The Methodology for Mapping and Valuation of Supply of Marine Ecosystem Services

Baltic Sea Case Study

R. Aps[1], M. Fetissov[1], M. Kopti[1], H. Orav-Kotta[1], J. Kotta[1], H. Tõnisson[2], Aija Kosk[3]

[1]Estonian Marine Institute, University of Tartu
[2]Institute of Ecology, Tallinn University
[3]Peipsi CTC, www.ctc.ee, Aija.Kosk@gmail.com

INTRODUCTION AND OBJECTIVE

- The poster presents result of the project 'Development of methodology for assessment and mapping of ecosystem services of marine and inland waters' – the express methodology for mapping and valuation of marine ecosystem services.
- Ecosystem services in this project are defined as the direct and indirect contributions of ecosystems to human well-being or so called 'final ecosystem services'.
- The overall concept of methodology for mapping and valuation supply of marine ecosystem services follows the research published by Burkhard, et al (2012).
- The methodology is based on matrix that presents the expert opinions in relation to relative supply scale for mapping and valuation of marine ecosystem services.

MATERIALS

- Marine ecosystem elements are: coastal zone, coastal sea (from shoreline to 20 isobath, both benthal and pelagial), and high sea (bental) and high sea (pelagial).
- The capacity of marine ecosystem to supply services are strongly linked to ecological status of waterbody and type of the shore.
- Ecological status is defined according to EU Water Framework Directive (2000/60/EU). The WFD classification scheme for water quality includes five status classes:

High	Good	Moderate	Poor	Bad

- The following shore types (Tõnisson, et al, 2013) have been used for mapping and valuation of ecosystem services of coastal zone:

Silt – depositional with fine-grained (silt) sediments; usually it has a very flat nearshore and a tendency to become overgrown
Till – an abrasion sloping till
Gravel – depositional with beach ridges formed of gravel and pebbles
Sand – depositional with sand ridges often backed by foredunes or dunes
Artificial – natural dynamics altered by anthropogenic constructions (breakwaters, protecting walls, berms)
Cliffed – an abrasion bluff in resistant Palaeozoic rocks (limestone, dolomite, sandstone)

- Colours in the previous table indicate sensitivity of shore to pollution (Tõnisson, et al, 2013):

Very sensitive to pollution	Medium or large sensitivity to pollution	Low sensitivity to pollution

- The classification of ecosystem services is based on the Common International Classification of Ecosystem Services (CICES) developed by the European Environment Agency. According to this classification ecosystem services are divided into three sections: provisioning, regulating and cultural services.
- The list of marine ecosystem services is compiled on the basis of CICES V4.3 (January 2013) ecosystem services list.
- The relative ecosystem services supply scale have values between 0-4:

4	3	2	1	0
Very significant supply	Significant supply	Moderate supply	Insignificant supply	No supply

VERIFICATION OF THE MATRIX

- Pärnu, Haapsalu and Tallinn Bay of Baltic Sea were used to verify expert estimates of ecosystem services supply.
- The focus group interview method was used to verify expert estimates. 7-8 people were invited to each interview: local municipality representative, representative of tourism sector, scientists, local residents and college students. The assessed regions were presented in approximately 10 minute presentation. Then participants had time for assessment of ecosystem services.
- Estimates of focus group on Pärnu bay differed from the matrix-based opinion to 5%. Slightly bigger difference (14-16%) appeared on Tallinn bay case. This may be due to a very strong human impact use and large proportion of artificial shore.

METHODOLOGY – MATRIX FOR DETERMINATION AND VALUATION MARINE ECOSYSTEM SERVICES

On the field of matrix, presented in the table 1, there are numbers from 0 to 4 that indicate relative value of ecosystem services supply of coastal zone, coastal sea and high sea of Baltic Sea.

Table 1. Matrix for mapping and evaluation of Baltic Sea ecosystem services

Ecological status	Shore type/Biome	Provisioning services					Regulating services					Cultural services						Abiotic services			
		Algea stock	Herbal biomass of costal grassland	Fish stock	Sediment stock	Reed-bed (Cane)	Habitat maintenance	Maintenance of water naturalness (natural water quality, wastewater dilution and selfpurification)	Maintenence of protected species habitats	Natural sedimentation and sedimentmotion, erosion regulation	Maintenance of hydrodynamics and reductionof flood risk	Suitable environmental conditions for rest (by types - both passive and active rest/sport)	Environmental conditions suitable for recreational fishing and hunting (by types)	Source of inspiration for creative activity	Opportunity for research	Opportunity for studies	Natural symbols (spiritual sites, national symbols)	Environmental conditions suitable for the production of wind energy	Environmental conditions suitable for production of hydrothermal energy	Environmental condition suitable for navigation (incl. cooling water, bilge water ect)	Environmental condition suitable for establishment of iced road
Bad	Silt	1	3	1	3	4	1	2	2	4	4	1	3	2	3	2	1	4	1	2	2
	Till	1	3	1	3	4	1	2	2	4	4	1	3	2	3	2	1	4	1	3	3
	Gravel	1	0	1	0	0	1	1	2	3	2	1	2	2	3	3	1	4	1	2	3
	Sand	1	1	1	1	1	1	1	1	3	2	1	2	2	3	2	1	4	1	2	4
	Artificial	1	0	1	0	0	1	0	1	1	2	3	0	2	1	3	0	3	4	4	1
	Cliffed	1	0	1	0	0	1	1	1	3	4	1	2	3	3	3	2	3	2	3	0
	Coastal sea (benthal, pelagial)	0	0	1	0	0	1	1	0	depends on bottom geology 3-4	depends on bottom geology 2-4	2	1	2	4	1	0	0	2	4	4
	High sea (pelagial)	0	0	1	0	0	1	1	0			2	1	2	4	0	0	4	0	4	4
	High sea (benthal)	0	0	0	0	0	1	0	0			2	1	2	4	0	0	4	0	4	4
Poor	Silt	2	4	2	3	4	2	2	2	4	4	1	4	2	4	3	2	4	1	2	2
	Till	2	4	2	3	4	2	2	2	4	4	2	3	2	4	3	2	4	1	3	3
	Gravel	2	0	2	0	0	2	2	1	3	2	1	3	2	4	3	2	4	1	2	3
	Sand	2	1	2	1	1	2	1	1	3	2	2	2	2	4	3	2	4	1	2	4
	Artificial	2	0	2	0	0	2	1	1	1	4	3	0	2	2	2	0	3	4	4	1
	Cliffed	2	0	2	0	0	2	1	1	3	4	3	2	4	4	3	3	3	2	3	0
	Coastal sea (benthal, pelagial)	1	0	2	0	0	2	2	1	depends on bottom geology 3-4	depends on bottom geology 2-4	3	2	2	4	2	0	0	2	4	4
	High sea (pelagial)	0	0	2	0	0	2	1	1			3	2	2	4	0	0	4	0	4	4
	High sea (benthal)	0	0	1	0	0	2	0	1			3	2	2	4	0	0	4	0	4	4
Moderate	Silt	4	4	3	4	4	3	2	3	3	3	3	3	3	4	4	3	4	1	2	3
	Till	4	4	3	4	4	3	2	3	3	3	3	4	3	4	4	3	4	1	3	3
	Gravel	4	0	3	0	0	3	2	2	2	2	2	3	3	4	3	3	4	1	2	3
	Sand	4	1	3	1	1	3	2	2	2	2	3	1	3	4	3	3	4	1	2	4
	Artificial	4	0	3	0	0	2	1	1	1	4	3	1	2	2	2	0	3	4	4	1
	Cliffed	4	0	3	0	0	3	2	2	2	4	3	3	3	4	3	4	3	2	3	0
	Coastal sea (benthal, pelagial)	4	0	3	0	0	3	2	2	depends on bottom geology 3-4	depends on bottom geology 2-4	3	3	3	4	3	0	0	2	4	4
	High sea (pelagial)	0	0	3	0	0	3	2	2			3	3	3	4	0	0	4	0	4	4
	High sea (benthal)	0	0	3	0	0	3	2	2			3	3	3	4	0	0	4	0	4	4
Good	Silt	4	4	4	4	3	4	3	4	3	3	4	4	4	4	4	3	4	1	2	3
	Till	4	4	4	4	3	4	3	4	2	2	3	4	4	4	4	4	4	1	3	4
	Gravel	4	0	4	0	0	4	3	3	2	1	2	3	3	4	3	3	4	1	2	3
	Sand	4	1	4	1	1	4	3	2	2	1	3	2	4	4	3	3	4	1	2	4
	Artificial	4	0	4	0	0	2	2	1	1	4	3	1	2	2	2	0	3	4	4	1
	Cliffed	4	0	4	0	0	4	2	3	2	4	3	4	4	4	4	3	2	3	0	
	Coastal sea (benthal, pelagial)	4	0	4	0	0	4	3	3	depends on bottom geology 3-4	depends on bottom geology 2-4	3	3	4	4	4	0	0	2	4	4
	High sea (pelagial)	0	0	4	0	0	4	3	3			3	3	4	4	0	0	4	0	4	4
	High sea (benthal)	0	0	4	0	0	4	3	3			3	3	4	4	0	0	4	0	4	4
High	Silt	2	3	2	4	2	3	4	4	3	2	4	3	4	3	3	4	4	1	2	4
	Till	2	2	2	3	2	3	4	4	2	1	4	3	4	3	3	4	4	1	3	3
	Gravel	2	0	2	0	0	3	3	2	1	1	3	2	4	3	2	3	4	1	2	4
	Sand	2	0	2	0	0	3	2	2	1	1	4	2	4	3	2	4	4	1	2	4
	Artificial	2	0	2	0	0	2	2	1	1	4	4	1	3	2	1	0	3	4	4	1
	Cliffed	2	0	2	0	0	3	3	3	2	4	4	3	4	4	3	2	3	0		
	Coastal sea (benthal, pelagial)	4	0	2	0	0	4	3	4	depends on bottom geology 3-4	depends on bottom geology 2-4	4	2	4	4	4	0	0	2	4	4
	High sea (pelagial)	0	0	2	0	0	4	3	4			4	2	4	4	0	0	4	0	4	4
	High sea (benthal)	0	0	2	0	0	4	3	4			4	2	4	4	0	0	4	0	4	4

CONCLUSION

- Based on marine ecosystem services mapping and valuation matrix (table 1) it is possible to assess to what extent different Baltic Sea areas could provide ecosystem services.
- This matrix does not allow to assess natural sedimentation, sediment motion, erosion regulation, maintenance of hydrodynamics and reduction of flood risk in costal sea and high sea. For that assessment information about geology of sea bottom would be required.
- The matrix (table 1) gives the primary, qualitative assessment on marine ecosystem services supply. For more accurate, quantitative assessment, values of ecosystem services the relevant indicators are needed. In assessment of marine ecosystem services supply it is important to keep in mind that every water body is unique.

REFERENCES

Burkhard, B., Kroll, F., Nedkov, S., Müller, F. (2012) Mapping ecosystem service supply, demand and budgets. Ecological Indicators 21, p.17–29

Tõnisson, H., Orviku, K., Lapinskis, J., Gulbinskas, S., Zaromskis, R. (2013). The Baltic States - Estonia, Latvia and Lithuania. In: Panzini, E. and Williams, A. (Ed.). Coastal erosion and protection in Europe (47–80). UK, US and Canada: Routledge.

The research was funded by European Economic Area 2009 – 2014 programme „Integrated marine and inland water management" and Estonian Environmental Investment Centre.