Towards operational assessments: selection, vetting, and standardized analysis of ecosystem indicators for the Northeast US Large Marine Ecosystem

Sarah Gaichas (1), Jason Link (2), Jon Hare (3), Michael Fogarty (1), Patrica Pinto da Silva (1), Geret DePiper (1), Jamie Cournane (4), John Manderson (5), Sean Lucey (1), Mike Lowe (6), Scott Large (1), and Gavin Fay (1)

(1) NOAA NMFS Northeast Fisheries Science Center, Woods Hole, MA, USA; (2) NOAA NMFS Office of the Assistant Administrator, Woods Hole, MA, USA; (3) NOAA NMFS Northeast Fisheries Science Center, Narragansett, RI, USA; (4) New England Fishery Management Council, Newburyport, MA, USA; (5) NOAA NMFS Northeast Fisheries Science Center, Sandy Hook, NJ, USA; (6) Woods Hole Oceanographic Institution, Woods Hole, MA, USA. Presenter contact details: Sarah.Gaichas@noaa.gov, Phone +1-508-495-2016

Summary

Operational ecosystem assessment requires a transparent and systematic approach to selection, analysis, and evaluation of information. Time series of ecosystem indicators are collected and available in many regions, but data may be of varying quality or relevance to a given set of management objectives. Here, we show two examples of how ecosystem indicator time series can be treated transparently and systematically as we move towards operational integrated ecosystem assessment. Systematically analyzing indicators contributes to both developing integrated assessment and prioritizing indicator development for improving these assessments.

Introduction

Marine ecosystem status reports with large numbers of indicators are being developed in many regions. What are the next steps towards operational assessments that make the best use of this information? Indicators are useful in preliminary risk analyses to prioritize issues for further evaluation, including management objectives (Fletcher, 2005). In turn, operational management objectives guide the selection and vetting of ecosystem indicators for use in integrated assessments (Levin et al., 2009).

Materials and Methods

In the Northeast US, an Ecosystem Status Report (ESR) is available and updated biennially (EcoAP, 2012). We present two examples of practical use of the ESR ecosystem indicators in risk assessment and preliminary IEA analysis. In the first example, we performed a standardized analysis of ecosystem pressure indicators from this ESR in a preliminary climate risk assessment for the Northeast US. In a second example, we selected a suite of indicators to determine their utility in measuring performance relative to multiple ecosystem-level conservation and socio-economic management objectives. Indicator evaluation criteria (ICES, 2013) were then applied to determine whether data quality and management relevance were adequate for use in assessments.

Results and Discussion

ESR climate indicators were applied in a risk assessment using a standardized analysis to evaluate the probability that anticipated climate changes (e.g. warming water, altered boundary currents, increased stratification) would occur in specific Northeast US regions (Fig 1). In addition, the potential severity of change over the next 10 years was evaluated using semi-quantitative analysis (Gaichas et al., 2014). While the ESR had previously presented the range of variability of these physical oceanographic indicators, this analysis reported their current status relative to a historical baseline, and also suggested which were most useful in assessing near-term climate impacts on living marine resources in two distinct ecosystems managed by different entities on the Northeast US shelf.

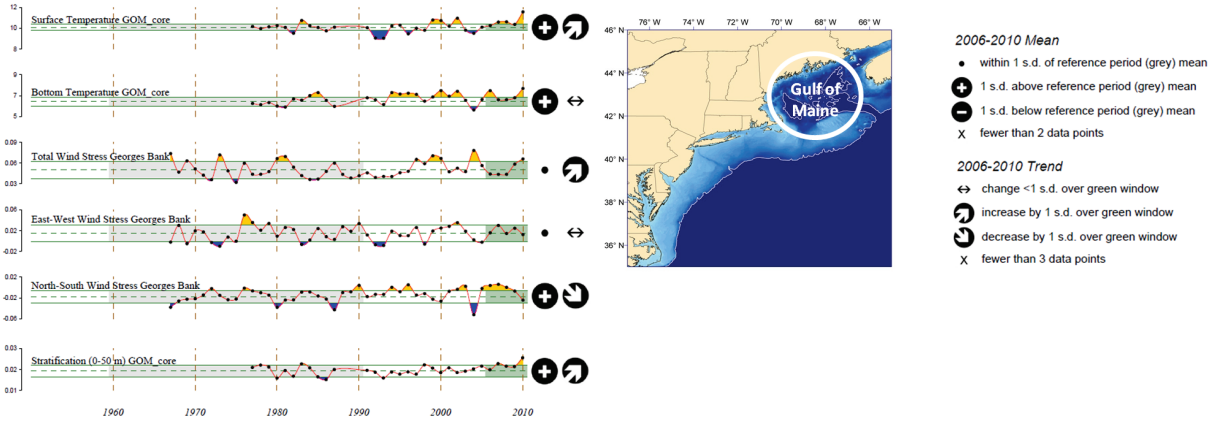

Figure 1. Standardized analysis of ecosystem indicators for climate risk assessment in the Gulf of Maine (GOM)

ESR (and other) indicators were next selected and rated using ICES criteria to determine their utility for assessing the ecosystem status relative to specific biological and socio-economic objectives. Considerable work was required to translate broadly stated management goals into specific, measurable, achievable, relevant, and time-bound ecosystem-based management objectives. We specified conservation objectives related to biomass and productivity of individual species, habitat integrity, and trophic structure, and socio-economic objectives related to food provision, recreational opportunities, commercial profits, employment, and stability. Once objectives were stated specifically, indicator selection was greatly streamlined, although further iteration and clarification of objectives is likely necessary. Indicators varied in availability and quality. Biomass and productivity indicators, which are standard in fisheries management, generally scored well relative to the ICES criteria for harvested species. Fewer existing ESR indicators addressed the habitat and trophic objectives, but substantial data are available to develop these indicators for the Northeast US shelf. Socio-economic status indicators relevant to the specific objectives are envisioned, and data are available to calculate them; however, time series are short relative to conservation indicators. The ICES indicator evaluation criteria seemed less oriented towards socio-economic indicators and management objectives than towards conservation objectives, so further development of both indicators and evaluation criteria for human dimensions in IEAs seems necessary.

Systematically analyzing indicators contributes to both developing integrated assessment and prioritizing indicator development for improving these assessments, all necessary in the broader context of operational integrated ecosystem assessment. The next steps in the process include testing the performance of the indicators relative to the management objectives, and defining thresholds for management action based on the indicators and the objectives (Fay et al., 2013; Large et al., 2013).

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