A systems approach framework for coastal management and its application in practice

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Importance of coastal ecosystems

Considered as one of the most productive systems worldwide, supporting a wide array of habitats and species, coastal ecosystems are also important drivers of human wellbeing and development (Costanza et al. 1997). With more than 60% of the world's population living at the coast (Turner et al. 2014), people depend on a healthy and fully functioning ecosystem to provide goods and services (Millennium Ecosystem Assessment 2005). However, to cope with population growth, the increasing demand for ecosystems goods and services has led, in general, to uncontrolled and unsustainable use of natural resources (Secretariat of the Convention on Biological Diversity 2010), resulting in the environmental degradation and loss of coastal ecosystems (Millennium Ecosystem Assessment 2005). While initially carried out in a sectorial way (managing different pressures individually), the complex multitude of anthropogenic uses both from land and sea requires that the management of coastal ecosystems is undertaken in a holistic and integrative approach (managing several pressured inclusively) (Apitz et al. 2006).

A major step in the direction of integrated coastal management

The adoption of Integrated Coastal [Zone] Management (ICZM) in the US (Knecht and Archer 1993), and later in Europe (EC 2000), was a major step in the direction of integrative approach to management and the wide application of the concept in several policies, research projects and frameworks at different spatial scales (Shipman and Stojanovic 2007) contributed to a better understanding and management of complex problems related to coastal conflicts. However, gaps and pitfalls related to the difficulty in translating the principles of ICZM into practice, the insufficient political and legal status, the lack of a consistent and applicable process for practitioners and policymakers and the insufficient monitoring of the proposed goals (Shipman and Stojanovic 2007; Soriani et al. 2016), led to the exploration of ways to further refine the structured approach to coastal management.

The systems approach framework (SAF)

To this end the EU-funded project SPICOSA (Science and Policy Integration for Coastal Systems Assessment, EU 6th, Nr. 036992) developed a new approach, The Systems Approach Framework (SAF), based on the Systems Theory (Von Bertalanffy 1968) which requires a holistic view focusing on the relationships between components of a system. The SAF was then tailored to provide a structured method for ICZM ensuring a holistic (ecosystem-based) approach, dealing with complex systems in a multidisciplinary way by including environmental, socio-economic and cultural elements (Hopkins et al. 2011). The application of SAF to multiple case studies around Europe revealed its capacity to address multiple issues simultaneously, implement transdisciplinary science and to mobilize the best knowledge to support ICZM

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policies (Hopkins et al. 2011, 2012) by using model-based scenario simulations to serve as a basis to promote interaction with stakeholders (Gillgren et al. 2018). Newton (2012, p.1) describes SAF as “not a strict methodology, it is truly a framework that can be used and adapted to different coastal systems, different issues, different stakeholders, and different countries”. However, the wide application of SAF also revealed its limitations. The lack of supportive tools for stakeholder engagement, and complexity in the terminology used in the approach as well as the weak inclusion of all parties interested, including citizens (Hopkins et al. 2012). Most importantly, what was lacking in the SAF process were the implementation and monitoring steps, necessary in the context of policy implementation and decision-making.

The new systems approach framework (SAF) and its practical application

To overcome these limitations and to aim at effectively addressing mainstream policies and approaches dealing with coastal management, SAF needed to be revisited and reformulated. To this end, this Special Issue of the Journal of Coastal Conservation introduces an improved and refreshed version of the SAF, the product of the work developed under the research project BONUS BaltCoast (A Systems Approach Framework for Coastal Research and Management in the Baltic) (www.baltcoast.net). The developments made within the BONUS BaltCoast project aim to enhance science-policy integration and prevent stakeholder fatigue (Gillgren et al. 2018). In this Special Issue, Støttrup et al. (2019) describes in detail the new version of the SAF. The original five steps were revised and merged into four: the Issue Identification, System Design, System Formulation and System Assessment (Støttrup et al. 2019). Furthermore, aiming at closing the loop of a complete ICZM measure, the new SAF introduces two more steps, the Implementation and the Monitoring and Evaluation steps, which aim at “helping to strengthen the science-policy integration, secure appropriate monitoring and evaluation, and maintain stakeholder participation” (Støttrup et al. 2019). Each step has now a concrete and comprehensive list of action to be taken assisted by a set of decision support tools and frameworks, especially in the framework of SAF.

This Special Issue also tests the new SAF process through several case studies comprised of the BONUS BaltCoast project: in Schernewski et al. (2017) to explore the possibility, together with stakeholders, to open a beach in the Curonian Lagoon (Lithuania); in Schernewski et al. (2018) the SAF is applied to evaluate the effects of three potential scenarios of Zebra mussel (*Dreissena polymorpha*) cultivation in the Oder Lagoon (Germany) in an ecological-social-economic context; in Tönisson et al. (2018), to support coastal zone management

in Pärnu (Estonia) by (re)evaluating coastal protection and flood prevention measures; and in Dinesen et al. (2019) to support sustainable fisheries management by understanding the decline of Atlantic cod (*Gadus morhua*) fishery in Danish waters. Highlighted by Gillgren et al. (2018), in the SAF application, an effective public participation strategy is of great importance to support the process of policy implementation and decision-making.

The information, experiences and lessons learned within the BONUS BaltCoast project, were transcribed into the development of a SAF Handbook, which is freely available online on a dedicated website as E-Learning material (www.safhandbook.net).

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