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UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS



Progress in Assessing Good Environmental Status in Deep-sea Benthic Ecosystems: D1, D3, D6 and D10

ATLAS 3rd General Assembly

Covadonga Orejas, Georgios Kazanidis, Lea-Anne Henry, Ángel Borja, Ellen Kenchington, Lenaick Menot, David A. Stirling, Francis Neat, Telmo Morato, Marina Carreiro-Silva, Dick van Oevelen, Steve Ross, Anthony Grehan, Stefan Aki Ragnarsson, Pablo Durán, Gerald Taranto, Nick Roterman & Murray Roberts





..break out group 2nd Annual Assembly 2017

- **NEAT approach**

- Selection of indicators
- Set up thresholds
- Test GES in a pilot case study
- Azores, Mingulay, Shetland Channel – for D1 and D6

- **MESMA-like approach**

- Map of pressures (need to be transformed into an impact index)
- Map of VMEs (based on predictive models)
- Terms of risk or likelihood of GES areas
- Build polygons with likelihood of the area being in GES or not



..break out group 2nd Annual Assembly 2017

- **NEAT approach**
 - Selection of indicators potentially applicable to the deep sea
 - Selected indicators shared with case study leaders (and some other ATLAS members highly involved in the GES issue) in July 2017



..break out group last year

- NEAT approach

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	marked with a red X the indicators considered more suitable												
2	Indicators marked in green are the ones with higher than 80% agreement among the participants												
3		Case study 1 Dick van Oevelen				Case study 2 Lea-Anne Henry				Case study 3 Francis Neat			
4	NEAT Indicators	D1	D3	D6	D10	D1	D3	D6	D10	D1	D3	D6	D10
5	Abundance and composition of functional groups in selected habitats	1				1				1			
6	Abundance and distribution of cetaceans (M4)												
7	Abundance and distribution of juvenile flounder												
8	Abundance and impact of non-native fish species (round goby example)	1											
9	Abundance of bacterioplankton												
10	Abundance of benthic invertebrates	1				1				1			
11	Abundance of bioengineering species							1				1	
12	Abundance of cephalopods												
13	Abundance of commercial fish (Catch per unit effort)	1	1			1	1			1	1		
14	Abundance of coral colonies alive			1				1				1	
15	Abundance of demersal elasmobranchs						1			1	1		
16	Abundance of demersal elasmobranchs - representation for georeferenced data (GIS)									1			
17	Abundance of demersal fish	1	1				1			1	1		
18	Abundance of demersal fish - representation for georeferenced data (GIS)									1			
19	Abundance of fish	1	1			1	1			1	1		
20	Abundance of functional groups of fish	1	1			1	1			1	1		



..break out group last year

- **NEAT approach**

In May 2017 a new commission decision was published (COMMISSION DECISION (EU) 2017/848 of 17 May 2017 that laid down criteria and methodological standards on GES of marine waters and specifications along with standardised methods for monitoring and assessment, repealing Decision 2010/477/EU).

D1 and D6 merged partially in a single descriptor D6
D1 → non commercial fish species

	K	L	M
1 marked with a r			
2 Indicators marke			
3			
4 NEAT Indicato			
5 Abundance and co			
6 Abundance and dist			
7 Abundance and dist			
8 Abundance and impa			
9 Abundance of bacteri			
10 Abundance of benthic			
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14 Abundance of coral colo			
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16 Abundance of demersal el			
17 Abundance of demersal fish			
18 Abundance of demersal fish - representation for georeferenced data (GIS)			
19 Abundance of fish			
20 Abundance of functional groups of fish			

	D1	D3	D6	D10
10 Abundance of benthic	1			
11 Abundance of bioengin			1	
12 Abundance of cephalop				1
13 Abundance of commerci	1	1		
14 Abundance of coral colo			1	1
15 Abundance of demersal e				
16 Abundance of demersal el			1	1
17 Abundance of demersal fish	1	1		
18 Abundance of demersal fish - representation for georeferenced data (GIS)			1	1
19 Abundance of fish	1	1		
20 Abundance of functional groups of fish	1	1		



..break out group last year

- **NEAT approach**
 - Selection of indicators potentially applicable to the deep sea
 - Selected indicators shared with case study leaders (and some other ATLAS members highly involved in the GES issue) in July 2017
 - Suggest to us the indicators selected for the 80% of us can be considered as "suitable"
 - ...in December 2017 we got all replies → selection of indicators

NEAT INDICATORS (> 65% AGREEMENT FOR D1 for non commercial fish species and > 80% AGREEMENT for D3 & D6)

D1	D3	D6	D10
Distributional range and pattern of selected (sensitive) non commercial demersal fish	Abundance ratio of mature individuals of selected fish species	Abundance of coral colonies alive	Areal extent of litter: Type (e.g. plastic, glass)/abundance/density/weight
Species richness of non commercial fish	Age class structure of commercial fish	Areal extent of biogenic / vulnerable habitats (type, abundance, biomass, condition and areal extent of relevant biogenic substrata)	Density of abandoned fishing gear (e.g. lines, nets, etc.)
Abundance of non-commercial demersal fish and cephalopods	Age-frequency distribution of fish	Areal extent of human affected area	Colonisation on litter
Abundance of non-commercial functional groups of fish	Biomass of demersal fish	Areal extent of protected sea areas	Microplastics / Contaminants in sediments/organisms
Species diversity (Shannon index) of non-commercial fish	Biomass of selected fish species	Number of traces from fishing activities (trawlmarks)	Number of organisms (e.g. coral colonies) entangled in fishing lines or nets
	Biomass of selected fish species (SSB - spawning stock biomass)	Density of biogenic reef forming species (type, abundance, biomass and areal extent of relevant biogenic substratum per habitat type)	
	Body length distribution of fish	Distribution and condition of habitat forming species	
	Body length distribution of fish in the community	Areal extent of sedimentary seafloor / vulnerable habitats (type, abundance, biomass, condition and areal extent of relevant sedimentary communities)	
	Fishing Effort (ComInd 10)	Impacts of anthropogenic physical disturbance on the sea pen community	
		Extent of area affected by cables and pipelines	
		Abundance and composition of functional groups in selected habitats	
		Species richness of corals	
		Ratio of live versus dead/overgrown coral cover	
		VMEs and VMEs indicator taxa (status, areal extent, size-frequency distribution)	
		Structural complexity	

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Species diversity (Shannon index) of non-commercial fish	Biomass of selected fish species	Number of traces from fishing (trawlmarks)	
	Biomass of selected fish species (SSB - spawning stock biomass)	Density of traces from fishing	
		Condition of habitat forming species	
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	Fishing Effort (ComInd 10)	Impacts of anthropogenic physical disturbance on the sea pen community	
		Extent of area affected by cables and pipelines	
		Abundance and composition of functional groups in selected habitats	
		Species richness of corals	
		Ratio of live versus dead/overgrown coral cover	
		VMEs and VMEs indicator taxa (status, areal extent, size-frequency distribution)	
		Structural complexity	

We kept D1 in our Descriptor list in order to consider the non commercial Fish and cephalopods species



...we have the indicators...how to measure??

- Quantitative measures, what we do already know?
- Literature research to extract measures to be able to use the selected indicators → 290 papers already checked
- Threshold set-up. Thresholds specific for each case study. Set-up spatial scale
- Spatial scale – polygon approach – divide a large area into polygons and define GES in that polygon unit



...we have the indicators...how to measure??

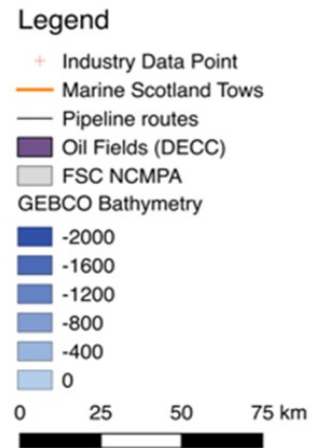
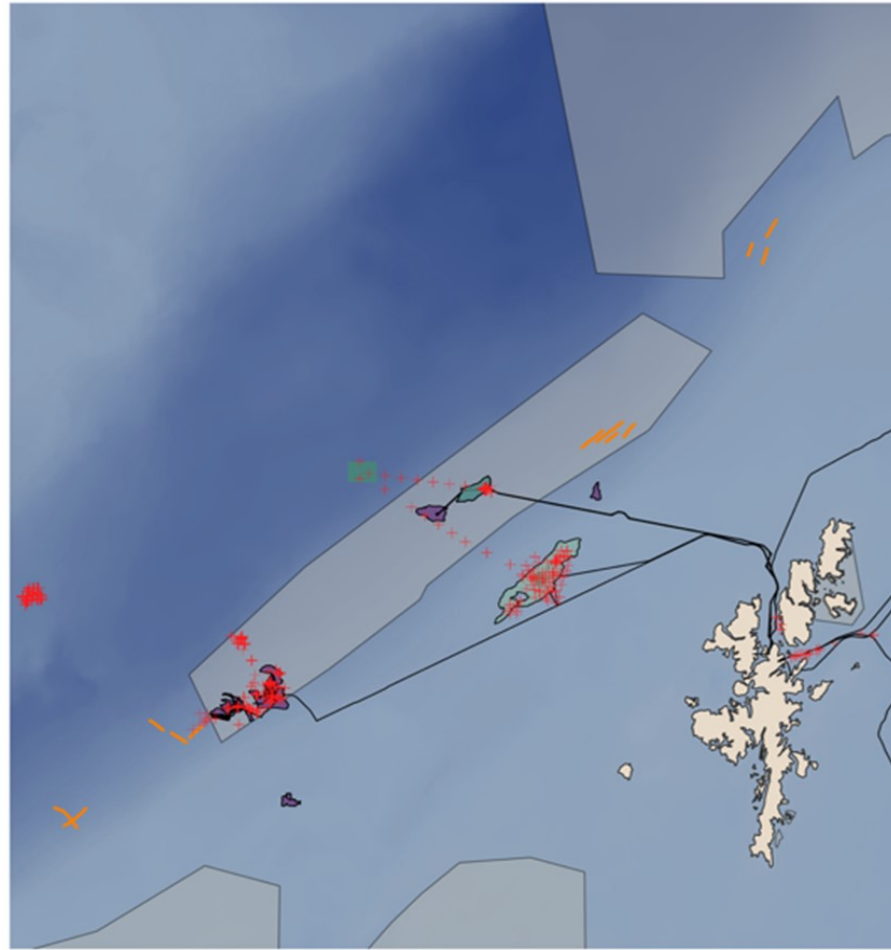
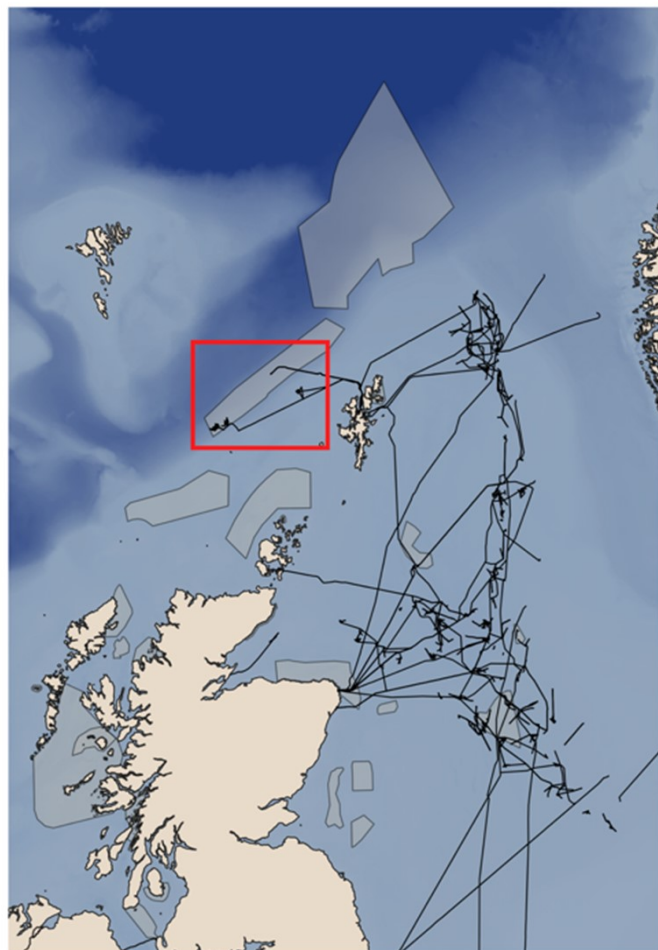
1	Region	Location	Setting	Depth (m)	Methodology used	Species studied
2	North-East Atlantic	Traena Coral Field (Norway)	Sponge ground	~300-350	ROV video transects	<i>Geodia</i> spp. & <i>Porifera</i> indet.
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4	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>P. carpenteri</i>
5	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>G. barretti</i>
6	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>C. longipilis</i>
7	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>G. atlantica/phlegraei</i>
8	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>A. beatrix</i>
9	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>Hexadella</i> sp.
10	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>G. macandrewii</i>
11	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>P. carpenteri</i>
12	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>G. barretti</i>
13	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>C. longipilis</i>
14	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>G. atlantica/phlegraei</i>
15	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>A. beatrix</i>
16	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>Hexadella</i> sp.
17	North-East Atlantic	Rosemary Bank Seamount	Seamount	1290-1440	Towed camera images	<i>G. macandrewii</i>
18	North/North-East Atlantic	Faroe Islands, Norway, Sweden, Iceland, Greenland	TBC	30-1800	Trawled samples	<i>G. barretti</i>
19	North/North-East Atlantic	Faroe Islands, Norway, Sweden, Iceland, Greenland	TBC	30-1800	Trawled samples	<i>I. pyriformis</i>
20	North/North-East Atlantic	Faroe Islands, Norway, Sweden, Iceland, Greenland	TBC	30-1800	Trawled samples	<i>G. mesotriena</i>
21	North-East Atlantic	Faroe-Shetland Channel (West Shetland Slope, north of Shetland, NE Atlantic)	TBC	354-1886	TBC	TBC
22	North-East Atlantic	Faroe-Shetland Sponge Belt Marine Protected Area (NE Atlantic)	Sponge ground	430-715	Towed camera images	Different morphotypes
23	North-East Atlantic	Wyville Thomason Ridge (NE Atlantic)	TBC	457-800	TBC	TBC
24	North-East Atlantic	Rosemary Bank Seamount (NE Atlantic)	TBC	430-867	TBC	TBC
25	North-East Atlantic	Hatton Bank (NE Atlantic)	TBC	837-1298	TBC	TBC
26	North-East Atlantic	Hebrides Continental Slope	TBC	1295	TBC	TBC
27	North-East Atlantic	Hatton Rockall Basin	TBC	1100-1175	TBC	TBC
28	North-East Atlantic	Rost Reef	Reef	282-388	Manned sub videos	<i>M. lingua</i>
29	North-East Atlantic	Sotbakken Reef	Reef	246-284	Manned sub videos	<i>M. lingua</i>
30	North-East Atlantic	Traena Reef (Norway)	Reef	297-319	Manned sub videos	<i>M. lingua</i>
31	North-East Atlantic	Rost Reef	Reef	282-388	Manned sub videos	<i>G. barretti</i>

...we have the indicators...how to measure??

Region	Location	Setting	Depth (m)	Methodology used	Species studied	Parameter studied	Findings	GES Indicator that can be tested using values measured	Protection status	Human impact	Reference
North-West Mediterranean	Cap de Creus	Canyon	105-390	ROV/manual sub videos	<i>L. pertusa</i>	Density of cold-water corals	0.002±0.035 to 0.01±0.08 colonies/m ² , max 1.33/m ²	Abundance of coral colonies alive, Density of biogenic reef forming species	No evaluation of conservation status	Litter/abandoned fishing gear	Orejas et al. 2009
North-West Mediterranean	Cap de Creus	Canyon	105-390	ROV/manual sub videos	<i>L. pertusa</i>	Distribution pattern of cold-water corals	Not in sufficient numbers to apply spatial statistics	Distribution and condition of habitat forming species	No evaluation of conservation status	Litter/abandoned fishing gear	Orejas et al. 2009
North-East Atlantic	Bay of Biscay (Croisic)	Canyon	850	ROV images	<i>L. pertusa</i>	Density of cold-water corals	0.62±0.76 colonies/m ²	Abundance of coral colonies alive, Density of biogenic reef forming species	No evaluation of conservation status		Arnaud-Haond et al. 2017
North-East Atlantic	Bay of Biscay (Guilvinec)	Canyon	850	ROV images	<i>L. pertusa</i>	Density of cold-water corals	0.69±0.90 colonies/m ²	Abundance of coral colonies alive, Density of biogenic reef forming species	No evaluation of conservation status		Arnaud-Haond et al. 2017
North-East Atlantic	Bay of Biscay (Petite Sole)	Canyon	650	ROV images	<i>L. pertusa</i>	Density of cold-water corals	0.02±0.11 colonies/m ²	Abundance of coral colonies alive, Density of biogenic reef forming species	No evaluation of conservation status		Arnaud-Haond et al. 2017



Measuring GES at ATLAS using NEAT: Case study 2: Faroe Shetland Channel Sponge Belt MPA





Measuring GES at ATLAS using NEAT:

Case study 2: Faroe Shetland Channel Sponge Belt MPA

Descriptor 6: Indicators → Density of biogenic reef -forming species. (Sponges/m²)
→ Areal extent of human affected area (Percentage of area affected by trawling)

Descriptor 10: Indicator → Density of litter/abandoned fishing gear (Number of items/m²)



Measuring GES at ATLAS using NEAT: Faroe Shetland Channel Sponge Belt MPA Descriptors, Indicators and Threshold values

Descriptor	Indicator	Suggested threshold values for Indicator		Measured value at Faroe Shetland Case Study
D6	Density of biogenic reef -forming species. (Sponges/m²)	Worst state	0 sponges/m ²	0.25±0.02 sponges/m²
		Poor/bad boundary	0.01 sponges/ m ²	
		Moderate/poor boundary	0.10 sponges/m ²	
		GES boundary good/moderate	0.20 sponges/m ²	
		High/good boundary	0.50 sponges/m ²	
		Best state reference	1.00 sponges/m ²	



Measuring GES at ATLAS using NEAT: Faroe Shetland Channel Sponge Belt MPA Descriptors, Indicators and Threshold values

Descriptor	Indicator	Suggested threshold values for Indicator		Measured value at Faroe Shetland Case Study
D6	Areal extent of human affected area (Percentage of area affected by trawling)	Worst state	20%	0.0±0.0%
		Poor/bad boundary	15%	
		Moderate/poor boundary	10%	
		GES boundary good/moderate	5%	
		High/good boundary	1%	
		Best state reference	0%	



Measuring GES at ATLAS using NEAT: Faroe Shetland Channel Sponge Belt MPA

Descriptors, Indicators and Threshold values

Descriptor	Indicator	Suggested threshold values for Indicator		Measured value at Faroe Shetland Case Study
D10	Density of litter/abandoned fishing gear (Number of items/m²)	Worst state	0.006 items /m ²	0.0±0.0 items/m²
		Poor/bad boundary	0.003 items /m ²	
		Moderate/poor boundary	0.001 items /m ²	
		GES boundary good/moderate	0.0005 items /m ²	
		High/good boundary	0.0002 items /m ²	
		Best state reference	0 items /m ²	



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Biodiversity assessment - < custom >



SAUs: Faroe Shetland Channel Sponge Belt MPA
Habitats: Deep-sea sponge ground
Ecosystem components: Sponges



Indicator:

- Abundance (per unit of surface) of structuring/engineering sp
- Abundance and composition of functional groups in selected
- Abundance and composition of intertidal macroalgae
- Abundance and composition of riparian vegetation
- Abundance and distribution each of harbour and grey seals (I
- Abundance and distribution of cetaceans (M4)
- Abundance and distribution of juvenile flounder
- Abundance and impact of non-native fish species (round gob

>> Add >>

<< Remove <<

Available Classifications:

SAU	Habitat	Ecosystem component	Worst	PB bc
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Value	Error	Data	Indicator	SAU	Habitat	Eco
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Close assessment Do assessment



SAUs: Faroe Shetland Channel Sponge Belt MPA
 Habitats: Deep-sea sponge ground
 Ecosystem components: Sponges

- Indicator:
- Nutritional status of marine mammals
 - Oceanic fronts
 - Pareto exponent of the distribution of species richness over t
 - Patch size standard deviation
 - Pathways management measures (NIS1)
 - Percentage of area affected by trawling (%)**
 - Perimeter of wetlands
 - Perimeters (mean) of rocky habitats
 - Perimeters (sum) of rocky habitats
 - Physical damage of predominant and special habitats (BH3)
 - Phytoplankton diversity

Available Classifications:

SAU	Habitat
NW coast of Scotland & N. Ireland (Via)	13 Upper bathy
Faroe Shetland Channel Sponge Belt MPA	Deep-sea spon

>> Add >>
 << Remove <<

Value	Error	Data
0.25	0.02	Indicator: Density of biogenic reef forming species (type, abundance, biomass and relevant biogenic substratum) SAU: Faroe Shetland Channel Sponge Belt MPA Habitat: Deep-sea sponge ground Biodiversity component: Sponges Classification: 0 <= bad < 0.01 <= poor < 0.10 <= moderate < 0.20 <= good < 0.50 < 1.00
0	0	Indicator: Density of litter/abandoned fishing gear SAU: Faroe Shetland Channel Sponge Belt MPA Habitat: Deep-sea sponge ground Biodiversity component: Sponges Classification: 0.006 >= bad > 0.003 >= poor > 0.001 >= moderate > 0.0005 >= good > 0
0	0	Indicator: Percentage of area affected by trawling () SAU: Faroe Shetland Channel Sponge Belt MPA Habitat: Deep-sea sponge ground Biodiversity component: Sponges Classification: 20 >= bad > 15 >= poor > 10 >= moderate > 5 >= good > 1 >= high

Close assessment Do assessment



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SAU weighting Weight by SAU area
 Do not weight by SAU area

Habitat weighting Weight by habitat area
 Do not weight by habitat area

Use SAU priority factors
Custom SAU priority factors ...

Custom habitat areas ...

Use habitat priority factors
Custom habitat priority factors ...

Descriptor filter Filter by MSFD descriptors
Configure descriptor filter ...

Other options [Configure options ...](#)

Display NEAT result as [SAUs with ecosystem compc](#) calculated as [summarized values](#)

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	Ecosystem components
SAUs	1	1.000	0.878	high		0.878



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...some important points for now and the breakout group...

- **It is the task of the case study leaders to develop thresholds for the indicators they can measure in their own case study area, and to measure these indicators using NEAT if possible**
- **Mile Stone 11 GES defined and GES indicators**
GES is defined in the MSFD as “The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive”
- **Need to redefine GES for the deep-sea?**
- **Base line issue...**
 - Need to agree how to move forward with D3, if applying ICES indicators, who will deal with this?
 - D3.1: “Conduct biodiversity assessments to measure GES in European Case Studies (M1-M36)”

*Thanks to all people who
contributed to select the list of indicators!*

