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Glossary of Terms

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DISCLAIMER

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Contents

1. Introduction

This glossary of terms aims to promote clarity and consistency of implementation of the Simple SES guidance (Gregory et al. 2023), providing clear definitions of terms used. Moreover, this glossary serves as an accessible reference tool, particularly useful for anyone unfamiliar with certain jargon or technical terminology included within Marine ecosystem-based management.

Through a word cloud analysis to support the identification of frequently used terms, the below graphic illustrates the top 100 frequently used words in the Literature Review (Deliverable 3.1) and Guidance Document (Deliverable 3.2, Part A).

Figure 1: Wordcloud of the SES Literature Review and Simple SES Guidance (created in NVivo © 2023 Lumivero).

2. Glossary

This glossary is compiled of the definitions relating to the Simple SES explored in the literature review (Deliverable 3.1), combined with the GES4SEAS/ MARBEFES/ Marine Plan glossaries of key terms to aid harmonisation across the Horizon Europe sister projects.

Term	*Definition*
Activities	Actions (potentially positive or negative) by society in an area or globally - what we do in the natural and built environment to give us the Drivers; actions throughout all stages including creating, operating, using, and removing infrastructure; creating an energy supply; obtaining food and water; being cognitive; using material by our presence (air), etc. (Elliott et al., 2022a).
Activity Footprint	The area, and/or time, based on the duration, intensity and frequency of an activity which ideally, has been legally sanctioned by a regulator in an authorisation, licence, permit or consent, and which should be so clearly defined and mapped in order to be legally-defendable; it should be both easily observed and monitored and attributable to the proponent of the activity (Cormier et al., 2020).
Alien species	Any live specimen of a species, subspecies or lower taxon of animals, plants, fungi or micro-organisms introduced outside its natural range; it includes any part, gametes, seeds, eggs or propagules of such species, as well as any hybrids, varieties or breeds that might survive and subsequently reproduce (EU, 2014).
Behaviour Over Time	Similar to a time series, behaviour over time refers to a visual trend for understanding the temporal dynamics of specific system variables (Kopainsky et al., 2015).
Baseline data	Fundamental units of basic inventory information that are crucial for biodiversity conservation planning and management. These are both biotic and abiotic and usually include: (1) the presence and/or abundance of species and other units; (2) other dependent biotic data (e.g., plant cover for macro-arthropods); (3) the appropriate influential abiotic variables, and (4) human variables[1].
Boundary	A border enclosing the parts of the system structure needed to generate the behaviour of interest. The system boundary excludes all components not relevant to the problem behaviour of concern (Ford, 2019). A system identified by a boundary will have inputs and outputs, which may be physical or abstract.
Causal Loop	A circular chain of causation that either reinforces or balances a change in the system (Garrity, 2018).
Causal Loop Diagram	Causal Loop Diagrams are rooted in systems thinking and are designed to visually represent the intricate interrelations between system variables (Senge, 1990).

[1] Glossary — European Environment Agency (europa.eu))

Coherence	Coherence is the quality of being logical and consistent and/or the quality of being regarded as forming a whole; that there is a clear relationship between the parts, that the whole is greater than the sum of the individual parts; that there is a similarity in marine aspects in adjoining transboundary areas; that similar actions and features occur either side of a boundary; i.e. actions are the same on each side of a boundary (Elliott et al., 2023).
Complexity	Complexity refers to the intricate interconnections and interdependencies among the system components, which lead to emergent behaviours and non-linear outcomes that are often unpredictable (Kauffman, 1993; Lovelock, 2007).
Connectivity	Connectivity is the state of being or being able to be connected; marine features that are linked and contiguous in some way, either naturally by ecology and hydrodynamics or by management measures (human interventions and actions); i.e. elements are joined/linked across boundaries (Elliott et al., 2023).
Cumulative pressures	Aggregated, collective, accruing, and (or) combined pressures acting at the same space and/or time (GES4SEAS, 2023)
Cumulative effect	Aggregated, collective, accruing, and (or) combined ecosystem changes that result from a combination of human activities and natural processes. (Scherer, 2011). They can be antagonistic, synergistic and additive (Birk et al., 2020).
Drivers	Societal basic needs – the qualities and their quantities that humans need from the natural and built environment for health and well-being, e.g., space, food, water, clean air, shelter, energy, comfort, employment, enjoyment and relaxation, education, good mental and physical health (Elliott et al. 2022a).
Ecosystem	The interaction between the biotic and the abiotic components, functioning as a whole in a particular location (Dolbeth and Arenas, 2021)
Ecosystem Services	“functions and products from nature that can be turned into benefits with varying degrees of human input” (Natural Capital Committee, 2019, p.3).
Ecosystem-based approach (to management)	An 'ecosystem-based approach' or 'ecosystem-based management' is an integrated approach to management of human activities that considers the entire ecosystem including humans. The goal is to maintain ecosystems in a healthy, clean, productive and resilient condition, so that they can provide humans with the services and goods upon which we depend. It is a spatial approach that builds around a) acknowledging connections, b) cumulative impacts and c) multiple objectives. In this way, it differs from traditional approaches that address single concerns e.g., species, sectors or activities. (CSWD, 2020).
Effect	Human activities exert pressures which have effects which may lead to impacts on receptors. So, pressure and effect are always coupled so that every pressure has an effect, but not every pressure necessarily leads to an impact (Judd et al., 2015).

Effects Footprint	The spatial (extent), temporal (duration), intensity, persistence and frequency characteristics resulting from (a) a single pressure from a marine activity, (b) all the pressures from that activity, (c) all the pressures from all activities in an area, or (d) all pressures from all activities in an area or emanating from outside the management area. They will have adverse consequences on the natural ecosystem components, but also are likely to affect the ecosystem services from which society gains goods and benefits. Hence, the determination of the effects-footprint needs to include the near-field and far-field effects and near- and far-time effects because of the dynamics and characteristics of marine areas and the uses and users of the area. Similarly, the effects- footprints may be larger in extent and more persistent than the causing activity-footprint and the resulting pressures-footprints. They also need to encompass the effects of both endogenic and exogenic pressures operating in that area (Cormier et al., 2020).
Element	An element is a variable that is liable to vary or change (Oxford English Dictionary).
Emergence	The generation of novel properties or functionalities that cannot be explained by their constituting elements alone, e.g., outcomes that are more than the sum of their parts (Moore et al. 2018; Page 2015).
Endogenous / Endogenic managed pressure	Anthropogenic pressures which originate within the management system, i.e. the causes of change can be controlled and their consequences addressed (Borja et al. 2010).
Environmental Impact	Environmental impact is an alteration from natural conditions, whether permanent or temporary, in a physical, chemical or biological aspect of environment state that is considered undesirable (an adverse effect). In applying the GES Decision, this undesirable state (for a GES criterion) is distinguished from the desirable state by a threshold value (CSWD, 2020).
Environmental Target	A qualitative or quantitative statement on the desired condition of the different components of, and pressures and impacts on, marine waters in respect of each marine region or subregion (EU, 2008).
Equivalence	Equivalence is that a relationship exists between two (or more) entities (e.g., national marine areas), and the relationship is described as one of likeness/sameness/similarity/equality in terms of one or more potential qualities; that the same and comparable outputs and outcomes occur either side of a boundary even if the methods used differ; i.e. actions have the same outcome on each side of a boundary irrespective of the methods used.

Exogenous / Exogenic unmanaged pressure	Causes of change which have their origin outside of a management system and cannot be controlled by local measures whereas the consequences which occur in the management site are subject to management measures (Borja et al., 2010)
Exposure	A measure of the degree to which a receptor is subjected to a pressure to which it is sensitive (Hiscock et al., 1999).
Feedback loop	When the effect of a causal impact comes back to influence the original cause of that effect. A feedback loop is a sequence of variables and causal links that creates a closed ring of causal influences (Ford, 2019).
Framework	Frameworks are described as an organisational and prescriptive tool to identify and order elements and relationships between them (Ostrom, 2011; Elliott et al., 2020b).
DA Process Management	Refers to the oversight of the Demonstration Area (DA) activities, ensuring that each phase of the project corresponds with its intended objectives. In the wider context of marine EBM, this consideration ensures that the specific goals of ecosystem conservation, sustainable resource use, and stakeholder engagement are integrated and managed (Smith et al., 2023; Gregory et al., 2023).
Good Environmental Status (GES)	The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations (under the Marine Strategy Framework Directive) (EC, 2008).
Governance	The structures and processes in which people in societies make decisions and share power, create the conditions for ordered rule and collective power (Folke et al., 2005); more specifically, the sum of the policies, politics, administration and legislation required in adaptive environmental management (Cormier et al., 2022).
Holism	Holism in this context refers to systems and their properties should be viewed as interconnected entities, not merely as a collection of individual parts (Capra, 1996).
Homeostasis	The tendency of organisms to preserve their equilibrium conditions. Control through the operation of negative feedback loops — homeostasisis is reached when the goal is attained and a stable equilibrium achieved (Ford, 2019). Environmental homeostasis is the ability of the environment to absorb environmental pressures with minimal overall change in status (Elliott and Quintino, 2007).

Impacts on human Welfare	Changes affecting wealth creation, quality of life required to satisfy the Drivers; changes in the results of the provisioning ecosystem services and cultural benefits; positive and negative influences on the human complementary assets/capital to extract societal goods and benefits from ecosystem services (Elliott et al., 2022a).
Indicator	In general, an indicator consists of one or several parameters chosen to represent (indicate) a certain situation or aspect and to simplify a complex reality CSWD (2020).
Intensity	The magnitude of a pressure, resulting effect or impact (ICES, 2019).
Invasive alien species	An alien species whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services (EU, 2014).
Loop Polarity	A characteristic of feedback loops represented by a positive (+) or negative (−) sign that indicates whether a loop is a reinforcing (positive) or balancing (negative) one. Loop polarity is found by the algebraic product of all signs around a loop (Ford, 2019).
Management Response-Footprint	The area and time covered by the governance means of monitoring, assessing and controlling the causes and consequences involved in the use of the marine environment through public policy-making, marine planning and regulatory processes. The policies, marine plans and technical measures produced by these processes indicate the means of determining if legal controls are satisfied, and of providing information and data to national and supra-national bodies. They focus on the area and/or time covered by the marine management actions and measures (e.g., Programme of Measures), including the distribution and range of a species (Elliott et al., 2022a)
Marine Processes and Functioning	All the ways in which marine biota and ecosystems control or modify the biotic and abiotic parameters defining the environment of people (i.e. all aspects of the 'ambient' environment). These marine ecosystem outputs are not consumed, but they affect the performance of individuals, communities and populations (Haines-Young and Potschin, 2018). Ecologically, this is taken to include the natural system as well as the 'environment of people'.
Persistence	The period over which a pressure continues to cause impact following cessation of the activity introducing that pressure (Knights et al., 2015)
Physical Disturbance	Abrasion, removal and deposition result in physical disturbances and may lead to physical loss depending on the intensity and/or persistence of the pressure. Sealing automatically implies physical loss. Any other physical pressures on the seabed that do not correspond to physical loss should be classified as physical disturbance. Such pressures do not induce permanent change since natural recovery, once the pressure has ceased, may be

	expected without human intervention (EC, 2022)
Physical Loss	Physical loss is defined as a permanent change of one of the following types (EC, 2022): 1. Sealing of natural substrate by an artificial structure or other allochthonous material. • Loss of biogenic substrate. • Seabed change at EUNIS level 2 (e.g., from sand to mud), or morphology or sediment changes at a more detailed level if significant and documented. 2. A permanent change is defined if one of the following conditions is true: • When reversal is only possible by active human intervention (e.g., by coral, seagrass and kelp transplantations, by removal of artificial structures, by sand capping, etc.). • When natural recovery rates exceed 12 years (such as the recovery time of some coral reefs or seagrass beds or the long-lasting effect of hydrographical or substrate change), or • When natural recovery rates are unknown or undocumented but suspected to exceed 12 years.
Pressure	Resulting from [human] activities - defined as the mechanisms (as rate processes) of change, in the way in which activity will change the natural and societal systems, by modifying the structure and functioning of the systems (Elliott et al., 2022a).
Pressures Footprint	The area and time covered by the mechanism(s) of change resulting from a given activity or all the activities in an area once avoidance and mitigation measures have been employed (the endogenic managed pressures). It does not necessarily coincide with the activity-footprint and may be larger or smaller. It also needs to include the influence and consequences of pressures emanating from outside the management area (the exogenic unmanaged pressures); given that these are caused by wide- scale events (and even global developments) then these are likely to have larger scale (spatial and temporal) consequences (Cormier et al., 2020)
Programme of Measures	The suite of measures which need to be taken by Member States in order to achieve or maintain GES. These include: input controls, output controls, Spatial and distribution controls, measures to improve traceability, economic incentives, mitigation and remediation tools, communication, stakeholder involvement and raising public awareness (EC, 2008).
Recovery	A return to a normal state of health, mind, or strength. The recovery of populations or ecosystems can be as simple increase, standardized or scaled increase, increase towards a specified target, increase to historical or pristine level or recovery of former structure or function (Lotze et al., 2011).
Resilience	The ability of an ecosystem or component, such as a habitat, to

	return to its original state after being disturbed. The recovery period (often measured in months and years) is used to assess sensitivity (to pressures or activities) for management purposes (CSWD, 2020).
Resistance	The ability of a receptor to absorb disturbance or stress without changing character (Hollings, 1973). Can be a synonym of intolerance.
Resource Management	Centered on the strategic distribution and use of resources, this element ensures the process operates within its stipulated budget and time constraints, efficiently utilising resources, from scientific tools to human expertise, ensuring that marine EBM projects are cost-effective and impactful (Smith et al., 2023; Gregory et al., 2023).
Response (using management Measures)	Using management measures (ecology/environment, technological, economic, societal behavior, governance (politics/policies, administration, legislation), culture, ethics/morals and communication, using stakeholders) as ways of influencing the Drivers and controlling the activities and pressures as the causes of change in order to prevent the consequences of state changes and impacts on welfare; to respond to both the exogenic and endogenic causes and consequences (Elliott et al., 2017, 2022a).
Scenario	A plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions about key relationships and driving forces (e.g., rate of technology changes, prices). Note that scenarios are neither predictions nor forecast[2]
Sensitivity	Susceptibility of an ecosystem component to a specific pressure. The concept of sensitivity accounts for the ecosystem components recovery potential, resistance and resilience with respect to a certain pressure and related effects (Stelzenmüller et al., 2018).
Shared Socio-Economic Pathways (SSP)	Shared socio-economic pathways (SSP) are a set of narratives developed by a group of climate researchers to describe "plausible alternative trends in the evolution of society and natural systems over the 21st century at the level of the world and large world regions" (O'Neill et al., 2014).
Simple	"Comprising those basic elements necessary to achieve the objectives in an easily conducted and understood manner through the minimum complexity necessary." (Collins, 2023; Beer, 1984).
Social-Ecological System	"A social-ecological system consists of a bio-geo-physical unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context." (Glaser et al., 2012)

[2] Glossary — European Environment Agency (europa.eu))

Societal Benefits, including material Goods (often termed Societal Goods and Benefits)	Those qualities and quantities satisfying human health and well-being and the economy which are derived from ecosystem services after inputting capital (built, human and social), including the human assets of energy, time, money, skills, knowledge and an ability to be sentient.
Stakeholder Identification, Engagement and Communication	Involves surfacing and actively involving all relevant people in the process, as well as seeking to create a dialogue that addresses their insights and reservations. This approach includes taking a critical perspective to who and how you are involving stakeholders in the process, ensuring this is done in a meaningful way. In the marine context, this could imply the involvement of everyone from fishermen to policymakers, ensuring that the diverse voices and concerns of all stakeholders are acknowledged in marine management decisions (Smith et al., 2023; Gregory et al., 2023a).
State	The term 'state' refers to the quality/condition of species/habitat/ecosystem elements. This can be determined through measurements in the environment of relevant parameters for such elements; such measurements, by definition, will reflect any impacts (individual and cumulative) to which the element has been subjected (CSWD, 2020).
State Change	Change on the natural system (as the ecology and its supporting physico-chemical aspects) – the resultant spatial and temporal changes in the environmental and ecological structure (situation at one time) and functioning (rate processes), the changes in the natural aspects of the supporting and regulating ecosystem services (Elliott et al., 2022a).
Storyline	A narrative description of a scenario, which highlights its main features and the relationships between the scenario's driving forces and its main features[3]. (Glossary — European Environment Agency (europa.eu))
Stressor	A type of direct or indirect, natural or human related driver that causes undesired change in an ecosystem to any physical, chemical, or biological entity that can induce adverse effects on ecosystems or human health (Selkoe et al., 2015).
System	A system is a whole, encompassing interconnected elements which are networks of interactions, which together work to create the achievement of a common goal or purpose (Jackson, 2019; Elliott et al., 2020b).
Systems Thinking	Reynolds and Holwell (2020) describe 'systems' as being constructs for "engaging with and improving situations of real-world complexity", hence, in this context systems thinking can refer to any approach that adopts a holistic approach to analysis (Reynolds and Holwell, 2020).
Threshold value	A value or range of values that allows for an assessment of the

[3] Glossary — European Environment Agency (europa.eu))

	quality level achieved for a particular criterion, thereby contributing to the assessment of the extent to which GES is being achieved (EU, 2017a).
Tipping point	Zones of rapid change in a nonlinear relationship between the state of an ecosystem or ecosystem component and intensity of a driver, human activity or pressure. This leads to abrupt transitions beyond a critical level, in which the system is unable to return to the precedent stable stage (Selkoe et al., 2015; Stelzenmüller et al., 2018).
Tolerance	The ability of an organism to endure unfavourable environmental conditions (EEA, 2001).
Worldviews	Worldviews are the system of values and beliefs shared by groups of people. They use them to make sense of the world they live in, and they represent the human bias for understanding nature and the individual's participation in social life. These perspectives represent the lens through which people see the future (Oliveira, 2022).

References:

Andersen J.H., Al-Hamdani Z., Harvey E.T., Kallenbach E., Murray C., Stock A., 2020.Relative impacts of multiple human stressors in estuaries and coastal waters in the North Sea–Baltic Sea transition zone. Science of The Total Environment. 704, 135316.

Atkins, J.P., Elliott, M., Burdon, D., Smith, G., Gregory, A.J. (2023). Societal Drivers, Benefits, Goods and Wellbeing, Deliverable 3.2. Marine SABRES, European Union's Horizon Europe research and innovation programme under grant agreement no. 101058956. and the UKRI Project Number 10050525.

Beer, S. (1984) The Viable System Model: Its Provenance, Development, Methodology and Pathology. Journal of the Operational Research Society, 35(1), 7-25. https://doi.org/10.1057/jors.1984.2

Birk S., Chapman D., Carvalho L., Spears B.M., Andersen H.E., Argillier C., Auer S., Baattrup-Pedersen A., Banin L., Beklioğlu M., Bondar-Kunze E., Borja A., Branco P., Bucak T., Buijse A.D., Cardoso A.C., Couture R.-M., Cremona F., de Zwart D., Feld C.K., Ferreira M.T., Feuchtmayr H., Gessner M.O., Gieswein A., Globevnik L., Graeber D., Graf W., Gutiérrez-Cánovas C., Hanganu J., Işkın U., Järvinen M., Jeppesen E., Kotamäki N., Kuijper M., Lemm J.U., Lu S., Solheim A.L., Mischke U., Moe S.J., Nõges P., Nõges T., Ormerod S.J., Panagopoulos Y., Phillips G., Posthuma L., Pouso S., Prudhomme C., Rankinen K., Rasmussen J.J., Richardson J., Sagouis A., Santos J.M., Schäfer R.B., Schinegger R., Schmutz S., Schneider S.C., Schülting L., Segurado P., Stefanidis K., Sures B., Thackeray S.J., Turunen J., Uyarra M.C., Venohr M., von der Ohe P.C., Willby N., Hering D., 2020. Impacts of multiple stressors on freshwater biota across spatial scales and ecosystems. Nature Ecology & Evolution, 4: 1060-1068.

Boero F., 2013. Review of jellyfish blooms in the Mediterranean and Black Sea. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 92. Rome, FAO 2013. 53p. http://www.fao.org/3/i3169e/i3169e.pdf

Borja Á., Dauer D.M., Grémare A., 2012. The importance of setting targets and reference conditions in assessing marine ecosystem quality. Ecological Indicators, 12: 1-7. Borja Á., Elliott M., 2021. From an economic crisis to a pandemic crisis: The need for accurate marine monitoring data to take informed management decisions. Advances in Marine Biology, 89: 79-114.

Borja Á., Elliott M., Andersen J.H., Cardoso A.C., Carstensen J., Ferreira J.G., Heiskanen A.-S., Marques J.C., Neto J., Teixeira H., Uusitalo L., Uyarra M.C., Zampoukas N., 2013. Good Environmental Status of marine ecosystems: What is it and how do we know when we have attained it? Marine Pollution Bulletin, 76: 16- 27.

Borja Á., Elliott M., Carstensen J., Heiskanen A.-S., van de Bund W., 2010. Marine management–towards an integrated implementation of the European Marine Strategy Framework and the Water Framework Directives. Marine Pollution Bulletin, 60, 2175-2186.

Capra F. (1996). The web of life : a new scientific understanding of living systems (1st Anchor books). Anchor Books. ISBN: 9780385476751, 9780385476768, 0385476752, 0385476760

Collins (2023) Simple definition and meaning: Collins English dictionary, Simple definition and meaning | Collins English Dictionary. HarperCollins Publishers Ltd. Available at: https://www.collinsdictionary.com/dictionary/english/simple

Cormier, R., Elliott, M. & Borja, Á. (2022) Managing Marine Resources Sustainably – The 'Management Response-Footprint Pyramid' Covering Policy, Plans and Technical Measures. Frontiers in Marine Science, 9.10.3389/fmars.2022.869992 https://www.frontiersin.org/articles/10.3389/fmars.2022.869992

CSWD, 2020. Commission Staff Working Document: Background document for the Marine Strategy Framework Directive on the determination of good environmental status and its links to assessments and the setting of environmental targets. Accompanying the Report from the Commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive (Directive 2008/56/EC). European Commission SWD(2020) 62 final.

Dolbeth, M., Arenas, F. (2021). Marine Ecosystems: Types, Their Importance and Main Impacts. In: Leal Filho, W., Azul, A.M., Brandli, L., Lange Salvia, A., Wall, T. (eds) Life Below Water. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. https://doi.org/10.1007/978-3-319-71064-8_38-1

Dubé M., Duinker P., Grieg L., Carver M., Servos M., McMaster M., Noble B., Schreier H., Jackson L., Munkittrick K.R., 2013. A framework for assess- ing cumulative effects in watersheds: an introduction to Canadian case stud- ies. Integrated Environmental Assessment & Management, 9(3): 363–369. doi:10.1002/ieam.1418.

EC, 2022. European Commission. MSFD CIS Guidance Document No. 19, Article 8 MSFD, May 2022.

EEA, 2001. EEA Glossary. https://www.eea.europa.eu/help/glossary/eea-glossary

Elliott M., Borja A, Cormier R., 2020. Activity-footprints, pressures-footprints and effects-footprints – Walking the pathway to determining and managing human impacts in the sea. Marine Pollution Bulletin, 155, 111201. doi.org/10.1016/j.marpolbul.2020.111201

Elliott M., Boyes S.J., Cormier R., 2022a. The operationalisation, governance and achievement of Good Environmental Status for UK marine areas. Unpublished Discussion Paper for Natural England, International Estuarine & Coastal Specialists (IECS) Ltd, Leven, HU17 5LQ, UK; pp112, https://www.iecs.ltd.

Elliott M., Burdon D., Atkins J.P., Borja A., Cormier R., de Jonge V.N., Turner R.K., 2017. "And DPSIR begat DAPSI(W)R(M)!" - A unifying framework for marine environmental management. Marine Pollution Bulletin, 118: 27-40.

Elliott M., Houde E.D., Lamberth S.J., Lonsdale J.-A., Tweedley J.R., 2022b. Chapter 12, Management of Fishes and Fisheries in Estuaries. In: Fish and Fisheries in Estuaries – A Global Perspective (ed., Whitfield, A.K., Able, K.W., Blaber, S.J.M. & Elliott, M.), pp. 706-797. John Wiley & Sons, Oxford, UK; ISBN 9781444336672.

Elliott, M., Borja, Á. & Cormier, R. (2020) Managing marine resources sustainably: A proposed integrated systems analysis approach. Ocean & Coastal Management, 197. https://doi.org/10.1016/j.ocecoaman.2020.105315

Elliott, Michael & Borja, Angel & Cormier, Roland. (2023). Managing marine resources sustainably – Ecological, societal and governance connectivity, coherence and equivalence in complex marine transboundary regions. Ocean & Coastal Management. 245. 106875. 10.1016/j.ocecoaman.2023.106875.

EU, 2008. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union. L 164: 19-40.

EU, 2014. Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Official Journal of the European Union. L 317, 4.11.2014, p. 35)

EU, 2017a. Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU. Official Journal of the European Union L 125/43

EU, 2017b. Commission Decision (EU) 2017/845 of 17 May 2017 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies. Official Journal of the European Union L 125/27 Page 27

Folke, C., Hahn, T., Olsson, P. & Norberg, J. (2005) ADAPTIVE GOVERNANCE OF SOCIAL-ECOLOGICAL SYSTEMS. Annual Review of Environment and Resources, 30(1), 441-473.10.1146/annurev.energy.30.050504.144511. https://www.annualreviews.org/doi/abs/10.1146/annurev.energy.30.050504.144511

Ford, D. (2019). A system dynamics glossary. System Dynamics Review, 35(4), 369–379. https://doi.org/10.1002/sdr.1641

Garrity, E.J., 2018. Using systems thinking to understand and enlarge mental models: Helping the transition to a sustainable world. Systems, 6(2), p.15.

Glaser, M., Krause, G., Ratter, B. M. & Welp, M. (2012) Human-nature interactions in the Anthropocene: potentials of social-ecological systems analysis.Routledge. https://doi.org/10.4324/9780203123195

Gregory, A.J., Atkins, J.P., Smith, G., Elliott, M. (2023). Simple Social-Ecological Systems Guidance, Deliverable 3.1. Marine SABRES, European Union's Horizon Europe research and innovation programme under grant agreement no. 101058956. and the UKRI Project Number 10050525

Gregory, A., Atkins, JP., Smith, G., Hummel, H., Meirelles de Oliveira, B. *(2023a). Stakeholders and Stakeholder Communication Briefing Note, Deliverable 3.2. Marine SABRES, European Union's Horizon Europe research and innovation programme under grant agreement no. 101058956. and the UKRI Project Number 10050525*

Haines-Young R., Potschin M.B., 2018. Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure. Available from www.cices.eu 53 pp.

Hiscock K, Jackson A., Lear D., 1999. Assessing seabed species and ecosystem sensitivities: existing approaches and development, October 1999 edition. Report to the Department of Environment, Transport and the Regions from the Marine Life Information Network (MarLIN). Marine Biological Association of the United Kingdom, Plymouth. [MarLIN Report No. 1.]

Holling C.S., 1973. Resilience and stability of ecological systems. Annual Review of Ecology and Systematics, 4(1), 1-23.

ICES, 2003. ICES Advisory Committee on Ecosystems, Report of the Regional Ecosystem Study Group for the North Sea, 34, ICES CM 2003/ACE 04.

ICES, 2019a. Working Group on Cumulative Effects Assessment Approaches in Management (WGCEAM). ICES Scientific Reports. 1:92. 23 pp. http://doi.org/10.17895/ices.pub.5759

ICES, 2019b. Workshop to evaluate and test operational assessment of human activities causing physical disturbance and loss to seabed habitats (MSFD D6 C1, C2 and C4) (WKBEDPRES2). ICES Scientific Reports. 1:69. http://doi.org/10.17895/ices.pub.5611

Jackson, M. C. (2019) Critical systems thinking and the management of complexity. John Wiley & Sons.

Judd A.D., Backhaus T., Goodsir F., 2015. An effective set of principles for practical implementation of marine cumulative effects assessment. Environ. Sci. Policy. 54, 254-262.

Kauffman, S. A. (1993). The origins of order. Self-organization and selection in evolution. New York/Oxford: Oxford University Press.

Knights A.M., Piet G.J., Jongbloed R.H., Tamis J.E., White L., Akoglu E., Boicenco L., Churilova T., Kryvenko O., Fleming-Lehtinen V., Leppanen J.-M., Galil B.S., Goodsir F., Goren M., Margonski P., Moncheva S., Oguz T., Papadopoulou K.N., Setälä O., Smith C.J., Stefanova K., Timofte F., Robinson L.A., 2014. An exposure-effect approach for evaluating ecosystem-wide risks from human activities. submitted Biological Conservation. ICES Journal of Marine Science, 72(3), 1105–1115. doi:10.1093/icesjms/fsu245

Kopainsky, B., Huber, R. & Pedercini, M. (2015) Food Provision and Environmental Goals in the Swiss Agri-Food System: System Dynamics and the Social-ecological Systems Framework. Systems Research and Behavioral Science, 32(4), 414-432. https://doi.org/10.1002/sres.2334

Lauerburg R.A.M., Diekmann R., Blanz B., Gee K., Held H., Kannen A., Möllmann C., Probst W.N., Rambo H., Cormier R., Stelzenmüller V., 2020. Socio-ecological vulnerability to tipping points: A review of empirical approaches and their use for marine management, Science of The Total Environment, 705, 135838, doi:10.1016/j.scitotenv.2019.135838.

Lotze, H. K., Coll, M., Magera, A. M., Ward-Paige, C., Airoldi, L., 2011. Recovery of marine animal populations and ecosystems. Trends in Ecological Evolution, 26, 595-605.

Lovelock, J. (2007). The revenge of Gaia: earth's climate in crisis and the fate of humanity. New York, Basic Books. ISBN 13: 9780713999143

Maes J., Teller A., Erhard M., Liquete C., Braat L., Berry P., Egoh B., Puydarrieux P., Fiorina C., Santos F., Paracchini M., Keune H., Wittmer H., Hauck J., Fiala I., Verburg P., Condé S., Schägner J., San Miguel J., Estreguil C., Ostermann O., Barredo J., Pereira H., Stott A., Laporte V., Meiner A., Olah B., Royo Gelabert E., Spyropoulou R., Petersen J., Maguire C., Zal N., Achilleos E., Rubin A., Ledoux L., Brown C., Raes C., Jacobs S., Vandewalle M., Connor D., Bidoglio G., 2013. Mapping and Assessment of Ecosystems and their Services. An analytical framework for ecosystem assessments under action 5 of the EU biodiversity strategy to 2020, Publications office of the European Union, Luxembourg

Marcos C., Díaz D., Fietz K., Forcada A., Ford A., García-Charton J.A., Goñi R., Lenfant P., Mallol S., Mouillot D., Pérez-Marcos M., Puebla O., Manel S., Pérez-Ruzafa A., 2021. Reviewing the Ecosystem Services, Societal Goods, and Benefits of Marine Protected Areas. Frontiers in Marine Science 8, 2021, doi:10.3389/fmars.2021.613819

McLeod K.L., Lubchenco J., Palumbi S.R. and Rosenberg A.A., 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. https://marineplanning.org/wpcontent/uploads/2015/07/Consensusstatement.pdf

Moore, M.-L., P. Olsson, W. Nilsson, L. Rose, and F. R. Westley. 2018. Navigating emergence and system reflexivity as key transformative capacities: experiences from a Global Fellowship program. Ecology and Society 23(2):38. https://doi.org/10.5751/ES-10166-230238

Natural Capital Committee (2019). Natural Capital Terminology. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/909202/ncc-terminology.pdf

Olenin S., Gollasch S., Lehtiniemi M., Sapota M., Zaiko A. 2017. Biological invasions. In: Biological Oceanography of the Baltic Sea, ed. by Snoeijs-Leijonmalm P., Schubert H., Redziejewska T. pp. 193-232. Springer, Dordrecht

Oliveira, B. (2022). Ecosystem-based management of social-ecological systems: A required perspective and agenda. En Oliveira, B; Pardo, J. & Turra, A. (Orgs) Challenges in ocean governance in the views of early career scientists: Achievements of the São Paulo School of Advanced Science on Ocean. S (p. 235). Instituto de Estudos Avançados da Universidade de São Paulo.

O'Neill, B.C., Kriegler, E., Riahi, K., Eni, K.L., Hallegatte, S., Carter, T.R., Mathur, R., van Vuuren, D.P. (2014). A new scenario framework for climate change research: the concept of shared socioeconomic pathways. Climatic Change 122, 387–400. https://doi-org.uea.idm.oclc.org/10.1007/s10584-013-0905-2

Orians G.H. 1974. Diversity, stability and maturity in natural ecosystems. Proc. First Int. Congr. Ecol., The Hague (1974), pp. 64-65

OSPAR, 2010. Quality Status Report. Glossary. Online: https://qsr2010.ospar.org/en/terms_glossary.html

Ostrom, E. & Cox, M. (2010) Moving beyond panaceas: a multi-tiered diagnostic approach for social-ecological analysis. Environmental Conservation, 37(4), https://doi.org/10.1017/S0376892910000834

Ostrom, E. (2011), Background on the Institutional Analysis and Development Framework. Policy Studies Journal, 39: 7-27. https://doi.org/10.1111/j.1541-0072.2010.00394.x

Ramírez F., Pennino M.G., Albo-Puigserver M., Steenbeek J., Bellido J.M., Coll M., 2021. SOS small pelagics: a Safe Operating Space for small pelagic fish in the Western Mediterranean Sea. Science of The Total Environment 756:144002 DOI:10.1016/j.scitotenv.2020.144002

Reynolds, M., Holwell, S. (2020). Introducing Systems Approaches. In: Reynolds, M., Holwell (Retired), S. (eds) Systems Approaches to Making Change: A Practical Guide. Springer, London. https://doi.org/10.1007/978-1-4471-7472-1_1

Robinson L.A., Rogers S., Frid C.L.J., 2008. A marine assessment and monitoring framework for application by UKMMAS and OSPAR - Assessment of Pressures and Impacts. Phase II: Application for regional assessments. JNCC Contract No: C-08-0007-0027. UKMMAS, 2010. Charting Progress 2.

Sanseverino I., Conduto D., Pozzoli L., Dobricic S., Lettieri T., 2016. Algal bloom and its economic impact. JRC Technical Report. EUR 27905 EN; doi:10.2788/660478

Scherer R.A., 2011. Cumulative effects: a primer for watershed managers. Streamline Watershed Management Bulletin, 14(2), 14–20. Available from http://nrin.forrex.org/sites/default/files/publications/articles/Streamline_Vol14_No2_art3.pdf

Selkoe K.A., Blenckner T., Caldwell M.R., Crowder L.B., Erickson A.L., Essington T.E., Estes J.A., Fujita R.M., Halpern B.S., Hunsicker M.E., Kappel C.V., Kelly R.P., Kittinger J.N., Levin P.S., Lynham J.M., Mach M.E., Martone R.G., Mease L.A., Salomon A.K., Samhouri J.F., Scarborough C., Stier A.C., White C., Zedler J., 2015. Principles for managing marine ecosystems prone to tipping points. Ecosystem Health and Sustainability. 1, art17.

Sellner K.G., Doucette G.J., Kirkpatrick G.J., 2003. Harmful algal blooms: causes, impacts and detection. J. Ind. Microbiol. Biotechnol. 30: 383–406 DOI 10.1007/s10295-003-0074-9

Senge, P.M., 1990. The fifth discipline: The art and practice of the learning organization. Currency Doubleday.

Smith, G., Gregory, A., Atkins, JP. (2023). The Process and Information Management System Briefing Paper, Deliverable 3.2. Marine SABRES, European Union's Horizon Europe research and innovation programme under grant agreement no. 101058956. and the UKRI Project Number 10050525

Stelzenmüller V., Coll M., Mazaris A.D., Giakoumi S., Katsanevakis S., Portman M.E., Degen R., Mackelworth P., Gimpel A., Albano P.G., Almpanidou V., Claudet J., Essl F., Evagelopoulos T., Heymans J.J., Genov T., Kark S., Micheli F., Pennino M.G., Rilov G., Rumes B., Steenbeek J., Ojaveer H., 2018. A risk-based approach to cumulative effect assessments for marine management. Sci. Total Environ. 612, 1132–1140.

Tillin H.M., Tyler-Walters H., 2014. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 1 Report: Rationale and proposed ecological groupings for Level 5 biotopes against which sensitivity assessments would be best undertaken. JNCC Report No. 512A. Joint Nature Conservation Committee. Peterborough, 68 pp.

Turner R.K., Schaafsma M., 2015. (Eds.) Coastal zones ecosystem services: from science to values and decision making. Springer Ecological Economic Series, Springer Internat. Publ. Switzerland, ISBN 978-3-319-17213-2.

van Nes E.H., Arani B.M.S., Staal A., van der Bolt B., Flores B.M., Bathiany S., Scheffer M., 2016. What Do You Mean, 'Tipping Point'? Trends in Ecology & Evolution, 31 (12), 902-904. Page 28

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