SCIENCE AND THE CHALLENGE OF REVERSING MARINE EUTROPHICATION

■ Eutrophication, the increase in the supply of organic matter due principally to enhanced primary production stimulated by nutrient inputs, has long been regarded as one of the most important problems in the Baltic Sea and its coastal areas. Creation of oxygen-depleted (hypoxic) bottom waters, elimination of seagrass and macroalgal meadows, and stimulation of blooms of Cyanobacteria and other harmful algae are among the many undesirable consequences of eutrophication. From the 1988 Ministerial Declaration that targeted on the order of 50% reduction in discharge of nitrogen and phosphorus through more recent HELCOM declarations and European Commission directives, reducing eutrophication has been regarded as a keystone element of Baltic environmental protection and restoration.

Progress in achieving goals set for reducing nutrient inputs or alleviating the consequences of eutrophication has been slower than first anticipated. In particular, it has proven difficult to reduce inputs from diffuse sources such as agricultural runoff and atmospheric emissions. Also, residual "internal loads" of phosphorus built up over decades may delay ecosystem recovery. Nonetheless, in some parts of the Baltic Sea region substantial progress has been made in reducing nutrient inputs from point sources and even some diffuse sources. Results presented at the June 2006 International Symposium on Research and Management of Eutrophication in Coastal Ecosystems in Nyborg, Denmark, brought together emerging knowledge of the responses of coastal ecosystems to the abatement of nutrient pollution. The knowledge resulting from such management "experiments" is yielding insights on the thresholds in nutrient loading required for restoration, lag times in responses, and resilience of coastal ecosystems that will prove invaluable in refining management goals and actions and, thus, achieving results.

Research in the Baltic region over the last thirty years has led the world in understanding the causes and consequences of marine eutrophication. Nonetheless, substantial and important scientific questions remain concerning limiting nutrients, nutrient storage and recycling, the causes of harmful algal blooms, recovery rates, and, most importantly, the effectiveness of various management practices. For example, last year I served on a panel of international experts advising the Swedish Environmental Protection Agency that in its report, *Eutrophication of Swedish Seas,* could not come to full agreement on the importance of reducing nitrogen as well as phosphorus inputs.

The BONUS-169 Baltic Sea Science Plan includes Combating Eutrophication as the third of its eight themes. The plan targets research on inputs and origins, flux and mass balance of nutrients; effects and consequences of eutrophication in the ecosystem; and scientific strategies for improving monitoring, assessment and management. In implementing this plan, BONUS has the unique opportunity to bring together the scientific resources and talents of the nations around the Baltic in a highly strategic and focused manner and link them to management of the critical and vexing issue of reducing eutrophication.

This Baltic initiative is opportune and important because much of the knowledge generated is transferable to the rest of Europe in its combat with eutrophication in the North, Irish, Mediterranean, Adriatic and Black seas and the many estuaries and embayments experiencing eutrophication. Moreover, it provides important comparisons and lessons for those of us in North America who are laboring to understand and reverse eutrophication in places like the Chesapeake Bay and the 13,000 km2 "Dead Zone" of hypoxia in the northern Gulf of Mexico off the Mississippi River.

Marine eutrophication is truly a global problem and as populations increase and standards of living improve in the developing world, impacts similar to those that were manifest during the latter 20th century in the industrial world are emerging. By working to solve regional problems in the Baltic or in the Chesapeake Bay where I live, scientists can also help the rest of the world avoid mistakes and find effective solutions.

Donald F. Boesch
University of Maryland
Center for Environmental Science
Member of BONUS Advisory Board

SCIENCE PLAN – POSTSCRIPT

PHOTO: WWW.SXC.HU

■ The Science Plan aims to cover almost all of the pertinent areas of research related to the Baltic Sea. The magnitude of the Plan development task has been truly daunting but also immensely exciting. When searching the world-wide web to compare and contrast what BONUS intended to do with other international schemes, one soon discovered that this venture appears to be the first time that such a wide coverage of science and policy issues and disciplines has been brought together in a single programme.

During the developing process, it was realised at an early stage that there were several options concerning formats and techniques for producing a Science Plan, and it is clear that 'many roads lead to Rome'. The wide coverage and numerous Themes comprising the BONUS-169 programme meant that one could not devote, for example, 30 pages on each relatively specialist subject. Furthermore, it was decided to avoid an unduly prescriptive emphasis connected with a potential desire to write reams on what one knows, and what one doesn't know, and detailing the various scientific paths to follow to find the 'holy grail'. Reflection on the evolutionary development of the European Community RTD Framework Programmes shows that there has been a sea-change away from such rigmarole.

We believe that the product that has emerged now succinctly describes the essential basis of the challenge and the framework to attract a critical mass of the Baltic Sea science community, without particular favouritism. Should there be a need for further emphasis and prioritisation, this can come as a future step. However, this will require that there is a fair and equitable mechanism for determining how to arrive at consensus about priorities across the board of varying types of funding agencies, while also meeting the overall holistic programme challenges. There is a saying that 'the proof of the pudding is in the eating'. In the context of the Science Plan, it is anticipated that project proposals will be evaluated objectively on their merits (e.g. quality and relevance) with respect to the overarching aims of the Plan. Perhaps it is up to those submitting project proposals to convince the evaluators of what is 'good science', or in the pudding analogy by including the appropriate justification in the form of 'tasty ingredients'.

Jan Thulin and Chris Hopkins
ICES

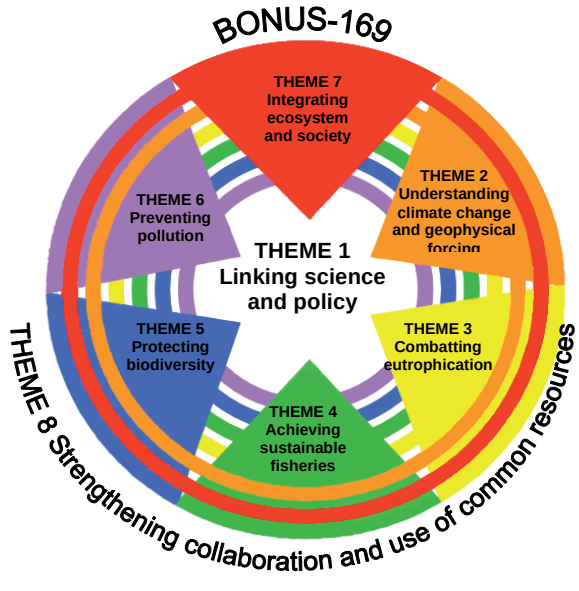

Figure 1. BONUS-169 organisational structure showing the relationship between the eight Themes.

THE ESSENTIAL FOCUS OF THE BONUS-169 SCIENCE PLAN:

- Mission of BONUS is to establish durable cooperation of the Baltic Sea States' research policies and their scientific communities in order to support the region's sustainable development.
- Goal is to create a cooperative, interdisciplinary, well integrated and focused transnational research programme in support of the Baltic Sea region's sustainable development, by providing scientific outputs that facilitate the implementation of ecosystem-based management of the Baltic Sea environmental issues.
- It will enhance our understanding and predictive capacity about the Baltic Sea ecosystem's response to impending changes caused by both naturally and human induced pressures and about linkages between environmental problems and the social and economic dynamics in responding to them. In turn it will form the basis for prudent management aimed at safeguarding the sustainable use of the ecosystem's good and services.
- It will act as a regional sea demonstration programme bridging science and policy, underpinning the European Marine Strategy and Maritime Policy. Lessons learnt and best practices will be exchanged with other European regional seas.
- BONUS-169 will also promote activities to foster the whole Baltic Sea Research Area – including four new EC Member States and the Russian Federation – through the formation of a Baltic Sea Research Council, and to cross the national borders of basic research towards application and dissemination of knowledge.

For the details, we encourage you to see the currently drafted version of the BONUS-169 Science Plan by visiting the BONUS website (www.bonusportal.org)