NOAA Science Advisory Board
ESMWG
Washington, DC
December 17, 2019

Topic 9 Report to the Science Advisory Board

Dr. Michael Castellini, University of Alaska
Dr. Robert Johnston, Clark University
Co-chairs

IMPROVING FISH STOCK ASSESSMENTS

A REPORT ON EMERGING STOCK ASSESSMENT TECHNOLOGIES

PRESENTED TO THE NOAA SCIENCE ADVISORY BOARD
BY THE SAB ECOSYSTEM SCIENCES AND MANAGEMENT WORKING GROUP

DECEMBER 17, 2019

CONTEXT

SAB Work Plan Topic 9:

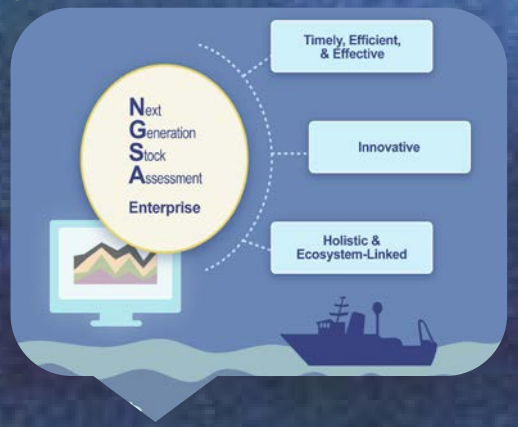
"Evaluate fisheries monitoring technologies to improve stock assessments. This evaluation should consider how to optimally balance electronic monitoring, eDNA, and other technologies…"

2018 Stock Assessment Improvement Plan (SAIP):
"To provide the best information possible and meet the demands for increased quality and quantity of stock assessments, we must continually improve stock assessments with new developments in science and technology."

2016 ESMWG report on Emerging Technologies

TIMELINE

- 2016: ESMWG report on broader New Technologies for NOAA
- May 2018: ESMWG discussions begin on Topic 9
- July 2018: SAB formally requests ESMWG Topic 9 report
- Fall 2018: ESMWG outlines concept
- May 2019: In-person meeting with NOAA experts
- May/July 2019: Literature review and writing
- July 2019: Draft outline to SAB
- October/November 2019: ESMWG meeting, writing & editing.
- December 2019: Submit report to SAB



Topic 9 Report Structure

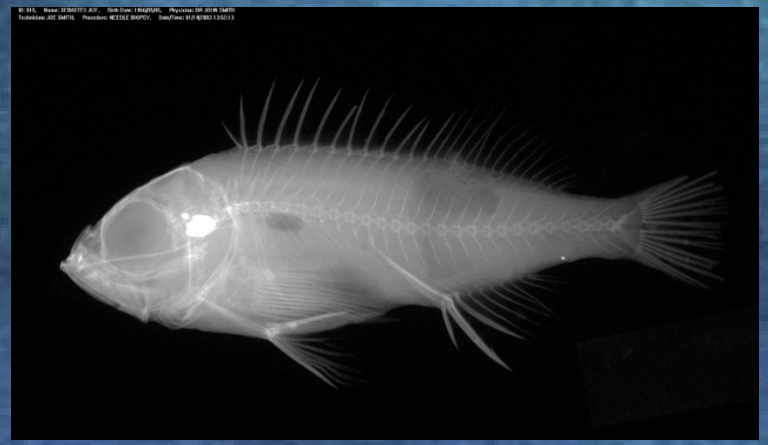
Three example technologies suggested by NOAA categorized by Technical Readiness Level:

TRL 1 = Research to TRL 9 = Fully Deployed

- Near term and currently being field verified TRL 7-8
  - Modern spectroscopy methods for fish aging
- Medium term at field testing stages TRL 5-6
  - Remote observing systems, e.g UxS surface vehicles
- Longer term development in laboratory and field TRL 2-3
  - ‘Omics and molecular methods

Near term: Dedicated field comparisons underway (TRL 7-8)

Modern methods in fish aging through otolith analysis



Near IR FFT analysis of composition of otolith layers provides rapid age estimation with good precision, and greater than 800% efficiency compared to traditional methods.

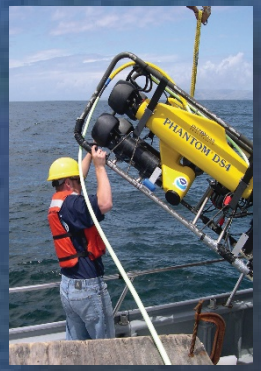
- Consulting NOAA expert: Dr. Tom Helser; AFSC

Medium term: Calibration, testing, trials (TRL 5-6)

Remote observing systems (e.g. UxS) for assessment of population distributions and oceanic conditions

Multiple trials underway. Comparing to ship trawls and wide or rapid deployment.

Consulting NOAA expert: Christian Meinig; PMEL

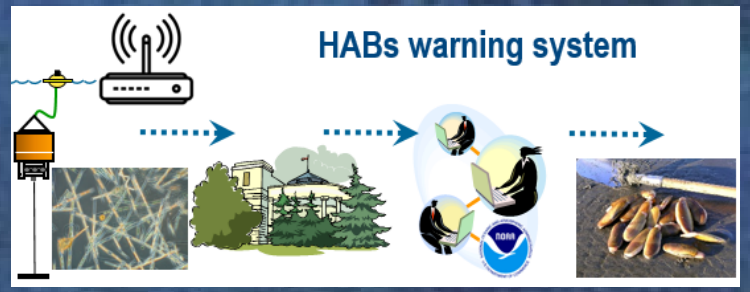


Longer term: Conceptual models, proof of concept studies, laboratory and university collaborations (TRL 2-3)

‘Omics and molecular methods

Environmental eDNA for species identification, presence, distribution, life history.

Consulting NOAA expert: Dr. Kelly Goodwin, OAR, AOML, SWFSC



Major Findings

All of the technologies have tremendous potential for enhancing current stock assessment methods. Some are more applicable to particular fisheries than others, but the potential for new directions and strategic utilization is high.

They should be considered *synergistic with ongoing stock assessment methods and processes*, and cannot serve as stand-alone replacements or provide immediate solutions to time, effort, funding and ship-use constraints.

Data created by some of these new techniques produce information that is substantially different from current data inputs to stock assessment and may have distinct biases that will need to be evaluated before they can be used.

These and other new methods will require dedicated studies comparing their results to NOAA's current best practices to ensure a high degree of integrity, reliability and credibility in stock assessments for fisheries management.

Major Findings

These techniques can expand the options, efficiency and accuracy of some existing NOAA research tools and may eventually enable new questions to be addressed.

The technologies require specialized personnel training to maximize their use.

These methods will likely provide information that goes beyond stock assessment and into areas of environmental assessment, ecosystem-based fisheries management, natural history and core biological information about the target species

Recommendations

A. Although new technologies may lead to efficiencies in the medium to long-term time frames, they should not be viewed primarily as cost-saving approaches, but rather as a means to improve stock assessments and ecological monitoring moving forward.

B. NOAA will need to examine whether and how the new technologies can be linked to current stock assessment models and supporting analyses.

C. New technologies can be advanced by holding workshops with diverse experts to develop ideas for how to apply these new technologies to stock assessment.

D. Side-by-side dedicated comparisons between new technologies and ongoing stock assessment analyses will be needed to advance these new techniques.

Recommendations

E. NOAA will need to invest in laboratory and field testing of these methods…and should consider Public-Private-Partnerships (P3) to develop support for these methods in areas where the agency does not have primary responsibility.

F. NOAA should explore the potential for workforce development, cooperative institutes, postdoctoral programs and training classes to provide current and prospective NOAA scientists training for these methods.

G. NOAA should consider how artificial intelligence, cloud computing and other approaches can be applied to process the large volumes of data that will be generated, and should consider implications for data access and ownership.

Conclusion

To make use of emerging technologies, NOAA will need to investigate how these and other new methods could be useful to validate, expand and provide new possibilities for improving, and possible reducing the costs and effort, of stock assessment analyses. However, given the levels of readiness of the techniques themselves and the ability of stock assessment models to accept new types of data, many technologies do not appear ready to replace current approaches on a wide scale. In the near-term, they could be useful for broad Ecosystem Based Fisheries Management (EFBM) efforts and might be especially useful in data-poor fisheries. All use will require trained personnel. The techniques clearly hold potential for new scientific developments beyond stock assessments and could open up new research directions for NOAA.

Questions & Comments