Annotated Bibliography of Integrated Ecosystem Assessment Concepts, Methods, Evaluations, and Implementation Examples
NOAA IEA Task Team
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Conceptual Framework Documents

Canada's Oceans Strategy/Policy and Operational Framework for Integrated Management of Estuarine, Coastal, and Marine Environments

The Oceans Act calls on the Minister of Fisheries and Oceans to lead and facilitate the development of a national oceans strategy that will guide the management of Canada's estuarine, coastal, and marine ecosystems. This strategy provides the overall strategic framework for Canada's oceans-related programs and policies, based on the principles of sustainable development, Integrated Management, and the precautionary approach. The central governance mechanism of the Strategy is applying these principles through the development and implementation of Integrated Management plans. This document is intended to foster discussion about Integrated Management approaches by setting out policy in the legislative context, along with concepts and principles. The document also proposes an Operational Framework with governance, management by areas, design for management bodies, and the type of planning processes that could be involved.

Canada's Oceans Strategy: Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada. 2002. Fisheries and Oceans Canada, Oceans Directorate, Ottawa, Ontario. ISBN 0-662-32449-8.
Source: http://www.cos-soc.gc.ca/doc/pdf/im_e.pdf

Translating Ecosystem Indicators into Decision Criteria

Defining and attaining suitable management goals probably represent the most difficult part of ecosystem-based fisheries management. To achieve those goals we ultimately need to define ecosystem overfishing in a way that is analogous to the concept used in single-species management. Ecosystem-based control rules can then be formulated when various ecosystem indicators are evaluated with respect to fishing-induced changes. However, these multi-attribute control rules will be less straightforward than those applied typically in single-species management, and may represent a gradient, rather than binary decision criteria. Some ecosystem-based decision criteria are suggested, based on indicators empirically derived from the Georges Bank, Gulf of Maine ecosystem. Further development in the translation of ecosystem indicators into decision criteria is one of the major areas for progress in fisheries science and management.

Link, J.S. 2005. Translating ecosystem indicators into decision criteria. *ICES Journal of Marine Science*, 62:569-576.
Source: The full text version of this paper is available via http://www.sciencedirect.com/

Environmental Health Indicators

Rice, J. Environmental health indicators. *Ocean & Coastal Management* 46 (2003) 235-259.

Source: The full text version of this paper is available via http://www.sciencedirect.com/

The Large Marine Ecosystem Concept: Research and Management Strategy for Living Marine Resources (circa 1991)

Sherman, K. The large marine ecosystem concept: research and management strategy for living marine resources. *Ecological applications*, 1(4), 1991, 349-360.
Source: The full text version is available via JSTOR.

Methods/Tools

Identification of Ecologically Significant Species and Community Properties

As with the criteria described above for Ecologically and Biologically Significant Areas, consistent criteria and guidance for their application are needed also for the identification of species and community properties for which protection should be enhanced, while allowing sustainable activities to be pursued in the ecosystem. This report contains the results of a national workshop held in 2006 to develop *a priori* criteria to assess species and community properties that are "particularly important" or "significant" with regard to maintaining ecosystem structure and function. Assessments using these criteria as a tool to rank species and community properties by their ecological significance are an important step in developing ecosystem objectives for integrated management.

Department of Fisheries and Oceans, 2006. Identification of Ecologically Significant Species and Community Properties. DFO Can. Sci. Advis. Sec. Sci. Advis. Report 2006/041.
Source: (delivered by DFO as an attachment that is stored currently in the IEA folder on the MB drive under the heading Canada_DFO_SAR_ESS_2006-041.)

Climate Change Impacts for the Conterminous USA: an Integrated Assessment

This special issue of the journal *Climatic Change* describes an effort to improve methodology for integrated assessment of impacts and consequences of climatic change. The methodology developed involves construction of scenarios of climate change that are used to drive individual sectoral models for simulating impacts on crop production, irrigation demand, water supply and change in productivity and geography of unmanaged ecosystems. Economic impacts of the changes predicted by integrating the results of the several sectoral simulations models are calculated through an agricultural land-use model. While these analyses were conducted for the conterminous United States, their global implications are also considered, as is the need for further improvements in integrated assessment methodology. The final chapter summarizes highlights of the first seven sector-specific chapters that constitute this special issue. These projects were supported by the National Science Foundation through the Methods and Models in Integrated Assessment Program and in some cases also by the U.S. Department of Energy Integrated Assessment Program, Biological and Environmental Research.

Edmonds, J.A., and N.J. Rosenberg. 2005. Climate change impacts for the conterminous USA: an integrated assessment. *Climatic Change* 69, 1-162. (the link to the summary chapter below (pgs 151-162)
Source: NOAA does not support the full text link needed to access this article.

Identification of Ecologically and Biologically Significant Areas
Department of Fisheries and Oceans, 2004. Identification of Ecologically and Biologically Significant Areas. DFO Canadian Science Advisory Secretariat. Ecosystem Status Report 2004/006.
Source: http://www.dfo-mpo.gc.ca/csas/Csas/status/2004/ESR2004_006_e.pdf
Note: For a recent geographic application of these criteria please see:
DFO, 2006. Proceedings of the Zonal Workshop on the Identification of Ecologically and Biologically Significant Areas within the Gulf of St. Lawrence and Estuary. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2006/011.
Source: http://www.dfo-mpo.gc.ca/csas/Csas/Proceedings/2006/PRO2006_011_B.pdf
Documentation for the Energy Modeling and Analysis eXercise (EMAX)
Link, J.S., Griswold, C.A., Methratta, E.T., and Gunnard, J. (Editors). 2006. Documentation for the Energy Modeling and Analysis eXercise (EMAX). Northeast Fisheries Science Center. Ref. Doc. 06-15, 166 pp.
Source: http://www.nefsc.noaa.gov/nefsc/publications/series/crdlist.htm
Computer-Based Models in Integrated Environmental Assessment
Peirce, Martin. 1998. Computer-based Models in Integrated Environmental Assessment. Technical report no 14, prepared for the European Environment Agency, Copenhagen, Denmark. 60 pp.
Source: can be downloaded at http://reports.eea.europa.eu/TEC14/en
Self-Organizing Map Methods in Integrated Modeling of Environmental and Economic Systems
Shanmuganathan, S., P. Sallis, and J. Buckeridge. 2006. Self-organizing map methods in integrated modeling of environmental and economic systems. *Environmental Modeling & Software* 21, 1247-1256.
Source: The full text version of this paper is available via http://www.sciencedirect.com/
Linking Ecology and Economics for Ecosystem Management
Farber, S. et al. 2006. Linking Ecology and Economics for Ecosystem Management. *BioScience* 56, 121-133.
Source: http://www.uvm.edu/giee/research/publications/Farber_et_al_2006.pdf
Supporting European Marine Integrated Ecosystem Assessments (SEMIEA)
ICES. 2004. Supporting European Marine Integrated Ecosystem Assessments: Specific Support Actions. Copenhagen, Denmark. 36 pp.
Source: http://www.ices.dk/globec/regns/SEMIEA.pdf

Evaluations of Integrated Assessment Products and Processes

Canadian Guidelines on Evaluating Ecosystem Overviews and Assessments: Necessary Documentation
The integrated management of human activities on the sea under Canada's Oceans Act calls for implementation strategies based on an ecosystem approach. In planning many of the activities necessary for integrated management, such as setting ecosystem objectives, identifying areas requiring enhanced protection, and developing regulatory approaches to various activities, it is necessary to have a reasonable understanding of the ecosystem being managed. The Department of Fisheries and Oceans has adopted an approach of preparing two types of documents--Ecosystem Overview Reports and Ecosystem Assessments to provide a common factual basis for dialogue among the parties in

integrated planning and management. Initial ecosystem overview reports and partial integrated ecosystem assessments were prepared for two ecosystems for which integrated management approaches are currently being developed: the Eastern Scotian Shelf and Gulf of St. Lawrence systems. The overview and assessment documents for the two systems were prepared in different ways, allowing the Department of Fisheries and Oceans to report here on insights gained from a review held in 2005 on the desirable contents to be included in both types of documents.

Department of Fisheries and Oceans, 2005. Guidelines on Evaluating Ecosystem Overview and Assessments: Necessary Documentation. DFO Canadian Science Advisory Secretariat Report 2005/026.
Source: http://www.meds-sdmm.dfo-mpo.gc.ca/csas/applications/publications/publication_e.asp?year_selected=2005&series=SSR

Standard Table of Contents for Canadian Ecosystem Overview and Assessment Reports
Source: (delivered by DFO as an attachment that is stored currently in the IEA folder on the MB drive under the heading Canada_DFO_EOA_report_StandardTOC_Oct2006-1)
Participatory Integrated Assessment Methods – An Assessment of Their Usefulness to the European Environmental Agency
Toth, F.L. 2001. Participatory Integrated Assessment Methods – An Assessment of Their Usefulness to the European Environmental Agency. Technical Report No 64 prepared for the European Environment Agency, Copenhagen, Denmark. 82 pp.
Source: can be downloaded at http://reports.eea.europa.ue/Technical_report_no_64/en
Integrated Assessment and Environmental Policy Making: in Pursuit of Usefulness
Parsons, E. 1995. Integrated assessment and environmental policy making: in pursuit of usefulness. *Energy Policy* 23:463-475.
Source: The full text version of this paper is available via http://www.sciencedirect.com/
Oversight Review Board Report on the Experience and Legacy of the National Acid Precipitation Assessment Program
National Acid Precipitation Assessment Program (NAPAP). 1991. Report from the Oversight Review Board. 1991. The Experience and Legacy of NAPAP. Washington, D.C.
Source: This report is available in hard copy only unless the document can be scanned.
Understanding and Solving Environmental Problems in the 21st Century: Toward a New, Integrated Hard Problem Science
Costanza, R. and S.E. Jorgensen (Editors). 2002. Understanding and Solving Environmental Problems in the 21st Century: Toward a New, Integrated Hard Problem Science. Elsevier Science. ISBN: 978-0-08-044111-5, 346 pp.
Source (description):
http://www.elsevier.com/wps/find/bookdescription.cws_home/623393/description#description

Integrated Assessment Implementation Examples
National

National Assessment of Harmful Algal Blooms in U.S. Waters
CENR. 2000. National Assessment of Harmful Algal Blooms in U.S. Waters. National Science and Technology Council Committee on Environment and Natural Resources, Washington, DC.
Source: http://www.cop.noaa.gov/pubs/habhrca/Nat_Assess_HABs.pdf
An Assessment of Coastal Hypoxia and Eutrophication in U.S. Waters
CENR. 2003. An Assessment of Coastal Hypoxia and Eutrophication in U.S. Waters. National Science and Technology Council Committee on Environment and Natural Resources, Washington, D.C.
Source: http://coastalscience.noaa.gov/documents/coastalhypoxia.pdf
The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States (2002)
Turgeon, D.D., et al. 2002. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States:2002. National Oceanic and Atmospheric Administration/National Ocean Service/National Centers for Coastal Ocean Science, Silver Spring, MD. 265 pp.
Source: http://coastalscience.noaa.gov/documents/status_coralreef.pdf
The State of coral Reef Ecosystems of the United States and Pacific Freely Associated States (2005)
Waddell, J.E. (ed.) 2005. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2005. NOAA Technical Memorandum NOS NCCOS 11. NOAA/NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team. Silver Spring, MD. 522 pp.
Source: http://ccma.nos.noaa.gov/ecosystems/coralreef/coral_report_2005/

Regional
Report on the Status of the Northeast U.S. Continental Shelf Ecosystem
Link, J.and Brodziak, J. (Editors). 2002. Report on the Status of the Northeast U.S. Continental Shelf Ecosystem. Northeast Fisheries Science Center Ref. Doc. 02-11, 245 pp.
Source: http://www.nefsc.noaa.gov/nefsc/publications/series/crdlist.htm
A Biogeographic Assessment of the Channel Islands National Marine Sanctuary: A Review of Boundary Expansion Concepts for NOAA's National Marine Sanctuary Program
NOAA National Centers for Coastal Ocean Science (NCCOS) 2005. A Biogeographic Assessment of the Channel Islands National Marine Sanctuary: A Review of Boundary Expansion Concepts for NOAA's National Marine Sanctuary Program (DVD). Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 21. 215 pp.
Source: Available in DVD format via
http://ccmaserver.nos.noaa.gov/products/biogeography/cinms/order.html
An Ecological Characterization of the Stellwagen Bank National Marine Sanctuary Region: Oceanographic, Biogeographic, and Contaminants Assessment
Source:
http://www.ccma.nos.noaa.gov/products/biogeography/stellwagen/welcome.html
An Integrated Assessment of Hypoxia in the Northern Gulf of Mexico

CENR. 2000. Integrated Assessment of Hypoxia in the Northern Gulf of Mexico. National Science and Technology Council Committee on Environment and Natural Resources, Washington, D.C. 58 pp.
Source: http://www.nos.noaa.gov/products/pubs_hypox.html#fia

An Integrated Assessment of the Introduction of Lionfish (*Pterois volitans/miles* complex) to the Western Atlantic Ocean

Hare, J.A., and P.E. Whitfield. 2003. An Integrated Assessment of the Introduction of Lionfish (*Pterois volitans/miles* complex) to the Western Atlantic Ocean. NOAA Technical Memorandum NOS NCCOS 2. 21 pp.
Source: http://coastalscience.noaa.gov/documents/lionfish_ia.pdf

Chapter on Ecological Consideration in Alaska Ocean Ecosystems for 2007

Stock Assessment and Fishery Evaluations. Draft Section on Ecosystem Considerations for 2007. November 2006. Jennifer Boldt (ed.) Appendix C. Alaska Fisheries Science Center, Seattle, WA. 360 pp.
Source: http://access.afsc.noaa.gov/reem/EcoWeb/content/pdf/AppendixC.pdf

National Coastal Condition Report II (2005): Chapter 9 – Health of Galveston Bay for Human Use

U.S. EPA (U.S. Environmental Protection Agency). 2005. National Coastal Condition Report II. EPA-620/R-03/002. Office of Research and Development and Office of Water, Washington, DC.
Source: http://www.epa.gov/owow/oceans/nccr/2005/Chapter9_GalvestonBay.pdf

An Approach to Integrated Ecological Assessment of Resource Condition: the Mid-Atlantic Estuaries as a Case Study

Brown, B.S., W. Munns, Jr. and J.F. Paul. 2002. An approach to integrated ecological assessment of resource condition: the Mid-Atlantic estuaries as a case study. *Journal of Environmental Management* 66: 411-427
Source: This article is available via http://www.sciencedirect.com/

International Examples

ICES Regional Ecosystem Study Group of the North Sea Report

The report summarizes the results of a meeting of the study group held in May 2006 to evaluate and prepare plans for finalization of an integrated assessment of the North Sea Ecosystem, an activity initiated by this group in 2003. The assessment, based on the compilation and analyses of a comprehensive integrated data set, has provided some valuable insights into the significance of the relationships between different human pressures (e.g., nutrient inputs and fisheries) and state changes (e.g., plankton, fish and seabirds) at different spatial scales and the time scales over which changes take place. For example, plankton community data in relation to the physical and chemical oceanography reveals both gradients of response to the major riverine inputs of nutrients into the North Sea and sources of nutrients from the Atlantic. In addition an assessment of all variables reveals two relatively stable states in the North Sea, one pre-1983 and the other post-1997. The intervening years are dominated by high ecosystem variability which represents a transition from one state to another and in part explains the number of studies which highlight different years for regime shifts. The sensitivity of such analysis to changes in temporal and spatial scales is explored as is the dependency on the number and type of ecosystem variables. By better understanding the relationship between the

causes of change at different scales in time and space, it should be possible to set more realistic targets for the management of human pressures.

ICES. 2006. Report of the Regional Ecosystem Study Group of the North Sea (REGNS), 15-19 May 2006, ICES Headquarters, Copenhagen. ICES CM 2006/RMC:06. 111pp.
Source: http://www.ices.dk/reports/RMC/2006/REGNS/regns06.pdf

State of the Eastern Scotian Shelf Ecosystem
DFO, 2003. State of the Eastern Scotian Shelf Ecosystem. DFO Can. Sci. Advis. Sec. Ecosystem Status Report 2003/004.
Source: http://www.dfo-mpo.gc.ca/csas/Csas/status/2003/ESR2003_004_e.pdf

The European Environment – State and Outlook 2005
European Environment Agency. 2005. The European environment – State and outlook 2005. Copenhagen. 570 pp. State of Environment Report No 1/2005. (ISBN: 92-9167-776-0).
Source: The report can be accessed via:
http://reports.eea.europa.eu/state_of_environment_report_2005_1/en

The Changing faces of Europe's Coastal Areas
European Environment Agency. 2006. The changing faces of Europe's coastal areas. Copenhagen. 107 pp. EEA Report No 6/2006. (ISBN 92-9167-842-2)
Source: http://reports.eea.europa.eu/eea_report_2006_6/en/eea_report_6_2006.pdf