

New tools needed for plans of measures and for new topics

Long time funding and commitment of the hosts and close cooperation with the end-users. These are crucial points to consider in the future development of decision support tools for the Baltic Sea environment.

Tools that support the development of plans and programs of measures should be prioritized, and tools dealing with issues such as non-indigenous species and marine litter remain to be developed.

The Baltic Sea ecosystem is under severe pressure from activities exercised by the 90 million people living in its drainage basin.

To protect the environment and ensure the future use of natural resources, comprehensive legislation has been developed, almost as complex as the ecosystem itself, and ecosystem-based management has become a guideline for the administration. To support the management and decision-making, several decision support tools (DSTs) have been developed for use in the region, but these tools do not fully comply with the ecosystem approach, according to the analyses done by the BONUS DESTONY project.

BONUS DESTONY has mapped existing tools and the current use of them, assessed their performance and how well they live up to the end-users' expectations, and assessed the remaining end-user demands. Although the variety of tools is large, several general gaps

Proposals for future development of decision support tools

To satisfy unmet needs:

- Tools that address impacts on welfare and link environmental and socio-economic aspects should be developed.
- DSTs covering topics not previously considered need to be developed: especially for non-indigenous species, but also for marine litter and underwater noise.
- New DSTs should support the development of plans and programs of measures, especially for the topics biodiversity, non-indigenous species, eutrophication and human uses and conflicts.

To increase the quality of tools:

- Outcome uncertainties should be documented and communicated – this important feature is not available in most existing DSTs.
- To fulfil the ecosystem approach, standard formats for DST inputs and outputs should be developed to enable interoperability – one tool covering all segments is not needed.
- DSTs need a host with continuous funding for maintenance and further development to be operational and useful for end-users.
- Tools should be flexible, so that the output can be adjusted according to the needs of specific end-users.

To increase awareness and use:

- End-users should play an essential role in the development of DSTs, even take part in the development.
- End-users need training and guidance: user-friendly guidelines, online tutorials – even cooperation with tool hosts.
- Awareness of existing tools has to be increased: end-users need information about existing DST – we made a database, it has to be maintained!

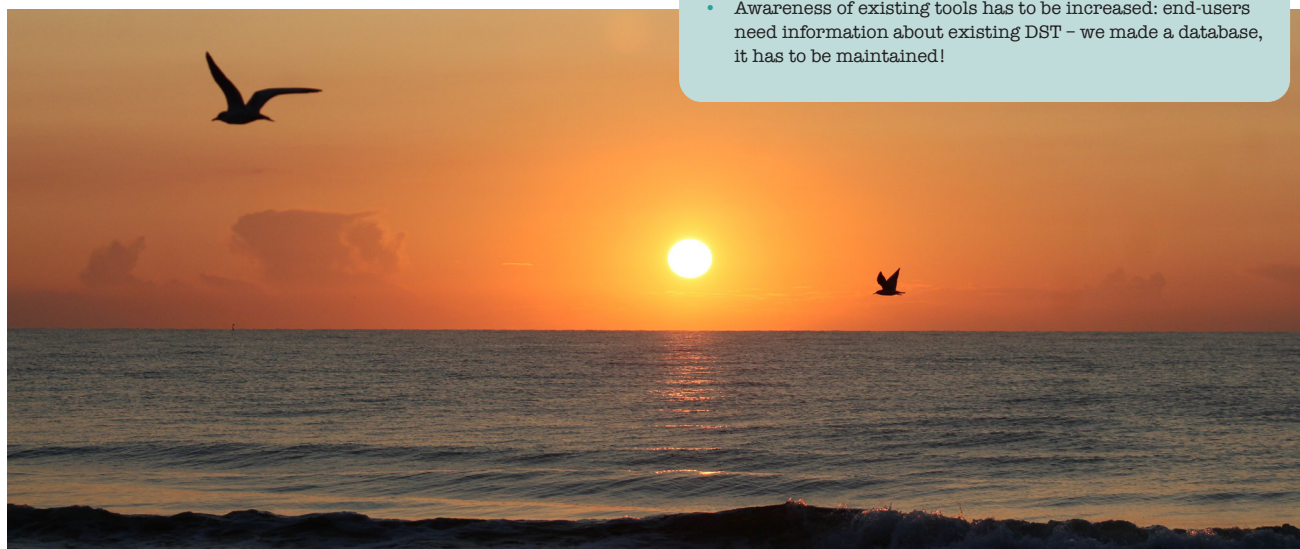


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could be found. Some environmental topics lack tools completely and, from an end-user perspective, some important policy requirements and implementation steps are poorly covered.

The analyses also show a gap between the ambitions of the tool developers and the end-user reality, and that the information about, and accessibility to, existing tools could be greatly improved.

Standard formats support ecosystem approach

To find out how well decision support tools fulfil the ecosystem approach, BONUS DESTONY has analyzed the existing tools against the DAPSIWRM framework. DAPSIWRM is a further development of the DPSIR framework, that is used as a way of structuring the relation between Drivers, human Actions, the Pressures they pose to the environment, the resulting changes in environmental State, the Impacts that such disturbance has on Welfare and the Responses/Measures we take to improve the situation. (For a further description of the framework see Policy Brief no. 1 in this series, *How do virtual tools support the management of the Baltic Sea.*)

The assessment shows that tools rarely cover the full DAPSIWRM cycle; only three tools, dealing with biodiversity and conservation, sea-area use and impact evaluation, do so. For the issues eutrophication and contaminants, tools can address all segments apart from the drivers.

Most of the tools address state changes, pressures and activities, whereas fewer tools address drivers, responses/measures and the impacts on welfare. DSTs that include socio-economic aspects are generally underrepresented. These segments are important to address as understanding the drivers and the impacts a degraded environment has on society, through the reduction of ecosystem services, are important for understanding the humans as a part of the ecosystem. BONUS DESTONY hence recommends that **new tools should be focusing on welfare impacts and on linking environmental and socio-economic aspects.**

When asked, the end-users of decision support tools don't rank number of DAPSIWRM segments addressed by a tool as being an important feature. To fulfil the ecosystem approach BONUS DESTONY recommends that **standard formats are developed for the DST inputs and outputs.** This would enable interoperability between tools and such a "toolbox" could support the ecosystem-based management, without the need of one single tool to cover all segments.

"New" topics require new tools

The existing decision support tools cover a wide range of environmental topics. The, by far, most frequently addressed issue is eutrophication, followed by biodiversity and conservation, impact evaluation and contaminants. Recently highlighted topics, such as non-indigenous species and underwater noise are rarely addressed and no tools that directly address marine litter have been found.

In two supplementary surveys BONUS DESTONY have asked the end-users of DSTs where they see a need for new tools to be developed. Just under 30 percent of the replicants see a demand for new tools, and the proportion is slightly larger for scientists than for people working in administration. Amongst other, topics for which the end-users indicate a lack of tools are contaminants (both in general and more specifically contaminants in seafood), fisheries, eutrophication from land-based nitrogen sources, biodiversity, marine litter, and non-indigenous species (for a summary of supply of and demands for DSTs see the matrix, page 4). Lacking knowledge on species distribution and the needed ecological coherence for diffe-

rent species and habitats are mentioned as specific challenges. To meet these demands BONUS DESTONY **recommends tools for uncovered topics to be developed: especially for non-indigenous species, but also for marine litter and underwater noise.**

Supply and demand – new tools needed?

The environmental topic where the end-users indicate the largest demand for new tools is also the area where the largest supply is found today – eutrophication. Why existing tools don't meet this demand could simply be that they are difficult to access or that they don't include properties that end-users need. Many of the DSTs that deal with eutrophication are models and not always directly applicable by end-users, as they require special expertise and cooperation with the hosts.

A major challenge in coastal and marine policy implementation mentioned by the end-users is reaching the policy objectives, for example reducing eutrophication. Also, the development of plans or programs of measures, especially the identification of effective measures, are posing challenges. There is a need for DSTs that show the environmental effectiveness as well as the cost-effectiveness of specific measures, and also how different measures can be combined to reach the policy objectives. For non-indigenous species there is a strong demand for DSTs for monitoring and for assessing risks, something that is required by regulation.

BONUS DESTONY suggests that **new tools should support the development of plans and programs of measures,** especially for the topics biodiversity, non-indigenous species, eutrophication and human uses and conflicts.

Uncertainty analysis needs improvement

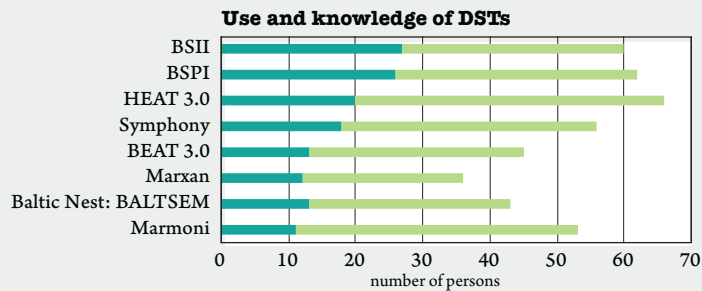
The most important features for the end-users of decision support tools are transparency and confidence assessment of the results out of the fifteen performance criteria developed by the BONUS DESTONY project. The performance criteria and the assessment is further described in Policy Brief no. 2: *High transparency but lack of confidence assessment in Baltic Sea decision support tools.* Other important features are management relevance to the Baltic Sea and time effort, the latter especially stated for people working in administration.

The analysis by BONUS DESTONY shows that most of the existing tools have a high level of transparency, but the requirements of confidence assessment of the results, or level of uncertainty expressed, are not met to the same extent. Most of the 42 decision support tools that were analyzed (58 percent) do not assess the uncertainty associated with the outcome at all, or provide only a qualitative expert judgement of the results. As environmental measures can be expensive to carry out and have large side effects, it is of the utmost importance for managers and decision-makers to be informed about to what extent the output of a decision support tool is reliable.

BONUS DESTONY sees a clear need for **adopting a standardized framework for quantifying, documenting and communicating uncertainty in DSTs** developed in the future.

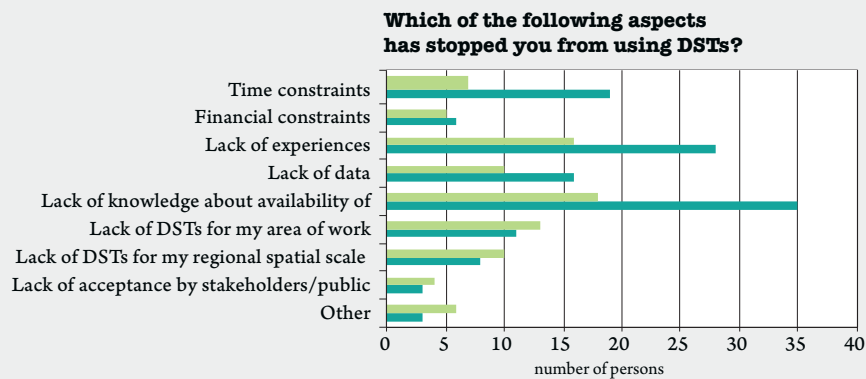
End-user cooperation is important

The surveys done by project DESTONY and sent to people working in Baltic Sea management show that a large portion of the replicants don't know what a BONUS DESTONY decision support tool is. When asked what has stopped them from applying tools in their work many replicants answer "lack of knowledge about availa-



■ I have used it
■ I have heard of it

The most frequently used DSTs according to the BONUS DESTONY end-user survey, answered by 108 persons.



■ Administration group
■ Researchers and others

Lack of experiences and lack of knowledge is what has stopped most of the replicants to apply DSTs. In total 54 persons working in administration and 54 persons in the group "researchers and others" answered the survey.



Marine litter and non-indigenous species are two environmental topics that currently lack DSTs. Below is the Round Goby, a non-indigenous fish in the Baltic Sea.

PHOTO: SHUTTERSTOCK



PHOTO: SHUTTERSTOCK

bility of tools" (48 percent) and "lack of experience" (42 percent). At the same time, many of the DST hosts and developers say that their tools have not been used for decision making to the extent expected. This suggests that there is an information gap to be bridged between hosts and end-users, something that is further supported by the fact that there is an end-user demand for tools in areas where there already is a large supply.

Although more than half of the hosts say that end-users have had a strong role in the initial tool development process, they are seldom directly involved in the development team. To raise awareness of tools and ensure that tools developed in the future are being used to a higher extent than today, BONUS DESTONY proposes that **end-users in the future should take part in the development** as paid members of the development team.

When the end-users are asked of shortcomings of the DSTs they know, many answer poor data and missing updates. Even lack of transparency is mentioned (in contradiction to the BONUS DESTONY assessment of existing tools) and a large portion of the replicants mention that the tools are too general, or too narrow, or not suitable for the spatial scales needed for management. This further emphasizes the need for stronger cooperation between developers and end-users, but to increase the use of DSTs and fulfil the end-users needs BONUS DESTONY also recommends that **new tools developed should be flexible and able to adjust according to end-users needs.**

Tool development - a long term commitment

Many of the existing decision support tools are the results of rather short-term projects. The effect of this is that the development is more or less terminated at the point where the tools just approach operationalization and that they will gradually get outdated. From

an end-user perspective this is a great shame, not to mention the poor resource management it entails to develop tools that can only be used for a short time period.

Although it can hardly be avoided that some projects or tools turn out unsuccessful, developing a decision support tool should be a long-term commitment. It is important to find ways to ensure a stable funding and **hosts and developers should be prepared to keep a new tool updated and to stay available for end-users for a long time ahead.** This includes arranging courses, updating the tool with new data, keeping the documentation updated and being prepared to answer questions and hold demonstrations. A better cooperation with end-user would also ensure that there is a long-term interest to apply a tool, which would be an incentive for the hosts to keep it updated.

Only a small part of the existing decision support tools are currently virtual, in the sense that they can be accessed and operated through the internet, without the effort of downloading a certain program. Making the tools directly available online could be a complementary way of further increasing their use.

BONUS DESTONY has created a database where information on 42 decision support tools is collected, together with an assessment of how well the tools meet a set of performance criteria. This database facilitates for a potential end-user to find a tool that meets his or her needs, when it comes to topic or policy relevance as well as level of scientific documentation, transparency or time effort. It is highly recommended **that this database is maintained in the future, that it is further developed to meet the end-users needs and updated with new tools as well as updates on existing ones.**

The database is publically available at **nest.su.se/bonus_dst/**

