Ecosystem Services Assessment Tool (ESAT): Concept and first application in Szczecin Lagoon

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A SYSTEM APPROACH FRAMEWORK FOR COASTAL RESEARCH & MANAGEMENT

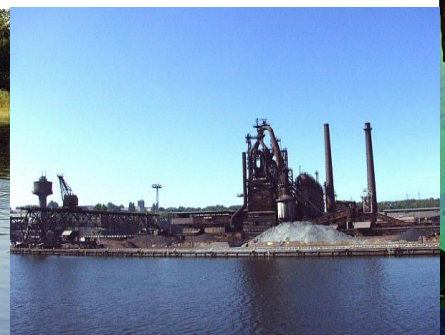
BONUS-BaltCoast received funding from BONUS (Art 185), funded jointly by the EU and Baltic Sea national funding institutions

ESAT -
Concept and first application in Szczecin Lagoon

- The main aim for the development of the methodology and the overall research is to:

Provide an easy to apply tool for ecosystem services assessment in the marine environment




Ecosystem Services Assessment Tool

- The tool was developed to overcome the **lack** of assessments of **marine ecosystem services**

- Uses Common International Classification on Ecosystem Services **(CICES)**, but with modifications for application in marine systems (leaving behind the services for land assessment)

- Makes use of the Indicators proposed for transitional and coastal waters, in the EU Project Mapping and Assessment of Ecosystem Services **(MAES)**, but with new additions (based on discussions)

Ecosystem Services Assessment Tool

Pillars of development:

- **User friendly** Excel spreadsheet tool
- **Fast assessment** with low use of resources
- Takes into account two time periods, **Good Status** (defined in line with WFD) and **Present Status**
- **Transferable** to other similar systems (Good Status)
- Make use of the existing **EU Policies** as basis for assessment and later for adaptation to management plans

Ecosystem Services Assessment Tool

3 Categories of ES
(Provisioning, Regulating and Maintenance and Cultural Services)

31 Ecosystem Services

54 Indicators
(modified from MAES)

Ecosystem Services Assessment Tool

Section	Provisioning Services									
Division	Nutrition				Materials				Energy	
Group	Biomass				Biomass		Water		Biomass-based energy resources	
Section	Regulating and Maintenance Services									
Division	Mediation of waste, toxics and other nuisances		Mediations of Flow		Maintenance of physical, chemical, biological conditions					
					Lifecycle maintenance,	Pest and	Soil formation		Atmospheric	
Section	Cultural Services									
Division	Physical and Intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]						Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes			
Group	Physical and experiential interactions		Intellectual and representative interactions				Spiritual and/or emblematic		Other cultural outputs	
Class	Experiential use of plants, animals and land-/seascapes in different environmental settings	Physical use of land-/seascapes in different environmental settings	Scientific and Educational	Heritage, cultural	Entertainment	Aesthetic	Symbolic	Sacred and/or religious	Existence	Bequest

Inácio et al (2016) submitted (please don't quote the material)

Section	Class	Indicator	Units
Provisioning Services	Wild plants, algae and their outputs	*Harvest of wild plants, algae*	Ton/yr./km2
		Nº of species of wild plants, algae	Nº/km2
	Wild animals and their outputs	Landings (wild animals)	Ton/yr./km2
		Landing of key market species (wild animals)	Ton/yr./km2
	Animals from in situ aquaculture	*Harvest (animals from aquaculture)*	Ton/yr./km2
		Nº of species (animals from aquaculture)	Nº/km2
	Plants and algae from in situ aquaculture	*Harvest (plants , algae from aquaculture)*	Ton/yr./km2
		Nº of species (plants , algae from aquaculture)	Nº/km2
	Surface water for drinking purposes	Use of water for drinking	m3/km2
	Fibers and other materials from plants, algae and animals for direct use or processing	Harvest of materials from plants, algae and animals for direct use or processing	Ton/yr./km2
	Materials from plants, algae and animals for agriculture	Harvest of materials from plants, algae and animals for agriculture, fodder	Ton/yr./km2
	Surface Water for non-drinking purposes	Use of water for non-drinking	m3/km2
	Plant based resources	Use of plant based resources for energy	Ton/yr./km2
	Animal based resources	Use of animal based resources for energy	Ton/yr./km2

Inácio et al (2016) submitted (please don't quote the material)

Section	Class	Indicator	Units
Regulating and Maintenance Services	Filtration/sequestration/storage/accumulation by ecosystems	N-fixation	kg/yr./km2
		Burial	kg/yr./km2
		Denitrification	kg/yr./km2
	Dilution by atmosphere, freshwater and marine ecosystems	Average of beach closures per year	Nº/km2
	Mass stabilization and control of erosion rates	*Extent of selected emerged, submerged and intertidal habitats*	km2/km2
	Buffering and attenuation of mass flows	Sediment accumulation rate	cm/yr.
	Flood Protection	Shoreline erosion rate	mm/yr./km2
		Maximum depth (to calculate maximum wave height)	m
		Design-basis Flood	m
	Maintaining nursery populations and habitats	Submerged and intertidal habitats diversity	Nº/km2
		Occurrence of Oxygen concentration < 6 mg/L	Days/yr.
		Secchi depth	m
		Species distribution	km2/km2
		Nursery areas	km2/km2
		% of nursery areas which are protected	km2/km2
	Pest and Disease control	Harmful Algal Bloom Outbreaks	Nº/km2
		Presence of alien species	Nº/km2
	Decomposition and fixing processes	*Nitrogen removal*	%
		Water residence time	Months
	Chemical condition of salt waters	Nutrients concentration	mg/L
		Salinity	PSU
		Oxygen Concentration	mg/L
	Global climate regulation by reduction of greenhouse gas concentrations	*C stock*	tonC/km2
		C sequestration	tonC/yr./km2
		pH	
		Primary production	tonC/yr./km2
	Micro and regional climate regulation	Evaporation rate	per km2

Inácio et al (2016) submitted (please don't quote the material)

Section	Class	Indicator	Units
Cultural Services	Experiential use of plants, animals and land-/seascapes in different environmental settings	Nº of visitors taking part in activities related to biota	Nº/yr./km2
	Physical use of land-/seascapes in different environmental settings	Nº of tourists (within 1 km of coastal zone)	Nº/km2
		Nº of ship berths in the marinas	Nº/km2
		Nº of Tourist Boat	Nº*capacity/km2
	Scientific and Educational	*Scientific studies, Documentaries, educational publications*	Nº/yr./km2
		Visits to scientific and artistic exhibits	Nº/yr.
	Heritage, cultural	Nº of cultural and heritage sites	Nº/km2
	Entertainment	Nº of movies and broadcasts in the area	Nº/km2
	Aesthetic	Nº of pictures	Nº/yr./km2
	Symbolic	Nº of Red List and iconic species	Nº/km2
	Sacred and/or religious	Nº of Religious events (within 1 km of coastal zone)	Nº/km2
	Existence	Nº of offers for health treatments (within 1 km of coastal zone)	Nº*capacity/km2
	Bequest	*Extent of marine protected areas*	km2 / km2

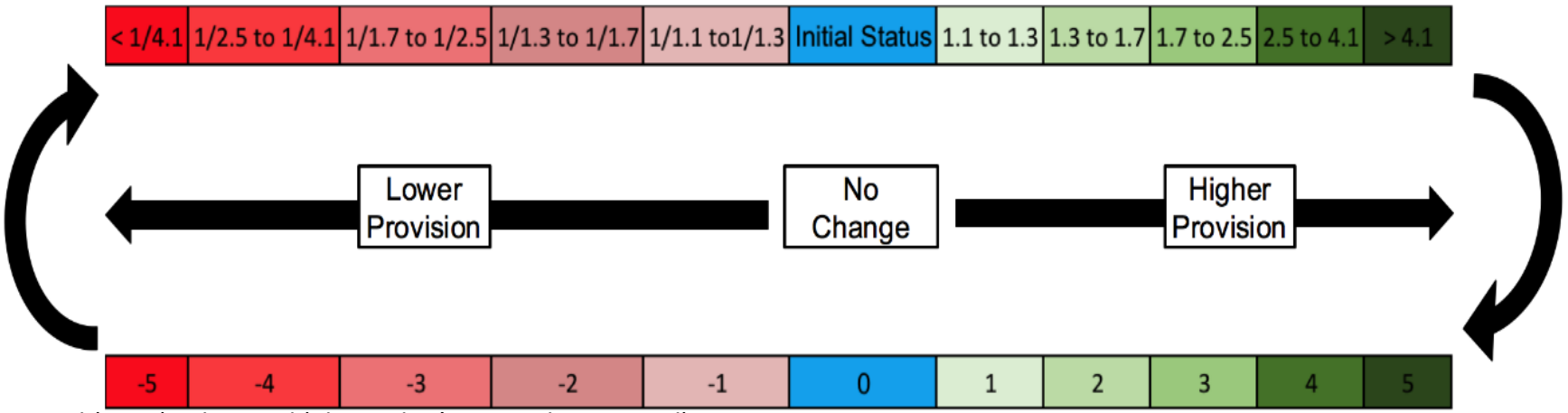
Inácio et al (2016) submitted (please don't quote the material)

Assessment of two time periods representing different ecological statuses

The initial status – based on WFD reference conditions of ecosystem

compared

The present status – representing the present state of the ecosystem



Inácio et al (2016) submitted (please don't quote the material)

Ecosystem Services Assessment Tool

Incorporate different types of Data

Observational Data	Literature and Reports	Other Sources (Modelling)	Expert Knowledge

For each source it is given criteria about
Quality or Reliability of data

1	2	3	4
Very High	**High**	**Moderate**	**Low**

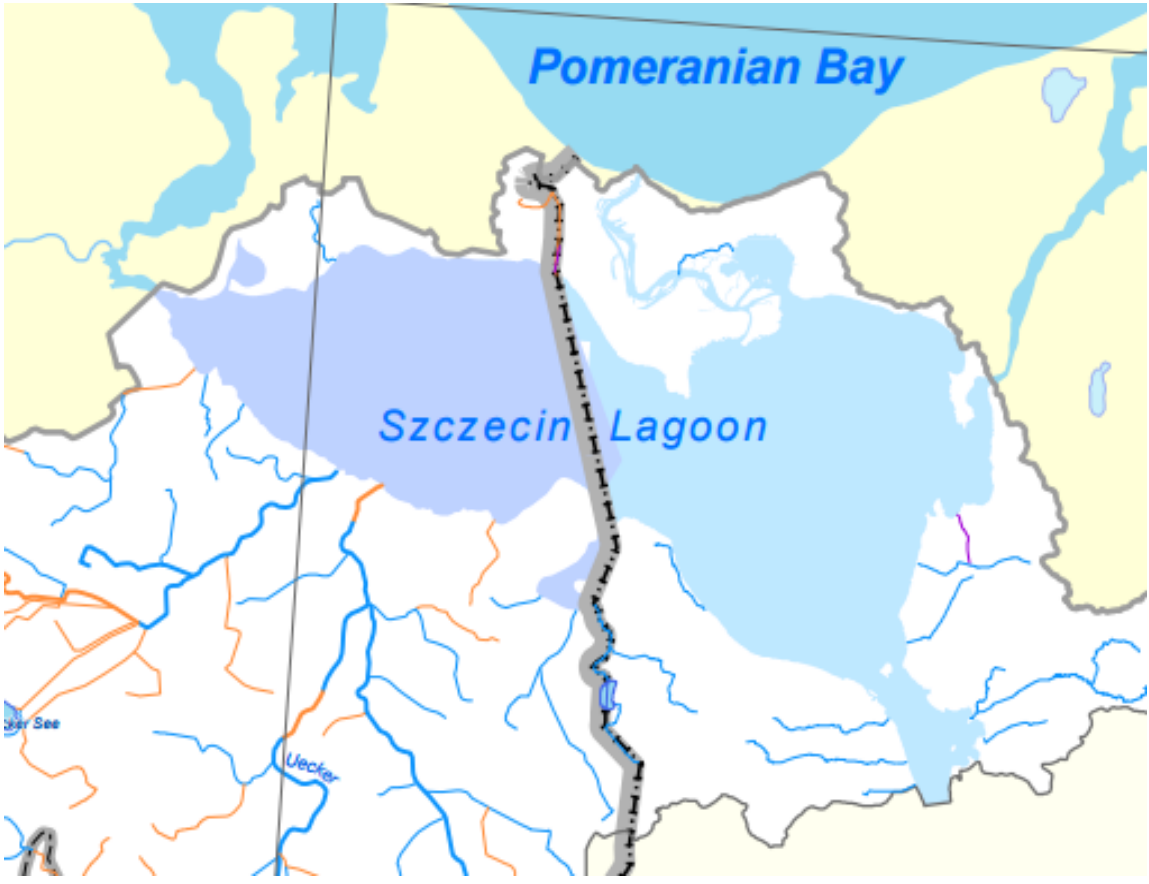
Inácio et al (2016) submitted (please don't quote the material)

Steps of Assessment

1 - Defining study area (using WFD Transitional WB type classification)

Szczecin Lagoon

- Border between Germany and Poland
- One of the biggest coastal lagoons in Europe with 687 km2
- Shallow system with a mean depth of 3.8m
- Important for human development with many cities and settlements around the lagoon



Steps of Assessment

2 – Assessing Initial Status (using WFD reference conditions as baseline for defining Good Status in time, in this case early 1960's)

(eg. Wild animals and their outputs – fisheries)

ES classification

Section	Division	Group	Class
Provisioning Services	Nutrition	Biomass	Wild animals and their outputs

Indicators

Indicator	Units	Value
Landings	Ton/yr./km2	**4.2**
Landing of key market species	Ton/yr./km2	**1.3**

Data Sources

Indicator	Units	Value	Type of Data	Quality / Reliability	
Landings	Ton/yr./km2	**4.2**	Reports/ Literature	1	Very High
Landing of key market species	Ton/yr./km2	**1.3**	Reports/ Literature	1	Very High

Ecosystem Services Assessment Tool

Steps of Assessment

2 – Assessing Initial Status

Classes of ES

< 1/4.1	1/2.5 to 1/4.1		1/1.7 to 1/2.5		1/1.3 to 1/1.7		1/1.1 to 1/1.3		Good Status		1.1 to 1.3		1.3 to 1.7		1.7 to 2.5		2.5 to 4.1		> 4.1
< 1/4.1	1/4.1	1/2.5	1/2.5	1/1.7	1/1.7	1/1.3	1/1.3	1/1.1	1/1.1	1.1	1.1	1.3	1.3	1.7	1.7	2.5	2.5	4.1	4.1
1.024	1.024	1.680	1.680	2.471	2.471	3.231	3.231	3.818	3.818	4.620	4.620	5.460	5.460	7.140	7.140	10.500	10.500	17.220	17.220
0.317	0.317	0.520	0.520	0.765	0.765	1.000	1.000	1.182	1.182	1.430	1.430	1.690	1.690	2.210	2.210	3.250	3.250	5.330	5.330

Indicator	Units	Value
Landings	Ton/yr./km2	**4.2**
Landing of key market species	Ton/yr./km2	**1.3**

Inácio et al (2016) submitted (please don't quote the material)

Steps of Assessment

3 – Assessing Present Status (present times status in this case from 2010 to present)

(eg. Wild animals and their outputs – fisheries)

ES classification

Section	Division	Group	Class
Provisioning Services	Nutrition	Biomass	Wild animals and their outputs

Indicators

Indicator	Units	Value	Class of change
Landings	Ton/yr./km2	3.3601	1/1.3 to 1/1.7
Landing of key market species	Ton/yr./km2	0.3309	1/2.5 to 1/4.1

Data Sources

Indicator	Units	Value	Class of change	Type of Data	Quality / Reliability	
Landings	Ton/yr./km2	3.3601	1/1.3 to 1/1.7	Database/ dataset	1	Very High
Landing of key market species	Ton/yr./km2	0.3309	1/2.5 to 1/4.1	Database/ dataset	1	Very High

Steps of Assessment

3 – Assessing Present Status

Classes of ES

< 1/4.1	1/2.5 to 1/4.1		1/1.7 to 1/2.5		1/1.3 to 1/1.7		1/1.1 to 1/1.3		Good Status		1.1 to 1.3		1.3 to 1.7		1.7 to 2.5		2.5 to 4.1		> 4.1
< 1/4.1	1/4.1	1/2.5	1/2.5	1/1.7	1/1.7	1/1.3	1/1.3	1/1.1	1/1.1	1.1	1.1	1.3	1.3	1.7	1.7	2.5	2.5	4.1	4.1
1.024	1.024	1.680	1.680	2.471	2.471	3.231	3.231	3.818	3.818	4.620	4.620	5.460	5.460	7.140	7.140	10.500	10.500	17.220	17.220
0.317	0.317	0.520	0.520	0.765	0.765	1.000	1.000	1.182	1.182	1.430	1.430	1.690	1.690	2.210	2.210	3.250	3.250	5.330	5.330

Indicator	Units	Value	Class of change
Landings	Ton/yr./km2	3.3601	1/1.3 to 1/1.7
Landing of key market species	Ton/yr./km2	0.3309	1/2.5 to 1/4.1

Inácio et al (2016) submitted (please don't quote the material)

Results from Assessment

ES classification

Section	Division	Group	Class
Provisioning Services	Nutrition	Biomass	Wild animals and their outputs

Good Status

Indicator	Units	Value
Landings	Ton/yr./km2	**4.2**
Landing of key market species	Ton/yr./km2	**1.3**

Present Status

Indicator	Units	Value	Class of change
Landings	Ton/yr./km2	3.3601	1/1.3 to 1/1.7
Landing of key market species	Ton/yr./km2	0.3309	1/2.5 to 1/4.1

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Ecosystem Services Classification						Assessment			Aggregated category			
Section	Division	Group	Class	Indicator	Units	Initial Status	Present Status	Category	Class	Group	Division	Section
			Wild plants, algae and their outputs	Harvest of wild plants, algae	Ton/yr./km2	not considered / not relevant						
				Nº of species of wild plants, algae	nº/km2							

Ecosystem Services Classification						Assessment			Aggregated Category			
Section	Division	Group	Class	Indicator	Units	Initial Status	Present Status	Category	Class	Group	Division	Section
vices	Mediation of waste, toxics and other nuisances	Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems	N-fixation	kg/yr./km2	0,1214	0,0629	-3	-2	-1	-1	
				Burial (P)	kg/yr./km2	23,0500	17,0400	-2				
				Denitrification	kg/yr./km2	23634,2240	22755,6790	0				
			Dilution by atmosphere, freshwater and marine ecosystems	Average of beach closures per year	Nº/km2	0	0	0	0			
	Mediations of Flow	Mass Flows	Mass stabilization and control of erosion rates	Extent of selected emerged, submerged and intertidal habitats	km2/km2	0,0997	0,0387	-4	-4	-2	-1	
			Buffering and attenuation of mass flows	Sediment accumulation rate	cm/yr.	0	0	0	0			

Ecosystem Services Classification						Assessment			Aggregated Category			
Section	Division	Group	Class	Indicator	Units	Initial Status	Present Status	Category	Class	Group	Division	Section
Cultural Services	Physical and Intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings	nº of visitors taking part in activities related to biota	nº/yr/km2			0	0	3	3	3
			Physical use of land-/seascapes in different environmental settings	Nº of tourists (within 1 km of coastal zone)	nº/km2	614,1131499	21229,85719	5	4			
				Nº of ship berths in the marinas	nº/km2	0	2,711790393	4				
				Nº of Tourist Boat	nº*capacity/km2	0	0,122743682	3				
		Intellectual and representative interactions	Scientific and Educational	Scientific studies, Documentaries, educational publications	Nº/yr./km2	0,0032	0,1138	5	5	4		
				Visits to scientific and artistic exhibits	Nº/yr	no data	no data	0				
			Heritage, cultural	nº of cultural and heritage sites	nº/km2	0,02195122	0,063414634	4	4			
			Entertainment	Nº of movies and broadcasts in the area	nº/km2	0	0,008491024	2	2			
			Aesthetic	Nº of pictures	Nº/yr./km2	0,007220217	0,056768559	5	5			
	Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes	Spiritual and/or emblematic	Symbolic	Nº of Red List and iconic species	nº/km2	0,001455604	0,04657933	4	4	3	3	
			Sacred and/or religious	Nº of Religious events (within 1 km of coastal zone)	nº/km2	0	0,03202329	3	3			
		Other cultural outputs	Existence	Nº of offers for health treatments (within 1 km of coastal zone)	nº*capacity/km2			0	0	2		
			Bequest	Extent of marine protected areas	km2 / km2	0	1	5	5			

Inácio et al (2016) submitted (please don't quote the material)

Section		Division		Group		Class	
Regulating and Maintenance Services	Good Status	Mediation of waste, toxics and other nuisances	1.3 to 1.7	Mediation by ecosystems	1.3 to 1.7	Filtration/sequestration /storage/accumulation by ecosystems	1.3 to 1.7
		Mediations of Flow	1/1.1 to1/1.3	Mass Flows	1/1.3 to 1/1.7	Dilution by atmosphere, freshwater and marine ecosystems	Good Status
						Mass stabilisation and control of erosion rates	1/1.7 to 1/2.5
						Buffering and attenuation of mass flows	Good Status
				Liquid Flows	Good Status	Flood Protection	Good Status
		Maintenance of physical, chemical, biological conditions	Good Status	Lifecycle maintenance, habitat and gene pool protection	1.1 to 1.3	Maintaining nursery populations and habitats	1.1 to 1.3
				Pest and disease control	2.5 to 4.1	Pest and Disease control	2.5 to 4.1
				Soil formation and composition	Good Status	Decomposition and fixing processes	Good Status
				Water conditions	1/1.1 to1/1.3	Chemical condition of salt waters	1/1.1 to1/1.3
				Atmospheric composition and climate regulation	Good Status	Global climate regulation by reduction of greenhouse gas concentrations	Good Status
						Micro and regional climate regulation	Good Status

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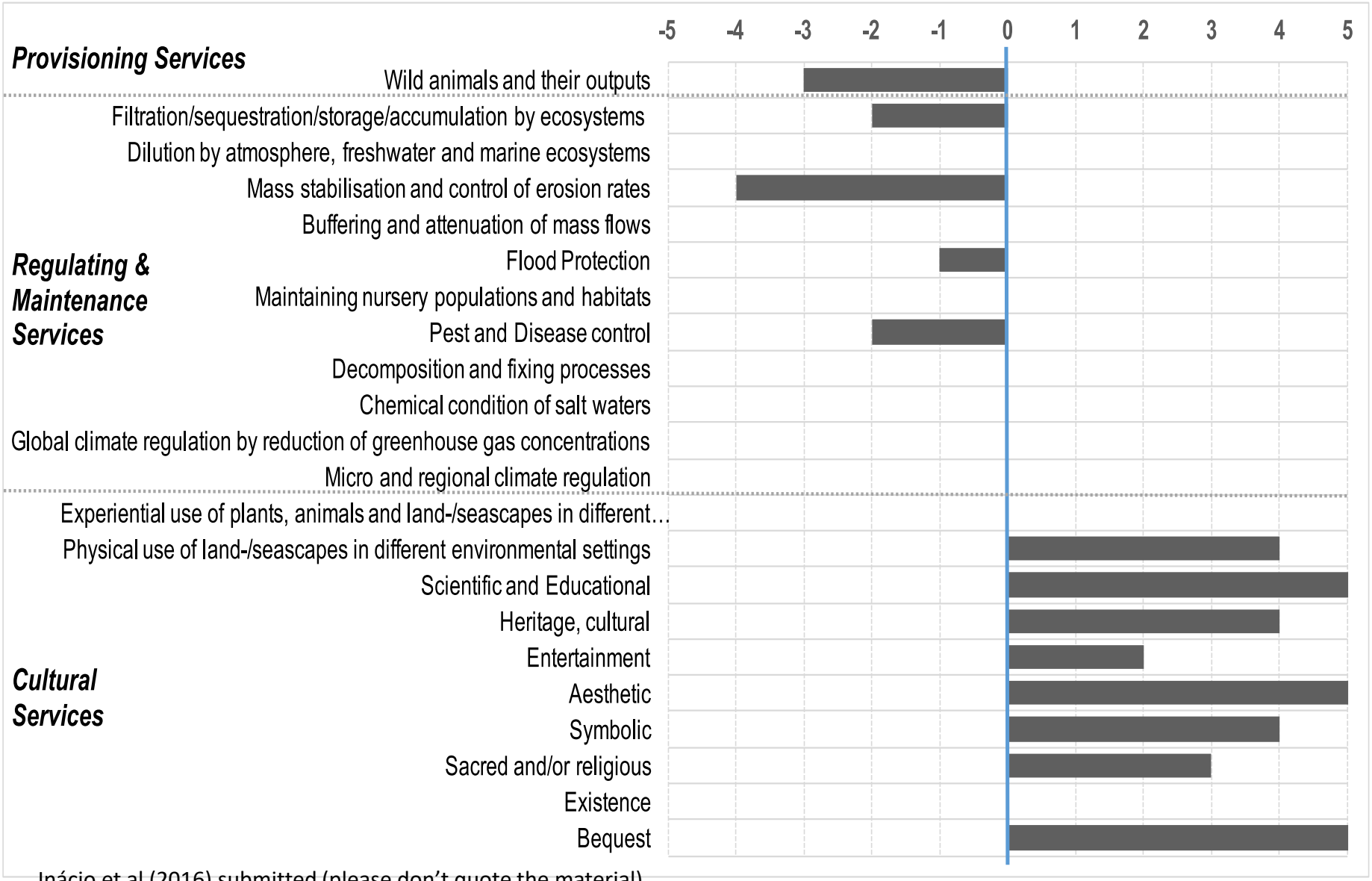

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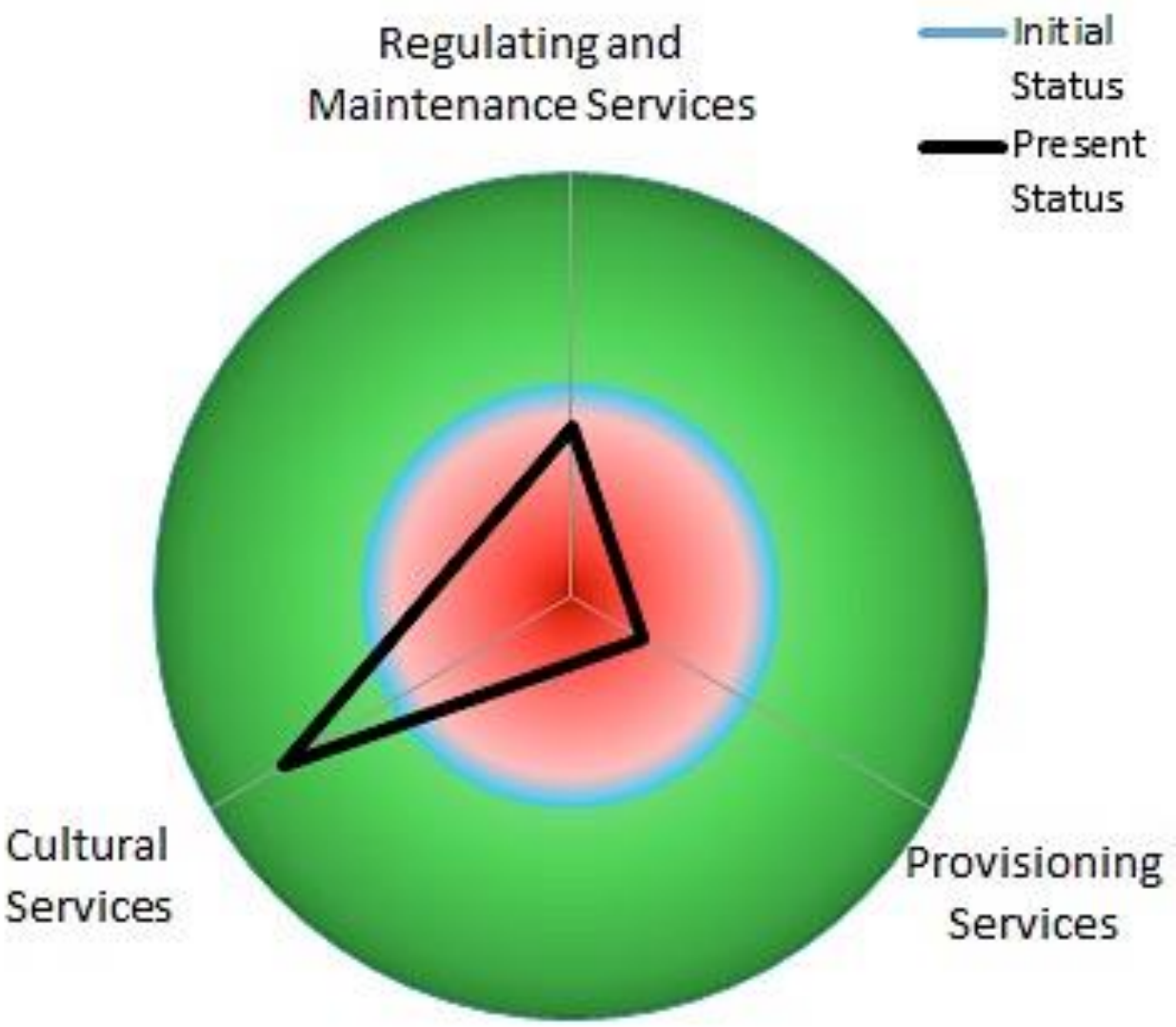

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Ecosystem Services Assessment Tool

Weaknesses

- Difficult access to data;
- Very detailed data;
- If there is no modeling output is very hard to go through;
- Difficult assessment for small spatial units;

Strengths

- Takes into consideration the ecological status of the environment;
- Fast (or faster) compared to other qualitative approaches;
- Data may be transferable for other locations;
- Analyze ES change over time and it's implications

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