Choosing, presenting and maintaining indicators for marine ecosystem monitoring
- experience from the NE Atlantic

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This presentation can be downloaded from

http://www.ices.dk/globec/data/presentations/
Bergen Declaration

Ministerial Declaration of the Fifth International Conference on the Protection of the North sea

Bergen, Norway 20–21 March 2002

http://odin.dep.no/md/nsc/
Bergen Declaration - concerns:

- Pollution by hazardous substances
- Eutrophication
- Direct and indirect effects of fishing
- Effects of climate change
- Release of GMOs
- Introduction of non-indigenous species
- Environmental impact of shipping
- Impact of offshore installations
Eutrophication

**Cause**
increased nutrient input

**Effect**
increased $1^\circ$ production

**Consequences**
HAB
Oxygen depletion
Higher fish production
Bergen Declaration

• Acknowledged need to involve regional and local authorities, organizations and other stakeholders in planning and decision making processes

• Recognised need to take an integrated ecosystem approach to the management of human activities

What is an integrated ecosystem approach?
The Ecosystem Approach will include:

- Management of human activities in an integrated manner
- Formulation of clear objectives, both general and operational
- Better use of existing scientific knowledge
- Focused research on the marine ecosystems, including climatic, biological and human driving forces of ecosystem variability

- Improved, integrated monitoring
- Integrated assessments prepared by experts on fish stocks, the environment and socio-economics
- Involvement of stakeholders, scientists, managers and politicians at different stages of the decision-making process.
Choosing, presenting and maintaining indicators for marine ecosystem monitoring – experience from the NE Atlantic

From REPORT OF THE STUDY GROUP ON ECOSYSTEM ASSESSMENT AND MONITORING ICES CM 2001/E: 09
What is an indicator?

“A variable, pointer or index. Its fluctuation reveals key elements of a system. The position and trend of the indicator in relation to reference points or values indicates the present state and dynamics of the system. Indicators provide a bridge between objectives and actions”

We are all familiar with indicators in many fields e.g.

Leading Health Indicators

The Leading Health Indicators reflect the major public health concerns in the United States and were chosen based on their ability to motivate action, the availability of data to measure their progress, and their relevance as broad public health issues.

The Leading Health Indicators illuminate individual behaviors, physical and social environmental factors, and important health system issues that greatly affect the health of individuals and communities. Underlying each of these indicators is the significant influence of income and education (see Income and Education, page 12).

The process of selecting the Leading Health Indicators mirrored the collaborative and extensive efforts undertaken to develop Healthy People 2010. The process was led by an interagency work group within the U.S. Department of Health and Human Services. Individuals and organizations provided comments at national and regional meetings or via mail and the Internet. A report by the Institute of Medicine, National Academy of Sciences, provided several scientific models on which to support a set of indicators. Focus groups were used to ensure that the indicators are meaningful and motivating to the public.

For each of the Leading Health Indicators, specific objectives derived from Healthy People 2010 will be used to track progress. This small set of measures will provide a snapshot of the health of the Nation. Tracking and communicating progress on the Leading Health Indicators through national- and State-level report cards will spotlight achievements and challenges in the next decade. The Leading Health Indicators serve as a link to the 467 objectives in Healthy People 2010 and can become the basic building blocks for community health initiatives.

The Leading Health Indicators are intended to help everyone more easily understand the importance of health promotion and disease prevention and to encourage wide participation in improving health in the next decade. Developing strategies and action plans to address one or more of these indicators can have a profound effect on increasing the quality of life and the years of healthy life and on eliminating health disparities—creating healthy people in healthy communities.
What kinds of indicator are there?

- Descriptive indicators
- Performance indicators
- Efficiency indicators
- Total welfare indicators

Often used within DPSIR framework: 
Driver; Pressure; State; Impact; Response

What are the qualities and attributes of indicators and monitoring?

1. Purpose
2. Nature, Specificity and Mode of application
3. Presentation and Interpretation
4. Design
1. Purpose of indicators
Why do we want to monitor?

• To measure environmental/ecological quality status

• To measure performance e.g. are management measures moving us in a desirable direction or towards a specified objective?

The same indicator may achieve both purposes
Bergen Declaration - concerns:

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What are the qualities and attributes of indicators and monitoring?

1. Purpose

2. Nature and Specificity and Mode of application

3. Presentation and Interpretation

4. Design
2. Nature and Specificity of indicators

• Primary (e.g. abundance of species A) or secondary (e.g. biodiversity)

• Measure of structure or function

Causes of change in these must be identifiable and their Specificity understood

Mode of application may be single, multiple or aggregated
What are the qualities and attributes of indicators and monitoring?

1. Purpose
2. Nature, Specificity and Mode of application
3. Presentation and Interpretation
4. Design
3. Presentation and Interpretation of indicators

- Easily understood by a wide audience
- Recognised boundaries for acceptable change
- Significance/sensitivity of observed changes
- Interpretable within a scientific framework

Hauge et al. ICES CM 2003/Y:05 sets out a “Framework for Communicating Qualities of Indicators”
What are the qualities and attributes of indicators and monitoring?

1. Purpose
2. Nature, Specificity and Mode of application
3. Presentation and Interpretation
4. Design
4. Design of indicators

- Simple, reliable, affordable
- Consistent over time and between people and institutes
- Sensitive to managed human activity
- Comparable against “reference” locations or values
Two examples of indicators
1 Indicators of change in fish distribution

a Biogeographic shifts of ~ 50km y\(^{-1}\) in NE Atlantic

b Increases in number of warm water species

Attributed to advection and change in local properties i.e transport of both biota and heat, salt etc.

(Issue of Eulerian vs Lagrangian observation)
What are these indicators telling us?

• Distribution of fish is changing (probably in response to strengthening of shelf edge current and warming, which may in turn be related to climate change)

• Species diversity may be increasing – is this good or bad?
2. Indicators of recovery from dredging, which compare a dredged and a reference site.

These indicators compare a dredged and a reference site. They are dimensionless (relative).
What are these indicators telling us?

- Abundance and species richness are affected to varying degrees by dredging

- The areas affected (at least the lightly dredged area) show signs of recovery

- Comparative indicators are a powerful (dimensionless) way of looking at specific effects
An example of a successful long term monitoring programme
Use of Continuous Plankton Recorder information in support of marine management: applications in fisheries, environmental protection, and in the study of ecosystem response to environmental change

Progress in Oceanography (2003)

K.M. Brander, R.R. Dickson, M. Edwards
The CPR was an applications-led development, designed from the start to provide improved scientific support for the fishing industry.
Increasingly valuable and complex scientific return with time: Major papers (arrows) classified by type and date.
Management issues become more complex as we become concerned about actual or potential anthropogenic impacts.
Some conclusions

• Long time series increase in value

• Monitoring must be carefully designed in relation to purpose (but purpose can change – there is feedback from monitoring to objectives!)

• Monitoring should be reviewed and improved (some conflict between consistency and improvement)
Three examples of Status Reports
Ecological Status 2001/2002

Using a number of ecological indices the section summarises unusual species found, large phytoplankton blooms, changes in community structure and trends in hydrobiological indicators from regions in the North Atlantic (with an emphasis on the North Sea)

Martin Edwards and Anthony Richardson of SAHFOS
www.sahfos.org
Indicators

This is a list of all published environmental indicators. The list of environmental indicators is as default sorted by name. By clicking on the table’s header you can sort by Indicator, Theme, DPSIR position or Assessment.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Theme</th>
<th>Policy issue</th>
<th>DPSIR</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to basic services [2001]</td>
<td>Transport</td>
<td>Ensure access to basic services by environment-friendly modes</td>
<td>D</td>
<td>😞</td>
</tr>
<tr>
<td>Access to transport services [2002]</td>
<td>Transport</td>
<td>Provide access to quality transport services for all citizens and all modes</td>
<td>D</td>
<td>😞</td>
</tr>
<tr>
<td>Agri-environmental management contracts [2001]</td>
<td>Agriculture</td>
<td>What environmental protection measures are being taken by the sector?</td>
<td>R</td>
<td>😊</td>
</tr>
<tr>
<td>Agricultural intensity [2001]</td>
<td>Agriculture</td>
<td>In which direction is the sector developing?</td>
<td>D</td>
<td>😞</td>
</tr>
</tbody>
</table>
**Indicator:** The North Sea cod (Gadus morhua) stock. [2002]

**Policy issue:** Sustainable exploitation of fish stocks is a target for the EU-CFP. Landings are regulated through TAC, but this does not directly lead to control of the actual catches.

The spawning stock biomass is at a new historic low in 2001, and the risk of stock collapse is high (ICES 2001). During February and April 2001, a large part of the North Sea was closed for cod fishing for 10 weeks to protect juvenile cod, as part of an emergency recovery plan. Currently the TAC has been set at approximately 50% of the TAC of 2000 and technical measures are in place. The EC has proposed additional effort regulations in the structural recovery plan proposal for cod and hake, but the decision process will take at least half a year.

The North Sea cod stock is outside safe biological limits. This situation is also true in all waters adjacent to the North Sea, where this species is distributed. The spawning stock biomass (SSB) is calculated to have been below Bpa (Biomass precautionary approach reference point) for the last 17 years (since 1984).

The status of the North Sea cod stock indicates that a sustainable EU CFP is still far from the target of sustainable fish-resource management.

[Click the thumbnail to view a large version of the image]
European Seas Quality Status Report 2003

Written in non-technical terms, as a general introduction.

Earlier QSRs in 1987, 1993, 2000 have given many technical details. See also HELCOM reports

Thanks for listening

http://www.ices.dk/reports/german/qsr/23222_ICES_Report_same.pdf
A Final Conclusion

We do not know how best to manage the marine ecosystem.

The processes of monitoring, assessment and management should therefore be open to evolve and improve.
REGISTRATION AND ABSTRACT SUBMISSION

PICES will manage registration and abstract submission for the Symposium. Abstracts must be submitted through the PICES website by end of 14 November 2003.

http://www.ecosystemindicators.org/