Boyd, I.L., Conover, D.O., Cury, P., Essington, T., Heppell, S.S., Houde, E.D., Mangel, M., Pauly, D., Plagányi, É., Sainsbury, K., and Steneck, R.S. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp.