Building an operational MBON: Vision and Opportunity

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Cross-MBON Virtual Meeting
Toward a National Operational MBON
Applied Ecosystem Function Case Studies
Marine Biodiversity Observation Network (MBON)

... a growing global initiative composed of regional networks of scientists, resource managers, and end-users working to integrate data from existing long-term programs to improve our understanding of changes and connections between marine biodiversity and ecosystem functions.

Integrate independent historical and current biology and ecosystem surveys with

• new observations,
• expanding application of remote sensing methods,
• novel molecular (eDNA) technologies,
• traditional environmental research tools, and
• coordinated experiments.
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Thoughts/discussion on:
- requirements for an operational MBON and what it would deliver, and
- how to engage NOAA and other external agencies nationally (and internationally).
Drawing on (seemingly) unrelated threads...
Changes in food web structure and interactions

Anchovy populations were low from 2011-2014, yet, 2015-2018 (a warm period) produced some of the strongest year classes.

eDNA-based characterization of prey & predators has the potential to provide insight on recruitment fluctuations.

(Courtesy of Rasmus Swalethorp, Scripps Inst. Oceanography, and Andrew Thompson, SWFSC, 2019)
Central California anchovy stock biomass and north end of their distribution expanded greatly from 2017-2019 summer CPS trawl surveys.

(NMFS Tech Memos)

(Courtesy of Nate Mantua, NOAA SWFSC)
Mechanisms, impacts, and mitigation for thiamine deficiency in Central Valley salmon

Thiamine Deficiency Complex (TDC)

Thiamine is **Vitamin B₁** (Fish don’t produce it)

It is an essential vitamin (we all require)

*Observed between hatch and first feeding and characterized by:*

- Loss of equilibrium
- Swimming in a spiral pattern
- Lethargy
- Hyperexcitability
- Hemorrhage, etc.

**Neurological Symptoms**

[Photos courtesy Dale Honeyfield, USGS]

(Courtesy of Rachel Johnson, SWFSC)
Identify the cause: Are anchovies to blame?

- Anchovies produce an enzyme (thiaminase) that breaks down B₁
- Early evidence salmon in 2019 narrow diet only anchovy [not squid, krill, or rockfish]
- Ongoing efforts to measuring thiamine, thiaminase, and stable isotopes in salmon prey from 2019 and 2020

- Fishing industry partners and CDFW Ocean Salmon Project collected and stored Chinook salmon stomachs in 2020 for gut content analysis.
- 2020 Chinook stomachs (N=337) dominated by anchovy (65%), empty (20%), Krill (7%); 97% anchovy by weight

(Courtesy of Rachel Johnson and Nate Mantua, SWFSC)
Domoic acid events more frequent with warming

- Domoic acid first identified in 1991 in Pacific Northwest
- Linkage to warmer ocean conditions

(Courtesy of Vera Trainer, NWFSC)
HAB: U.S. West Coast Domoic Acid

2015 Impacts

Razor clam harvests: tribes, commercial, recreational

2015 $100M loss

From McCabe et al. 2016

(Courtesy of Vera Trainer, NWFSC)
Measurable DA in ALL anchovy & sardine (2015)

Other cascading effects of HABs

High domoic acid levels (via consumption of prey, e.g., anchovies) known to impact sea lions – can it also affect whales?

“Seizuring” sea lion (off WA coast)

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“Eastern boundary current coastal upwelling systems are among the most biologically productive regions in the global ocean (e.g., Ryther 1969).

In the past two decades, short-term shifts in the dominant phytoplankton group from diatoms to dinoflagellates have been observed in the CCS ... with ecological and economic impacts related to increased dinoflagellate harmful algal blooms (HABs). When dinoflagellates dominated the CCS phytoplankton community and base of the food web in 2005–2006, zooplankton biomass, forage sh biomass, and seabird fecundity decreased, and marine mammal foraging was altered...”
... to fisheries & protected species...
to human health...

Environmental Sample Processor

- Laboratory in a can
- Identifies organisms through DNA-DNA hybridization
- Data integrated into management decisions, with data products available in near real-time

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Shore-based

server
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2G ESP with cell modem

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Data available as little as 3 hours after sample collection
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Northwest Association of Networked Ocean Observing Systems (NANOOS):
to date, domoic acid and six HAB species reported via portal

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End-user notification & data dissemination
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Near-real time data handling and visualization for coastal managers via the NANOOS Data Visualization System

Pacific Northwest HAB Bulletins
www.nanoos.org/products/habs/
www.orhab.org
MBON is more than about “observing biodiversity”.

It’s about understanding the changes in ecosystem structure and function to anticipate future states of our marine systems, services, and resources, and develop actions for the benefit of the communities that depend on them.

It’s time (we know the questions and we have the tools) to think BIGger!
Thank you

Special thanks to Rachel Johnson, Nate Mantua, Andrew Thompson, Vera Trainer, Kelly Goodwin, Frank Muller-Karger, and many others for thoughtful discussions and invaluable input.