



An approach for the Ecological Value Assessment of coastal and marine areas



Anita Franco*, Eva Amorim, Michael Elliott

International Estuarine and Coastal Specialists (IECS) Ltd, UK - www.iecs.ltd; *Anita.Franco@iecs.ltd

1. Background and rationale

The concept and methodology for ecological value assessment has been developed based on existing literature on marine biological valuation (first proposed by Derous et al. [1] and since applied in various case studies) and on relevant properties of the marine ecosystem. The resulting method expands and improves on previous biodiversity valuation approaches.

[1] Derous, S., Agardy, T., Hillewaert, H., et al., 2007. A concept for biological valuation in the marine environment. *Oceanologia* 49(1), 99–128.

Ecological value (EV) is defined from an eco-centric perspective as the **inherent value** of the **biodiversity qualities** of an ecosystem, independently from any human association/interests (i.e., excluding utilitarian/instrumental value related to the uses humans make of the environment and associated social interests). As such, it is measured in **non-monetary terms**.

Ecological Value Assessment (EVA) is the process of assigning ecological value to an area through the integration of the inherent value of the ecosystem qualities within it. The spatial distribution of the EV within the study area allows to identify subzones with particularly high ecological or biological significance and to inform on a greater-than-usual degree of risk aversion in spatial planning activities in these subzones [1].

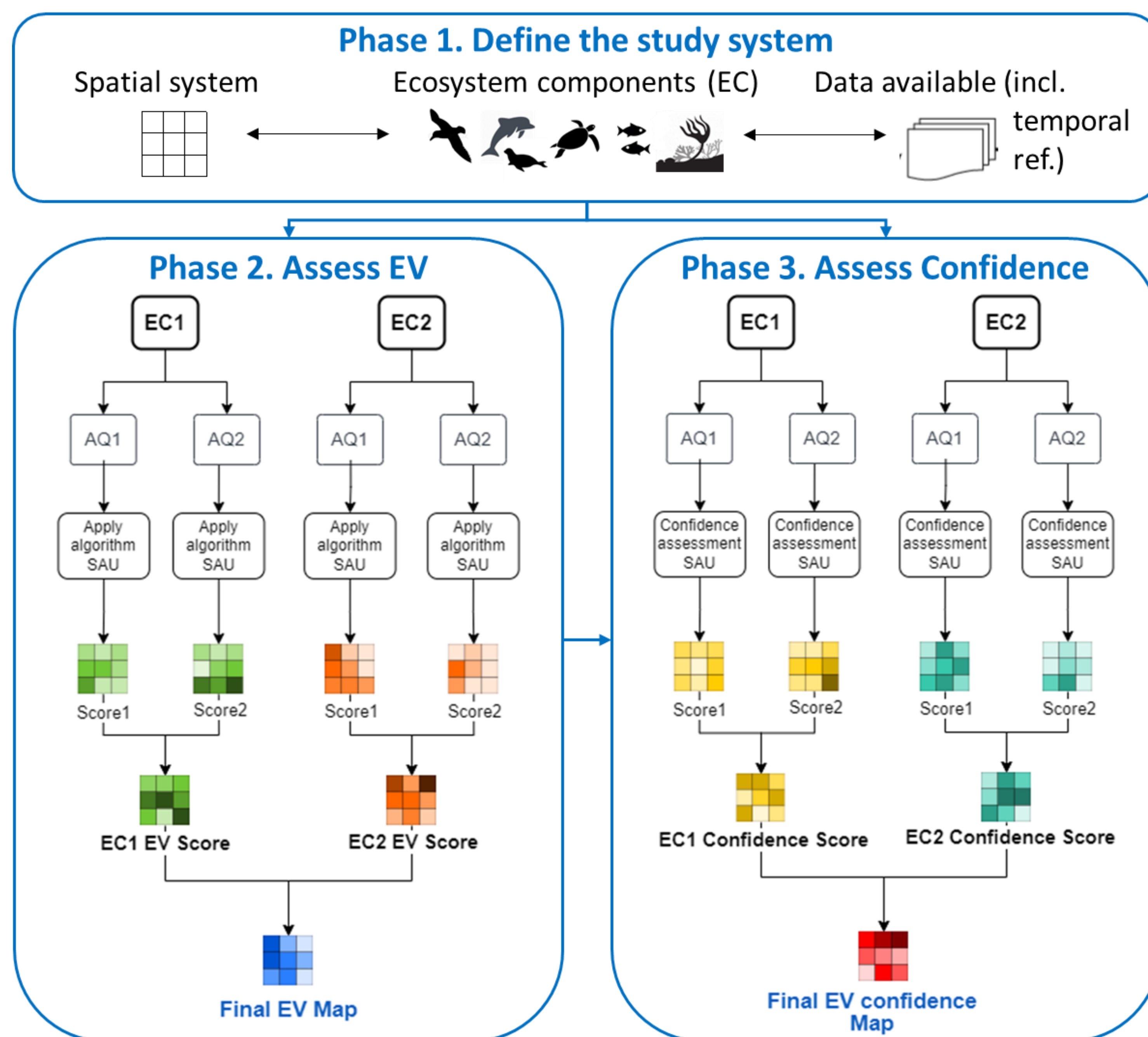
The EVA process is undertaken in three phases: a preparatory one where the study system is defined (Phase 1), one where the EV is calculated and mapped (Phase 2) and one where the confidence associated with the EV results is assigned and mapped (Phase 3).

2. Ecosystem Components

The Ecological Value of an area is assessed combining multiple **Ecosystem Components (ECs)** characterising the ecosystem:

EC type	EC	Further EC subdivision*
Species group	Seabirds	
	Marine mammals / Marine reptiles	
Fish	Zooplankton	Demersal / Pelagic fish
		Macrobenthos / Epibenthos / Hyperbenthos / Meiobenthos; Hard / Soft substrata
Phytobenthos	Plankton	Macroalgae / Plants (seagrass, saltmarsh); Hard / Soft substrata
		Zooplankton / Phytoplankton
Habitats	Marine benthic habitats	
	Marine pelagic habitats	Vertical depth zonation

As many ECs as possible should be included in the assessment, provided their relevance to the studied system and data availability. The nature of the evidence base influences the granularity of EC (e.g., different monitoring methods or programmes affecting data comparability).



5. Assessing EV

Each EC is assessed separately and then the results are averaged across ECs into a **total EV**. The **EC-specific EV** is assessed by answering as many **Assessment Questions (AQs)** as possible out of 15 AQs provided. The answer to each AQ is a measure of the diversity of specific sub-groups of species or habitats within an EC. These **features of interest** are identified based on the added value they provide to the ecosystem according to their frequency of occurrence (Rarity) or their importance in supporting the structure and processes of the ecosystem (Aggregation-Fitness consequences). The answer to an AQ is calculated using predefined algorithms relying on qualitative (occurrence, presence/absence) or quantitative evidence (abundance, density, extent, etc) and the resulting value is scaled on a 0-5 range. The average across AQs gives the EC-specific EV.

Feature of interest	Selection criterion
Locally rare feature (LRF)	Species or habitat occurring in <2% of the subzones in the BBT
Regionally rare feature (RRF)	(i) Species occurring in <2% of 50 x 50 km squares of each of three bathymetric zones (littoral, sublittoral, bathyal/abissal) in the region / Habitat occurring in <2% of 50 x 50km squares in the region, OR (ii) Species or habitat identified as regionally rare from accredited national/international lists, OR (iii) based on expert judgement
Nationally rare species/ habitats (NRF)	Species occurring in <0.5% of 10 x 10 km squares within national waters / habitat type restricted to a limited number of locations in territorial waters, OR (ii) Species or habitat identified as nationally rare from accredited national/international lists, OR (iii) based on expert judgement
Regularly occurring feature (in the study area) (ROF)	Species/habitats occurring in >5% of the subzones for the study area (i.e. all species/habitat excluding locally rare ones)
Ecologically significant feature (ESF)	Species or habitats which have a significant ecological role in supporting the ecosystem structure and functioning. E.g., keystone species; species which constitute important food sources of certain seabirds or have a key/pivotal role in the foodweb (e.g. keystone, top predator); species which are important for recruitment of fish stocks (e.g. fish larvae); habitats which play a key function in supporting viable populations of certain species (e.g. areas or habitats identified as essential habitats for fish/shellfish nursery, spawning, feeding or other functions).
Habitat-forming species or biogenic habitat (HFS/BH)	These can be identified as the species with habitat forming role or as the respective biogenic habitat. Their distribution is indicative of habitats often supporting diverse biota and key functions (e.g. refuge from predators)
Symbiotic species (SS)	Species living in a symbiotic relationship with another species (as relevant to the region/ecosystem of interest)

Assessment question (AQ)	Feature of interest	Type of evidence
AQ1. Is the subzone characterized by the presence of many locally rare features?	LRF	Qual.
AQ2. Is the subzone characterized by high abundance of many locally rare features?	LRF	Quant.
AQ3. Is the subzone characterized by the presence of many regionally rare features?	RRF	Qual.
AQ4. Is the subzone characterized by high abundance of many regionally rare features?	RRF	Quant.
AQ5. Is the subzone characterized by the presence of many nationally rare features?	NRF	Qual.
AQ6. Is the subzone characterized by high abundance of many nationally rare features?	NRF	Quant.
AQ7. Is the number of features in the subzone high?	all species/habitats	Qual.
AQ8. Is the subzone characterized by high counts of many species?	ROF	Quant.
AQ9. Is the abundance of certain species very high in the subzone?	ROF	Quant.
AQ10. Is the presence of ecologically significant features high in the subzone?	ESF	Qual.
AQ11. Is the abundance of ecologically significant features high in the subzone?	ESF	Quant.
AQ12. Is the presence of habitat-forming species high in the subzone?	HFS/BH	Qual.
AQ13. Is the abundance of habitat-forming species high in the subzone?	HFS/BH	Quant.
AQ14. Is the presence of mutualist or symbiotic species high in the subzone?	SS	Qual.
AQ15. Is the abundance of mutualist or symbiotic species high in the subzone?	SS	Quant.

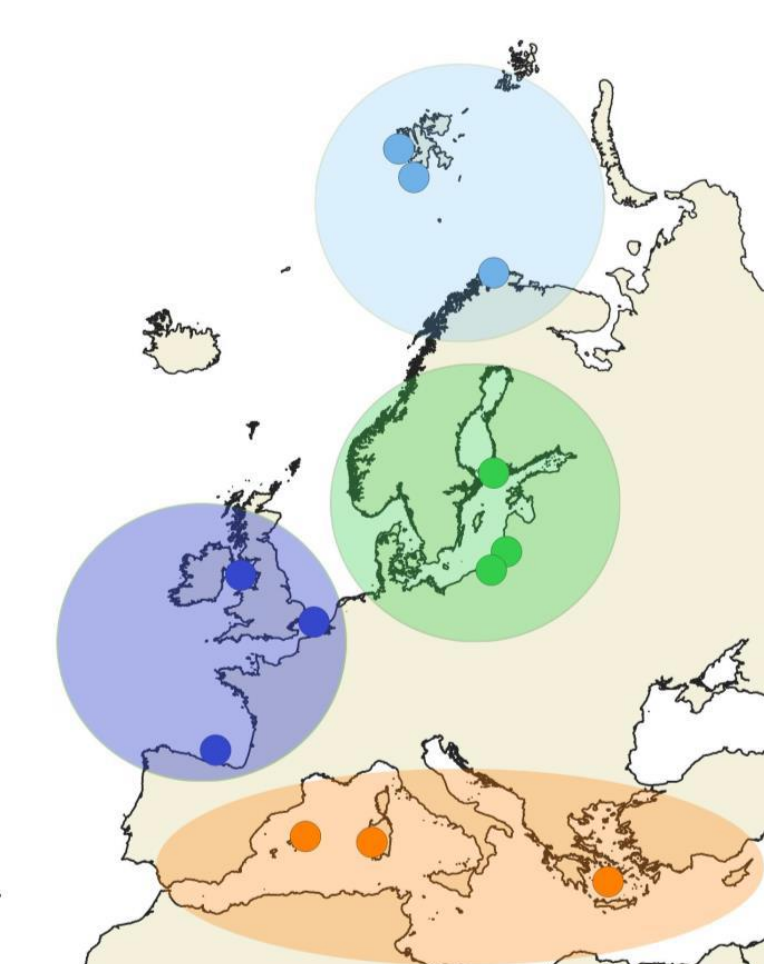
$$Confidence = \frac{1}{N} \sum_{i=1}^N AQ_i w_i$$

N = max. number of AQs available for the EC; **AQ_i** = 1 if the AQ_i has been answered, 0 if not; **w_i** = weight assigned to AQ_i, where answered, which takes into consideration different sources of uncertainty (table below)

Base for the assessment & Data use	Data availability (d)*					
	Low	Medium-low	Medium	Medium-High	High	Not known/relevant
Expert judgment	-	-	-	-	-	1
Data based	Indirect use of the data (model products)	1	1	2	3	3
	Direct use of monitoring data	1	2	3	4	5

7. Way forward

The EVA protocol is being tested in 12 case studies (BBTs) within the MARBEFES project, distributed across marine regions (Arctic, Baltic, Atlantic, Mediterranean). At the same time, the EVA method is being revised (via clarifications, protocol adjustments etc) as testing and discussions with the BBTs progress. The final protocol will be published in a handbook for valuation methods due to be delivered at the end of the project.



EVA currently relies on 'traditional' measures of biodiversity (species/habitat level), but may be expanded and adapted to account for biodiversity measured at other ecological levels (genetic, functional/biological traits, etc).