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## The EBM Toolbox: Methods for assessing marine ecosystem status

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*Editor's note: This work is a product of the DEVOTES project (DEvelopment Of innovative Tools for understanding marine biodiversity and assessing good Environmental Status), a project for developing tools for the implementation of marine legislation management funded by the European Union. Ángel Borja is coordinator of the DEVOTES project as well as head of projects at AZTI Tecnalia and a member of the Scientific Committee of the European Environment Agency. He can be reached at [aborja@azti.es](mailto:aborja@azti.es).*

Since the 1960's, many methods have been developed to assess the status of single ecosystem components, especially in estuaries and coastal waters. However, few methods exist for assessing multiple ecosystem components in a holistic way, using an ecosystem approach that accounts for the response of marine systems to human pressures. In addition to methods for assessing multiple ecosystem components, innovative monitoring approaches that encompass and combine all the relevant features of ecosystems are also needed for determining the health of large marine areas in a holistic way.

The DEVOTES project conducted between 2012 and 2016 sought existing methods that addressed both of these needs (monitoring and assessment). They found numerous marine ecosystem status assessment methods based on qualitative status descriptions but found very few that were quantitative. Five quantitative methods they found were:

- [Helsinki Convention Ecosystem Health Assessment Tool \(HOLAS\)](#), a multi-metric indicator-based assessment tool for the Baltic Sea
- [a method for assessing status for the Marine Strategy Framework Directive](#) in the Bay of Biscay
- [Ocean Health Index \(OHI\)](#), a framework that scores ecosystem benefits delivered to people by assessing current status and likely future state. The OHI is applicable to a wide range of assessment areas, and assessments have been completed in 11 regions to date with numerous others underway
- [Marine Biodiversity Assessment Tool \(MARMONI tool\)](#), a web-based application to perform indicator-based, integrated marine biodiversity assessments. The tool has been tested in four areas within the Baltic Sea
- [Nested Environmental status Assessment Tool \(NEAT\)](#), a tool developed by the DEVOTES project for assessing the environmental status of marine waters using biodiversity status rather than pressures leading to state changes.

Summaries and comparisons of these tools were published in 2016 in *Frontiers in Marine Science*. Additionally, the DEVOTES project provided lessons about key attributes needed for assessment of environmental status of open and coastal systems. They found that assessment methods should:

- Use the ecosystem approach, requiring a common and explicit vision of the desired status of the environment, and multiple stakeholders need to be involved in the definition of that status
- Include multiple components of the ecosystem, biotic and abiotic
- Use reference conditions or baselines and be repeated to track changes
- Use an integrative assessment of all components
- Use a range of values for capturing status, including a target value that separates what is considered good and what is not good
- Weight components when integrating
- Calculate the uncertainty associated with the assessment
- Ensure comparability across regions and time
- Use robust monitoring approaches and data
- Address pressures and impacts.

Finally, for any ecosystem assessment to be effective and be used to inform marine management, it needs to be transparent and repeatable and provide results that can be easily communicated to wide audiences, including scientists, managers, and policymakers.

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