

Lenfest Ocean Program Town Hall Event Summary: *Benchmarks for Ecosystem Assessment: Indicators for Practical Ecosystem-Based Fisheries Management*

Hosted by the Lenfest Ocean Program during the 4th International Symposium on the Effects of Climate Change on the World's Oceans, June 4 – 8, 2018 in Washington, D.C.

Event Overview

On Wednesday, June 6, 2018 the Lenfest Ocean Program hosted a town hall event to discuss a recently funded project – [Benchmarks for ecosystem assessment: Practical indicators for ecosystem-based fisheries management](#) – on the development of indicators for ecosystem structure and function, along with guidelines for applying them in a variety of ecosystems and management contexts. The work is being led by Drs. Beth Fulton (Principal Senior Research Scientist, Commonwealth Scientific and Industrial Research Organization (CSIRO)), and Keith Sainsbury (Professor, Marine Systems Management, University of Tasmania) and involves a collaboration of scientists, managers and policymakers from four case study regions:

- Bering Sea – Alaska, U.S.A.
- Marine waters off of Southeast Australia
- Marine waters off of Southwest India
- Humboldt current upwelling system – Chile

In this lunchtime discussion, Charlotte Hudson, Director, Lenfest Ocean Program, discussed the Lenfest Ocean Program and its work to strengthen relationships between science and decision-making through funding usable science. Dr. Beth Fulton then provided an overview of the project, its progress to date, including collaborating with managers and policymakers to better align indicators of ecosystem structure and function with existing management frameworks and processes. In this document, we provide a summary of the speakers and group discussion.

Connecting Science to Policy: Funding Usable Science

Charlotte Hudson, Director, Lenfest Ocean Program

The Lenfest Ocean Program is a grant-making program that supports peer-reviewed scientific research that informs decisions about the world's oceans. We fund projects that address science needs at the intersection of science and policy. Our projects seek to generate adaptive recommendations, seed innovation, and empower people with scientific knowledge.

Connecting Science to Decision-Making Through Grants



Our process has evolved over the last 15 years. Initially, we would hear project ideas from scientists that they believed would inform some management decision. If funded, the project would yield peer reviewed papers, which we and the scientist then provided to decision-makers, often with minimal follow up.

However, we quickly learned how critical it is to bring decision-makers and other potential end users into projects from the beginning. We adapted our process to identify new projects by investing substantial time at the outset into engaging with policymakers, managers, and stakeholders. Through these efforts, we came to more thoroughly understand the most pressing ocean policy and management issues, and the associated information needs and research gaps that impede decisions. We then worked with leading researchers to develop rigorous projects that address those gaps.

Our projects may be led by a single researcher or by interdisciplinary research teams, depending on the research question and scientific methods, and they may address issues at the regional, national, and international scales. Once projects are underway, we work with the researchers to continue to involve decision-makers and stakeholders. This ensures researchers stay focused on policy-relevant questions and approaches, and can adjust to any shifts in the policy landscape. And congruently, decision-makers are able to respond to scientific results as they emerge.

Project Now Underway: Benchmarks for Ecosystem Assessment

We funded this project in the Fall of 2017. Dr. Fulton will describe the project in more detail, but what is equally critical to us at the Lenfest Ocean Program is not just what Drs. Fulton and Sainsbury aim to accomplish, but how they intend to accomplish it. They have convened an advisory body of fishery managers, policymakers, and other scientists to help guide the selection and development of indicators. This essentially positions scientists and decision-makers as partners in conducting the science, rather than the typical approach of scientists as generators of knowledge and decision-makers as recipients.

It is our hope that not only will valuable indicators be generated that inform ecosystem-based fisheries management (EBFM), but also by putting in place a collaborative process, the project will help bring the realms of science and decision-making closer together. Both outcomes are equally important to the Lenfest Ocean Program.

Connect With Us

If you would like to learn more about any of our projects, or have a project idea, please reach out to me at chudson@lenfestocean.org. We are always looking to better understand science-policy landscapes, and new research ideas that can advance dialogues and inform decisions.

Developing Ecosystem-Based Fisheries Management Indicators: Work to Date

Beth Fulton, Keith Sainsbury, Ingrid van Putten, Linda Thomas, Leo Dutra, Fabio Boschetti, Jacob Rogers, Sara Hornborg, Camila Novaglio

Operationalizing EBMF has faced many hurdles, not the least of which have been:

1. Recognizing when a marine ecosystem is compromised – as exhibited by reduced resilience, diminished productivity, or disrupted species relationships – or is at serious risk of becoming compromised;
2. Implementing EBFM in ways that are suitable for multiple fisheries, operating in diverse ecosystems and under different fisheries management systems; and
3. Identifying which indicators can help deliver the most useful scientific information into those fisheries management systems.

Project Goal: Inform Multi-Species Fisheries Management

A significant gap in operational capacity extends from a lack of scientific agreement on what indicators best reflect the structure and function of an ecosystem and how to relate such indicators to management decisions regarding individual species exploitation and broader ecosystem state. In this project, we will develop practical indicators for ecosystem structure and function, along with guidelines for applying them in a variety of ecosystems and management contexts. The idea is to build on existing management approaches by relating species or groups of species to their ecosystem role and vulnerability, and then identify ways to steer the ecosystem in desirable directions (as defined by management and policy objectives).

To start, we are working with scientists, managers and policymakers from four case study regions:

- Bering Sea – Alaska, U.S.A.
- Marine waters off of Southeast Australia
- Marine waters off of Southwest India
- Humboldt current upwelling system – Chile

However, we hope to expand partnerships, including with other scientists and nations that may be able to benefit from this work as we go.

Project Structure: International Team of Scientists and Collaborating with Decision-Makers

We are working with an international team of scientists to conduct the work in three primary phases:

1. Review: We are currently consolidating a variety of indicator options (i.e., social, economic, institutional, ecological, and network) based on existing scientific efforts.
2. Model-based testing: We will use a range of existing and new models (i.e., MICE models and system models) to test the performance of the most promising indicators across different ecosystem types, target species, levels of selectivity, and levels of fishing intensity. Informed by the outcomes of these simulations, we will define thresholds and benchmarks for ecosystem structure and function.
3. Empirical testing and application: We will use data and models from the case study regions to explore the robustness of ecosystem assessments and potential EBFM management approaches for multi-species fisheries.

Guiding these phases is an advisory committee composed of a manager, a policymaker, and a scientist from nations associated with four case study regions. The purpose of the committee is to work with the researchers to identify indicators that could be readily applied in their regions, and what challenges would need to be overcome in the context of local conditions and objectives. They will ground the research in existing regulatory frameworks and advise on how best to operationalize the findings, ensuring the indicators can be adopted into existing fisheries management programs.

Project Status: What We're Learning

We are currently in the first phase of reviewing indicator options. Some commonalities are starting to emerge. Review of human dimension indicators, which include institutional, social, and economic indicators, has revealed insights into management objectives. For institutional indicators, most existing indicators relate to government effectiveness and governance structure; for economic indicators, most relate to catch profitability and costs; and for social indicators, most relate to equity and employment. On ecological indicators, there are multiple existing reviews to build upon due to the growing interest in ecosystem-based management over the last 15 or so years. However, while there are many indicators about understanding ecosystem state and trends, there are few for ecosystem structure and function.

The Work Ahead

We're working to explore candidate indicators across not only fisheries science and economics, but also more distant disciplines such as medicine, traffic flow, and stock markets to better understand if anything is adaptable to challenges related to fisheries management. We aim to use models to test and filter ideas under a range of different stressors (man-made or otherwise) and environmental conditions, then supplement with network models to get at structure and function, including identifying reference points and exploring thresholds based on management and policy objectives.

We can then compare different indicators and ecosystem trajectories in terms of what is desirable and undesirable. Network models offer a lot of promise as tools to analyze food webs, and characterize the relationships between species, from predator-prey interactions to transmission of productivity, and between species and their environment, from vulnerability to different stressors to responses to changing ocean conditions.

Group Discussion

Facilitated by Charlotte Hudson

We asked to hear reactions and ideas from the group. Specifically, we requested feedback on:

- recommended available datasets and candidate indicators of ecosystem structure and function;
- perceived challenges or barriers to developing suites of these indicators for a variety of ecosystems and management contexts;
- common experiences related to operationalizing EBFM and/or scientist-decision-maker collaborations from other regions; and

- ideas on how usable indicators can better facilitate adaptive EBFM frameworks in the face of environmental change.

Question & Answer

1. Are you trying to link the indicators to management goals, and if so, how?
 - a. By bringing managers in from the beginning, we've already started the conversation about linking indicators to management goals. We held the first meeting of the research team and the Advisory Committee in Chile in late May. There, we discussed management objectives that are already in place in each of the case study regions. Our plan is to then build upon those existing objectives, and to create guidelines on how to go about such a process.
2. If you have an objective how do you know if you've identified the right indicator to track progress towards that objective?
 - a. There is a fair amount of existing research from NOAA Fisheries on defining reference points for ecological indicators. There isn't so much on indicators of structure and function specifically. However, network theory is potentially valuable in helping us think through this challenge.
3. In terms of testing indicator performance, I think about whether an indicator reflects the thing it's measuring, and if it then matches an objective. But is it also relevant to management? Or can it be translated into an appropriate management response?
 - a. We aim to explore this in the four formal case studies regions, but yes, they can be. For example, we plan to explore specific management options, such as harvest control rules, in simulation testing.
4. This is a related question around policy thresholds in harvest control rules, and historical fishing patterns by a specific fleet. I am wondering if you have started thinking about that under changing ocean conditions and what that might mean going forward?
 - a. Yes. First, some patterns won't change, but we are running through data with known changes (in gear type) through time, and trying to identify métiers that are winners and losers.
5. I am working with the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to advance their ecosystem-based fisheries management plan. First, I'd be interested in seeing if our efforts can align in some way. And second, when do you expect to see products?
 - a. We are very happy to share the methods, products, and ideas. The project is another 2.5 years, but we want products to be coming out during that time. Guidelines for how to practically develop usable indicators should come over the next year, including training courses. However, published papers will take longer, given journal timelines.
6. In Alaska, some fishing organizations and NOAA Fisheries have an ongoing ecosystem assessment that includes seabirds. It is unclear how that feeds into modeling in the region, but will your effort include seabirds?

- a. The Alaska Fisheries Science Center is one of our formal partners. Thus, they are actively engaged in showing us how to use indicators, including formal ways to bring in time series like seabirds based on what is culturally and managerially relevant.
- 7. Is data collection at all part of the process, or at least identification of data collection needs?
 - a. Part of the project is looking to see if there's big data gaps in the ecological and fishery science fields. So far, across the case studies – which represent a diverse set of circumstances in terms of data types and availability – there has been enough to identify indicators of structure and function, which is a positive sign. We want to see how much we can do with what we already have, and that is part of why we chose our different case study regions. We will see.
- 8. I have been working with managers and fishermen a long time on these issues. Are you looking for any indicators of climate forcing, especially given that concern for changing ocean conditions varies across different stakeholders?
 - a. It's not just a cognitive issue. It depends on what species (and fisheries) you are looking at. For example, in Australia, it only took about 9 months for climate change to transition into an issue that fishermen widely cared about. As we gather new information and knowledge, sometimes it's not about convincing everyone in the industry that they should care, but reaching a few key players and relating the issue to their specific experiences.
- 9. How do you plan to reconcile both ecological and human dimensions indicators, and translate them to more fully understand tradeoffs?
 - a. So far, our experience is to not try to convert them into one value or currency. In that sense, they are difficult to translate or compare. It is more like a pie chart, so you are not biasing it by putting certain indicators first, and you can then have qualitative and quantitative indicators in the same space.
- 10. How do you plan to account for observational issues raised by extracting indicators from real world systems?
 - a. We have in place a two-part filter before any is released: First, they must pass a knowledge filter, i.e. perform well under knowledge-rich conditions with little uncertainty. Second, they must pass through simulation testing involving the way people sample. Then we take into the real world, i.e. they will be tested and calculated with real world data.
- 11. I am involved in indicator development with the Marine Strategy Framework Directive (of the European Commission). We have a big list of indicators, but our issue is we don't have good models. Will you test indicators that come from models?
 - a. We'll take ones we can anywhere, but we are aware that model-based indicators are problematic if the system has changed. We need simple indicators, and I am inclined to think it will be largely data-based, perhaps with some statistical testing to help understand it better.
- 12. Are you thinking about spatial indicators as well, and how are you accounting for environmental change?

- a. We are thinking about spatial indicators using down-scaled products and historical ranges to help account for environmental variation. This will help give some sense of past changes, especially those that might continue to happen and even be amplified. It will also give some insight into the opposite, i.e. past changes that may no longer happen.
13. How does the project build on the IndiSeas effort?
- a. We are building upon those, but given that we don't collect fishery independent data in Australia, we won't have the opportunity to build upon it there. So we plan to relax some of the constraints from that effort so we can learn more lessons from it. And we do admire the collaborative nature of that effort, and are emulating that.
14. I am looking forward to your outputs. Do plan to extract lessons from the case study regions – especially approaches to data-limited situations – that can be applied to other places?
- a. Yes. Australia is data-limited. India collects a lot of data, but there's also a lot of people. In Alaska, there is a lot of data and longer time series. We can use that to explore the best ways to use the data and everything that can be done with it. Our goal is for it to be transferable to other regions out of the gate.
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