

Executive summary

The ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea (WGIAB) was set up as a forum for developing and combining ecosystem-based management efforts for the Baltic Sea, and is intended to serve as a counterpart and support for the ICES Baltic Fisheries Assessment Working Group (WGBFAS) as well as related HELCOM assessment efforts and projects, such as HELCOM CORESET and HELCOM FISH PRO. To this end, WGIAB has given itself three main tasks:

- 1) to conduct holistic ecosystem assessments based on large multivariate datasets;
- 2) to consider the use of ecosystem modelling in the assessment framework; and
- 3) to develop adaptive management strategies for the different Baltic Sea ecosystems.

WGIAB has focused most of its previous work on the first two tasks (ICES 2007, 2008, 2009a, 2010a), by (i) performing multivariate analyses of ecosystem status and trends in, until now, eight Baltic Sea subsystems, demonstrating large-scale shifts in ecosystem structure and functioning (Diekmann & Möllmann 2010), and by (ii) developing Biological Ensemble Modelling to further long-term management advice (ICES 2009a; Gårdmark *et al.*, in prep.). During the 2011 meeting, the major activities undertaken therefore related to Task 3. The meeting was held 4–8 April at IMEDEA in Esporles, Spain, with 25 participants from 11 countries.

To develop adaptive management strategies for the Baltic Sea subsystems, WGIAB has decided to follow the broader understanding of Integrated Ecosystem Assessments (IEAs) as a full assessment- and management cycle (Levin *et al.* 2009, Tallis *et al.* 2010). Last year WGIAB identified indicator systems for ecosystem-based management as an aspect of the IEA-cycle that was not already covered by WGIAB activities under tasks 1 and 2. While WGIAB 2010 started working on indicator systems by e.g. evaluating indicators proposed in relation to the EC Marine Strategy Framework Directive and HELCOM Baltic Sea Action Plan, this meeting took a more process-based approach to development of ecosystem indicator systems. In the IEA cycle, the purpose of indicators is to signal when management objectives regarding ecosystem attributes are not met (Levin *et al.* 2009, Tallis *et al.* 2010). To develop such indicators, a thorough understanding of ecosystem processes and responses to human pressures is needed. A major goal of this meeting was therefore to start analyses towards a better understanding of processes leading to the shifts in ecosystem structure, with the aim to use this for future developments of indicators for an IEA cycle. The questions addressed were (i) Are there any discontinuous foodweb interactions in the Central Baltic Sea pelagic ecosystem?; (ii) How does climate affect different trophic levels and does it differ across basins?; and (iii) How does trophic control (bottom-up vs. top-down) regulate different trophic levels and does it differ across basins?

In parallel, the meeting also assessed the potential to derive indicators to forewarn of large ecosystem restructurings, by evaluating a set of proposed “early-warning indicator” methods on real monitoring data assembled by WGIAB. Application of six different types of early-warning indicators to spatio-temporally resolved data on a key ecosystem component in the central Baltic Sea, *Pseudocalanus acuspes*, showed that no single method provided sufficient early warning in real monitoring data. Instead, multiple methods should be applied to derive system-specific detections of ecosystem shifts.

WGIAB also continued to develop ecosystem-based fisheries advice. Due to large uncertainty in recent stock assessment estimates for the Eastern Baltic (EB) cod (Gårdmark *et al.* 2011), WGBFAS had asked for information on environmental conditions relevant for recruitment of Eastern Baltic cod. Based on tests of potential indicators, WGIAB developed and assessed two indicators of abiotic conditions for cod recruitment and growth (i.e. food levels). This showed favourable salinity conditions for recent cod year-classes, but poor conditions in terms of both reproductive volume and food abundance. The assessment of the cod recruitment environment was provided to the WGBFAS meeting to support the stock assessment (ICES 2011a). Detailed analyses of environmentally sensitive stock-recruitment functions were also made for Eastern Baltic cod and some coastal fish stocks.

The meeting further pursued a WGIAB core activity, the multivariate analyses of ecosystem status and trends, which were updated and further developed. The primary goal of this activity during WGIAB 2011 was to advance ecosystem status and trend analyses of coastal ecosystems across the Baltic Sea. A first review of data availability and quality was made for nine coastal and small-scale subsystems. Initial ecosystem status and trend analyses were made for six of these subsystems, demonstrating shifts in ecosystem structure in at least four systems. The databases and analyses will be further refined by WGIAB and used in comparative analyses across systems. In addition, the Central Baltic Sea (CBS) biotic dataset was updated to 2009. The analyses still demonstrated the major shift to be in the end of the 1980s, with no significant changes in foodweb composition in the most recent years. This suggests that the CBS foodweb currently remains in an ecosystem “regime” which has been characterized by e.g. low levels of cod and *Pseudocalanus acuspes*, and high sprat abundances, for which important changes in foodweb function in relation to in previous “regimes” has been shown (Casini *et al.* 2009).

In 2012 WGIAB will continue developing Integrated Ecosystem Assessment cycles for the Baltic Sea subsystems, by (i) improving knowledge of the processes causing shifts in ecosystem structure to further develop IEA indicators and modelling, and (ii) further developing the multivariate ecosystem trend and status analyses and their application to Baltic Sea subsystems.