MARINE SABRES

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Indicators for the Simple SES approach

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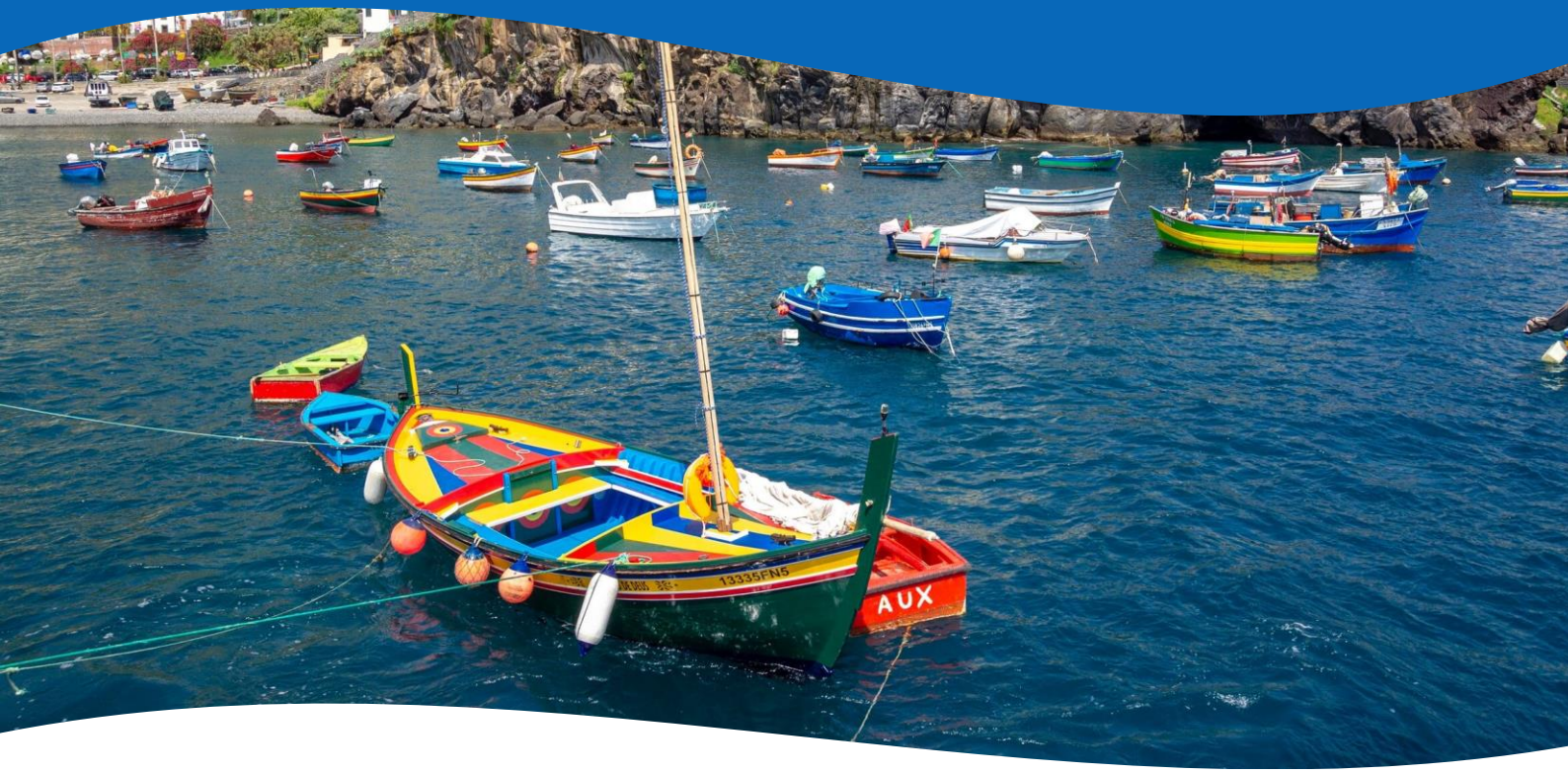

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DISCLAIMER

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This briefing note is one in a series of documents aimed at supporting the Simple Social-Ecological Guidance. For the complete set of briefing documents, please refer to the accompanying signposting document, which can be found here.

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Contents

1. Introduction

How do we know if a pressure on the marine environment has reduced or an environmental state has changed? How do we know whether the drivers for change, and the intensity of activities within the marine system are lessening or strengthening? Do the impacts of changes in the state of the marine environment affect human health, wellbeing, and the economy (societal benefits)?' 'You cannot manage something unless you can measure it', and hence, good management requires effective monitoring (Elliott, 2023). Quantitative measurements using standards, indicators, and objectives support decision-makers in determining what management may be required and the success of management actions (Cormier and Elliott, 2017). Objectives and targets can be very specific or more ambiguous and aspirational; for example, the target of '30x30' (the 30% of area protected by 2030, OECD, 2019) is more far-reaching and ambiguous than the target of Good Ecological Status (European Commission, 2008) in a particular river basin. If targets are subjective and ambiguous, then it is difficult to determine if they have been effectively achieved, so if the target is to reduce levels of phosphate in a water body, and this is reduced by a small amount but not enough to counteract the negative results, then this objective is achieved, but the outcome is not effective.

An indicator is an 'observed value representative of a phenomenon to study' (European Commission, 2017). In addition, indicators are tools 'to monitor and assess the state of the marine environment and to manage human activities having an impact upon it' (European Commission, 2008). Atkins et al. (2015) argues that environmental indicators serve three primary functions: to simplify the components of an ecosystem to allow for the characterisation of the state of the ecosystem; to quantify elements so they can be analysed alongside reference values; and to be in a form to easily communicate state changes in reference to targets and objectives with stakeholders. In general, an indicator consists of one or more parameters chosen to represent ('indicate') a certain situation or aspect and to simplify a complex reality (CSWD, 2020).

In Marine SABRES, indicators are being defined as quantitative measures associated with elements of the DAPSI(W)R(M) framework which underpins the Simple Social-Ecological System (SES) as indicators are a tool for reducing the challenge of understanding the whole complexity of an Social-Ecological System and to support management decisions.

2. SMART Indicators

Previous literature (Doran, 1981; Cormier and Elliott, 2017) refer to the selection of indicators to be based on criteria reflecting operational, value, and success criteria (Atkins, et al., 2015). These criteria require indicators to be SMART, that is

- Specific – what exactly is the indicator of success?
- Measurable – can you quantitatively measure this indicator?
- Achievable - Do the objectives describe a state of the ecosystem, including the position and activities of humans within it, which accurately reflects the values and desires of a majority of stakeholders?
- Realistic – Are the objectives implementable using the resources (research, monitoring, and assessment and enforcement tools) available to developers, managers and stakeholders? 'Good objectives should reflect the aspirations of stakeholders, such that the majority of stakeholders will strive to achieve them and ensure sustainable development' (Cormier, 2017).
- Time-bounded – is there a clearly defined time scale for meeting objectives?

Further explored by Elliott (2011), these SMART characteristics were expanded to include 18 attributes specifically for marine management and are embedded within the DAPSI(W)R(M) framework underpinning the Simple Social Ecological System in Marine SABRES. The additional attributes include 'anticipatory; biologically/environmentally important; broadly applicable and integrative over space and time; giving continuity over time and space; cost-effective in monitoring; grounded in theory/relevant and appropriate; interpretable; low redundancy; non-destructive; responsive feedback to management; sensitive to a known stressor or stressors; and socially relevant' (Atkins, et al., 2015; Elliott, 2011). Identification and assessment of indicators relating to social, economic, and cultural qualities are relevant at multiple stages of the DAPSI(W)R(M) framework and the ISA approach. Drivers of the activities are inherently social, economic, and cultural, as they are the reason societal benefits are sought from coastal and marine environments. Furthermore, in order to be effective in marine management, indicators and monitoring should fulfil, as a minimum, the SMART criteria (Cormier and Elliott, 2017).

3. Key Indicators supporting the Integrated Systems Analysis Approach: **The DAPSI(W)R(M) elements**

As noted above, the Integrated Systems Analysis approach (ISA) of Elliott et al. (2020), including the DAPSI(W)R(M) framework as the underpinning framework, was selected as the basis for the Marine SABRES Simple SES (Gregory et al., 2023). The use of the underpinning DAPSI(W)R(M) framework logically structures problems from the Drivers, Activities, and Pressures, which cause State changes leading to Impacts on human Welfare, which may warrant Response Measures (DAPSI(W)R(M)) (Elliott et al., 2017) (For further information on this framework see Briefing Paper 3: *'Cause-Consequence-Response Chains – DAPSI(W)R(M)'*). This approach is being used increasingly in climate change reports and in marine studies; for example, the EU Marine Strategy Framework Directive (MSFD) and Water Framework Directive (WFD), the UK Marine Strategy, and the Regional Seas Conventions Quality Status Reports (such as OSPAR, the Oslo and Paris Convention) are all focusing attention on such a method (see; Ducommun et al., 2020; OSPAR, 2023; Gregory et al., 2022).

Through the use of the DAPSI(W)R(M) framework, which can be considered a problem structuring method (Gregory et al, 2013), key indicators will be specified for each element of the framework in the Demonstration Areas and support reviews of progress associated with measures implemented, policy and response evaluations, and provide a benchmark of standards to communicate with stakeholders. Specifying indicators for the elements of the framework facilitates understanding of how response measures affect the coastal or marine system in focus. The DAPSI(W)R(M) framework is for use within the Simple SES approach, it is noted that linkages can be examined conceptually, qualitatively, or quantitatively and promote forward thinking to the process (Teixeira et al., 2016). Therefore, indicators for various aspects of the problem structuring framework can provide insight into the status of the component about the management objectives (Elliott, 2011); highlighting the necessity of indicators when making informed management decisions on which response measures are appropriate. A non-exhaustive list of indicators relating to different elements of the DAPSI(W)R(M) framework are given in Annex 1.

4. Further reading

- Atkins, J.P., Burdon, D., Elliott, M., 2015. Chapter 5: Identification of a practicable set of indicators for coastal and marine ecosystem services. In: Turner, R.K. & Schaafsma, M. (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; p79-102. https://doi.org/10.1007/978-3-319-17214-9

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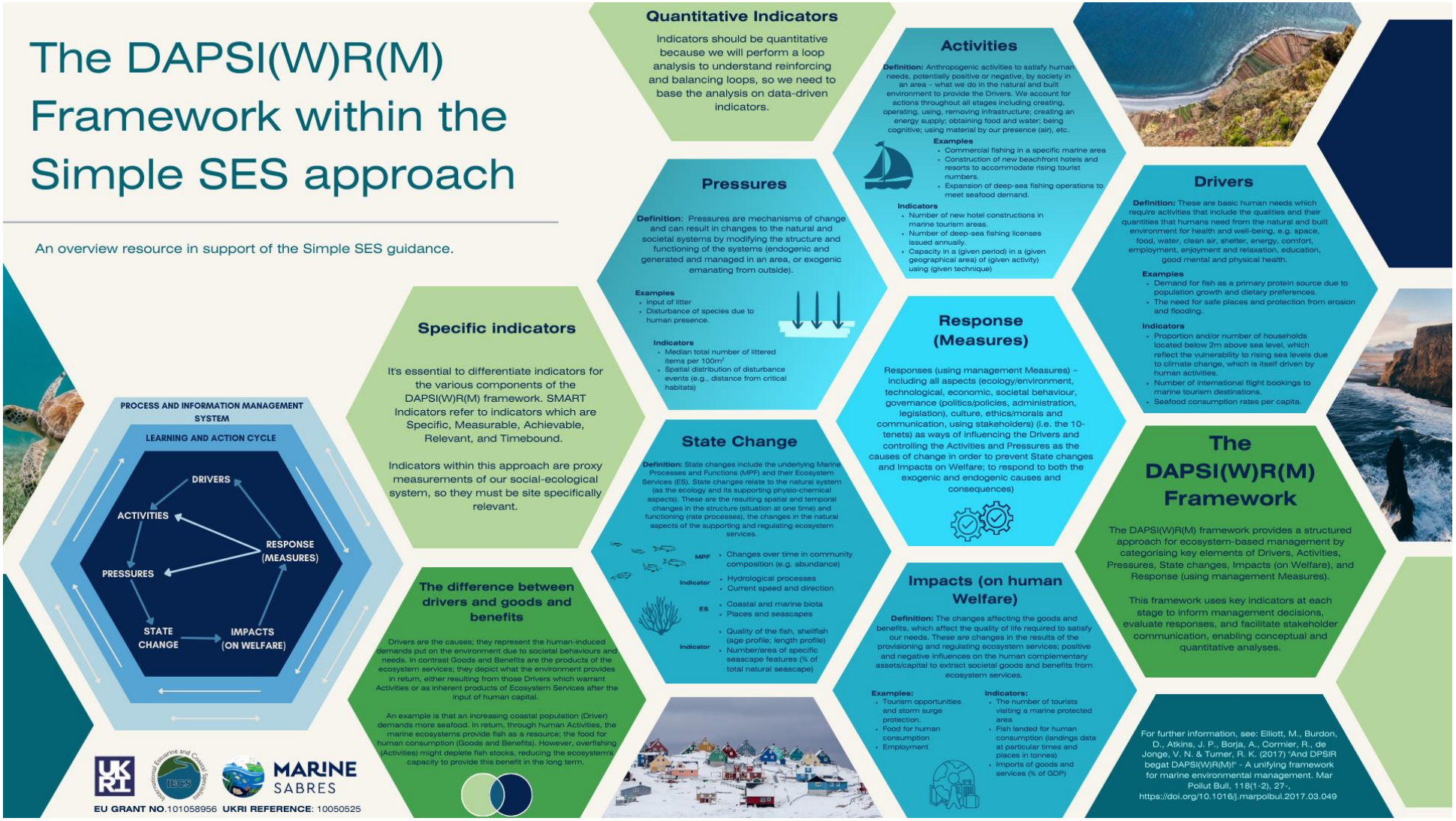
5. Summary Diagram

Link to online resource pictured in the summary diagram: https://0630f3fe-3d89-4a18-bd3e-e74fbefeb169.usrfiles.com/ugd/0630f3_b75ee66f5b5a458ba077460d625546c2.pdf



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Ducommun, L., Brignon, J.-M., Verling, E., & O'Higgins, T. (2020). Standard operating procedure for implementation of risk-based methodology. Risk-based approaches to good environmental status deliverable 5.1.

Elliott M, Burdon D, Atkins JP, Borja A, Cormier R, de Jonge VN, Turner RK. (2017) "And DPSIR begat DAPSI(W)R(M)!" - A unifying framework for marine environmental management. Mar Pollut Bull. May 15;118(1-2):27-40. https://doi.org/10.1016/j.marpolbul.2017.03.049

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OECD (2019), "The Post-2020 Biodiversity Framework: Targets, indicators and measurability implications at global and national level"

OSPAR, 2023. Climate Change Thematic Assessment. In: OSPAR, 2023: Quality Status Report 2023. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/thematic-assessments/climate-change/

Annex 1 – A non-exhaustive list of indicators relating to the various DAPSI(W)R(M) elements (adapted from Atkins, et al., 2015).

Element	Indicators	DAPSI(W)R(M) type
Cleaner water	Days x miles of shoreline closed due to sewage, biotoxins or pollution	Driver
	(quantitative policy target) for (households with fresh water) in the region for the period ('X -Y' in terms of years/months)	Driver
	(quantitative policy target) for (provisions for safely managed water) in the region for the period ('X' Years/Months)'	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Cultural wellbeing	% of shoreline that is publicly accessible or owned	Driver
	(quantitative policy target) for (cultural engagement) in the region for the period ('X -Y' in terms of years/months)	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Equality Diversity and Inclusion	Proportion of adults encountering barriers which prevent them from experiencing particular cultural activities (%)	Driver
	(quantitative policy target) for (EDI) in the region for the period ('X -Y' in terms of years/months)	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Food security and improved nutrition	(quantitative policy target) for (nutrition) in the region for the period ('X -Y' in terms of years/months)	Driver
	Proportion of population that do not satisfy current regional government (or UN SDG) target nutrition levels (%)	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Healthier climate	(quantitative policy target) for (Sea level rise risk) in the region for the period ('X' Years/Months)'	Driver
	Total population in a named region ('000)	Driver

	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Identity and belonging	(quantitative policy target) for (community based initiatives) in the region for the period ('X' Years/Months)'	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Safer places	Area of land in the coastal region below 2 metres above sea level	Driver
	(quantitative policy target) for (amount of at-risk properties) in the region for the period ('X' Years/Months)	Driver
	Total population in a named region ('000)	Driver
	Population growth rate (%)	Driver
	Number of people living within X km of the area ('000)	Driver
Pipelines	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number/ total length of pipeline(s) in a (given period) in a (given geographical area)	Activity
Telecommunication cables	Number/ total length of telecommunication cable(s) in a (given period) in a (given geographical area)	Activity
	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Vessel anchorages	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of within the geographical area	Activity
Vessel moorings	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of within the geographical area	Activity
Oil and gas infrastructure	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity

Cargo operations and landward transportation	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Aerial military activity	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Sea surface military activity	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Port and harbours Operation	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Vessel movements and maintenance	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Powerboating or sailing with an engine	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Dredging (Capital, aggregate and maintenance)	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of sites within an area	Activity
Beach sand extraction	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of sites within an area	Activity
Exploratory drilling	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of sites within an area	Activity
	The area sites use (in hectares or square kilometres) in a given period	Activity
Water abstraction	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of sites within an area	
Deep sea mining	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	Number of sites within an area	Activity
	The area sites use (in hectares or square kilometres) in a given period	Activity

Demersal seine netting	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Demersal trawling	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Dredging shellfish	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Extraction of genetic resources	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Harvesting - seaweed and other sea-based food	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Line fishing	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Pelagic fishing	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Purse Seining	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Set net fishing	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Shellfish aquaculture Bottom culture	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Finfish aquaculture	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Seaweed Shellfish aquaculture, Suspended rope net culture and Trestle culture	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Coastal flood and erosion risk	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity

management schemes	The area (in hectares or square kilometres) in a given period	Activity
Piling_Port and Harbours Coastal flood and erosion risk management schemes	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	The area (in hectares or square kilometres) in a given period	Activity
Offshore coastal defence structures	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	The area (in hectares or square kilometres) in a given period in a (given geographical area)	
Managed realignment	The area (in hectares or square kilometres) in a given period	Activity
Leisure e.g. swimming, rock pooling	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Cultural and heritage sites e.g. wrecks, sculptures, foundations etc.	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Marine and Coastal Research and teaching	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Surveys	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Marine archaeological research	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Offshore wind	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Tidal lagoon impoundment	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
	The area (in hectares or square kilometres) in a given period	Activity
Power cable	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity

Thermal and nuclear Powerstation	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Shoreside industry and operations	Capacity in a (given period) in a (given geographical area) of (given activity) using (given technique)	Activity
Input or spread of nonindigenous species	Amount of non-indigenous species (Abundance in the area)	Pressure
	Presence of non-indigenous species (Number of species per area)	Pressure
Input of microbial pathogens	Levels of E. coli (cfu/mL)	Pressure
	Levels of Enterococci (cfu/mL)	Pressure
	Species distribution (number of species per hectare)	Pressure
Input of genetically modified species and translocation of native species	Species abundance (number of)	Pressure
Loss of or change to natural biological communities due to cultivation of animal or plant species	Total biomass of surveyed species (kg/m^2)	Pressure
	Area loss of habitat type in the area (% of the area lost)	Pressure
Disturbance of species due to human presence	Area of habitat disturbed or lost (km^2)	Pressure
	Frequency and duration of disturbance events (e.g., number of events per year)	Pressure
	Proportion of critical habitats (breeding grounds, nursery areas, etc.) impacted	Pressure
	Spatial distribution of disturbance events (e.g., distance from critical habitats)	Pressure
Extraction mortality or injury to wild species	Individuals killed or injured per activity or per year (number of)	Pressure
	Fishing effort e.g., number of fishing vessels, fishing days, gear type per year (number of)	Pressure
Physical disturbance to	Change in topography and bathymetry of the seabed	Pressure

seabed temporary or reversible	Area of seabed cover (km²)	Pressure
	Change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa.	Pressure
Physical loss due to permanent change of seabed substrate or morphology and to extraction of seabed substrate	Change in topography and bathymetry of the seabed	Pressure
	Area of existing habitats (km²)	Pressure
Changes to hydrological conditions	Velocity	Pressure
	Upwelling	Pressure
	Wave Exposure	Pressure
	Mixing characteristics	Pressure
	Turbidity	Pressure
	Residence	Pressure
	Time, spatial and temporal distribution of salinity	Pressure
	Spatial and temporal distribution of nutrients (DIN, TN, DIP, TP, TOC)	Pressure
	Oxygen, pH, pCO2 profiles	Pressure
	Equivalent information used to measure marine acidification	Pressure
Input of nutrients diffuse sources	Discharge of total Phosphates in the waterbody	Pressure
	Levels of Biological Oxygen Demand (BOD)	Pressure
	Chemical Oxygen Demand (COD)	Pressure
	Total Organic Carbon (TOC)	Pressure
	pH levels	Pressure
	Discharge of total Nitrates in the waterbody	Pressure
Input of other substances	Input of: Oily waste (Gallons	Pressure
	Garbage (Tonnes)	Pressure
	Sewage (Gallons)	Pressure
	Total amount of liquids released into the marine environment area (Gallons)	Pressure
	Oil spill incidents: The number and severity of oil spills resulting from offshore activities, typically measured using satellite imagery or field monitoring.	Pressure
Input of litter	Median total number of littered items per 100m²	Pressure
	Sound Exposure Level (in dB re 1 µPa 2 .s); peak sound pressure level (in dB re 1 µPa peak) at one	Pressure

Input of anthropogenic sound	metre, measured over the frequency band 10 Hz to 10 kHz (11.1.1);	
	Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa RMS; the average noise level in these octave bands over a year)	Pressure
Input of other forms of energy	The temperature of the water	Pressure
	Light emitting structures in the area (Number of)	Pressure
	Cable characteristics and power transmitted determine the sources and intensity of the EMFs emitted (volts per meter (V/m)	Pressure
Input of waterpoint sources	Input of water (Gallons)	Pressure
	the temperature of inputted water	Pressure
	velocity of inputted water	Pressure
	BOD contents of inputted water	Pressure
Habitats and species	Abundance (number)	Marine processing and functioning
	Biomass (g, kg)	Marine processing and functioning
	Species diversity (Shannon Wiener Index)	Marine processing and functioning
	% cover of habitat	Marine processing and functioning
	Area of habitat (ha)	Marine processing and functioning
	Gene pool	Marine processing and functioning
	Biotope matrix	Marine processing and functioning
	AMBI (marine biotic index)	Marine processing and functioning
	Phytoplankton index	Marine processing and functioning
Sea space	Area of surface (ha)	Marine processing and functioning
	Volume (m 3)	Marine processing and functioning
	Tidal range (m)	Marine processing and functioning
	Depth (m)	Marine processing and functioning
	Bathymetry	Marine processing and functioning
	Topography	Marine processing and functioning

Sea water	Depth (m)	Marine processing and functioning
	Volume (m 3)	Marine processing and functioning
	pH	Marine processing and functioning
	Salinity	Marine processing and functioning
	Turbidity (mg/l)	Marine processing and functioning
Substratum	Area (ha) and depth (m) by type (mud, sand, gravel, etc.)	Marine processing and functioning
Production	Community production (kcal)	Marine processing and functioning
	Net productivity by species (kcal/ha/yr)	Marine processing and functioning
	P:B (productivity: biomass) ratios	Marine processing and functioning
Decomposition	Amount and number of decomposers (n/ha)	Marine processing and functioning
	Decomposition rate (kg/ha/yr)	Marine processing and functioning
Food web dynamics	Changes over time in community composition (abundance (number)	Marine processing and functioning
	Biomass (g, kg); species diversity (diversity indices))	Marine processing and functioning
	Population dynamics (age classes, male: female ratios)	Marine processing and functioning
Ecological interactions	Competition for food and space	Marine processing and functioning
	Resilience and resistance (predator: prey, adults: juveniles, etc.)	Marine processing and functioning
Hydrological processes	Current speed (m/s) and direction	Marine processing and functioning
	Wave height	Marine processing and functioning
	Changes in temperature (°C)	Marine processing and functioning
	Changes in salinity	Marine processing and functioning
	Changes in turbidity (mg/l)	Marine processing and functioning
	NAO (North- Atlantic Oscillation) cycles	Marine processing and functioning
Geological processes	Sediment accumulation rates	Marine processing and functioning

	Beach slopes and gradients	Marine processing and functioning
	Seabed form	Marine processing and functioning
	Channel depths	Marine processing and functioning
	Erosion- deposition cycles	Marine processing and functioning
Evolutionary process	Changes in genetic diversity	Marine processing and functioning
	Mutation rates	Marine processing and functioning
	Influx/efflux of species (number)	Marine processing and functioning
Primary production	Quality of primary production (e.g., efficiency of converting sunlight to carbon)	Marine processing and functioning
	Quantity of primary production (g C per unit area/ volume)	Marine processing and functioning
Larval and Gamete supply	Quantity of larvae/gametes supplied to a particular location (number per m 3)	Marine processing and functioning
	Quality of larvae/gametes supplied to a particular location (% affected by disease; mortality rates)	Marine processing and functioning
Nutrient cycling	Changes (output of the system less input to the system) in the amount of nitrates, phosphates, silica (g per unit area/ volume)	Marine processing and functioning
	Denitrification (kg N/ha/yr)	Marine processing and functioning
Water cycling	Changes (output of the system less input to the system) in the amount of water (m 3)	Marine processing and functioning
Formation of species habitat	Change in area of habitat (per ha); change in quality of habitat	Marine processing and functioning
	Change in number of juveniles	Marine processing and functioning
Formation of physical barriers	Change in amount of natural barriers e.g., saltmarsh, reefs, sand dunes, reed beds etc. (% cover, ha)	Marine processing and functioning
Formation of seascape	Changes in area by scenic type (ha, % cover, visual range (m, km))	Marine processing and functioning
Biological control	Quantity of pest/disease/predator-control species (number)	Ecosystem Services
	Quality of pest-control species (prevalence)	Ecosystem Services
Natural hazard regulation	Width or area (and volume if applicable) of saltmarsh, reed bed, mudflat, sand dunes etc. (m, % cover, ha, m 3) absorbing energy	Ecosystem Services
Waste breakdown	Water quality indicators (N mg/l, P mg/l, bacterial levels mg/l etc.)	Ecosystem Services

and detoxification	Total dissolved solids (mg/l)	Ecosystem Services
	Water volume	Ecosystem Services
	Assimilative capacity	Ecosystem Services
Carbon sequestration	Amount of carbon dioxide sequestered (tonnes of CO 2 per m 2 or m 3)	Ecosystem Services
	Assimilative and recycling capacity, net carbon burial (tonnes per ha per year)	Ecosystem Services
Coastal and marine biota	Fish and shellfish population size (biomass of fish/ shellfish in tonnes)	Ecosystem Services
	Quality of the fish, shellfish (age profile; length profile; % affected by disease; mortalit rates)	Ecosystem Services
	Quantity of seaweed stock (biomass in tonnes, area of seaweed ha)	Ecosystem Services
	Quality of seaweed stock (% affected by disease; mortality rates)	Ecosystem Services
	Quantity of raw material (tonnes)	Ecosystem Services
	Quality of raw material (concentration)	Ecosystem Services
	Quantity of species with potential/actual useful genetic raw material (tonnes)	Ecosystem Services
	Gene bank composition (e.g., number of species and subspecies)	Ecosystem Services
	Quality of species with potential/ actual useful genetic raw material (tonnes equivalent if variation in quality)	Ecosystem Services
	Quality of species with potential/ actual useful genetic raw material (tonnes equivalent if variation in quality)	Ecosystem Services
Climate regulation	Greenhouse gas balance especially carbon sequestration (g C)	Ecosystem Services
	Quantity of greenhouse gases fixed and/or emitted	Ecosystem Services
	Effect on climate parameters (temperature, rainfall, wind, etc.)	Ecosystem Services
Natural hazard protection	Width or area of saltmarsh, reed bed, mudflat, sand dunes etc. providing natural hazard protection (m, % cover, ha)	Ecosystem Services
	Sediment stabilisation properties	Ecosystem Services
	Water retention capacity (m 3)	Ecosystem Services
	(wave) energy dissipation capacity (joules/m 2)	Ecosystem Services
Clean water and sediments	Amount of waste that can be recycled or immobilised (tonnes)	Ecosystem Services
	Biological oxygen demand (mg O 2 /litre/day)	Ecosystem Services
	Amount of organic matter in water and sediment (mg/l)	Ecosystem Services

	Amount of heavy metals in water and sediment (mg/l)	Ecosystem Services
	Amount of bacteria in water and sediments (mg/l)	Ecosystem Services
	Heavy metal (and other pollutant) content in marine organisms (concentration)	Ecosystem Services
	Bathing water quality status under WFD (physicochemical parameters (mineral oils, surface-active substances and phenols).	Ecosystem Services
Places and seascapes	Designated sites (number of)	Ecosystem Services
	Number/area of specific seascape features (% of total natural seascape)	Ecosystem Services
Aesthetic benefits	Number and/or area of marine features of given stated appreciation	Goods and Benefits
	Length of heritage coast (km)	Goods and Benefits
Clean water and sediments	Amount of waste that can be recycled or immobilised (tonnes)	Goods and Benefits
	Biological oxygen demand (mg O 2 /litre/day)	Goods and Benefits
	Amount of organic matter in water and sediment (mg/l)	Goods and Benefits
	Amount of heavy metals in water and sediment (mg/l)	Goods and Benefits
	Amount of bacteria in water and sediments (mg/l)	Goods and Benefits
	Heavy metal (and other pollutant) content in marine organisms (concentration).	Goods and Benefits
Education and Research	Field trips (number and number of people involved)	Goods and Benefits
	Classes (numbers and number of people involved)	Goods and Benefits
	Total number of publications in all forms	Goods and Benefits
	Scientific studies (number of research papers, subscriptions, library borrowing, on-line downloads)	Goods and Benefits
	Books (number, print run, library usage, e-book downloads);	Goods and Benefits
	Other publications including newspaper articles (circulation including on-line accessing)	Goods and Benefits
	works of art (number of works, number of people viewing work)	Goods and Benefits
Equality Inclusion and Diversity	Proportion of people living below 50 percent of median income, by sex, age, race, and persons with disabilities the geographical area (%)	Goods and Benefits
	Changes in the gender pay gap in geographical area (%)	Goods and Benefits
Fertilisers and biofuels	Mineral and other content used (e.g. N concentration in g, tonnes)	Goods and Benefits
	Quantity of biomass harvested for energy production	Goods and Benefits

Food for human consumption	Nutrition from seafood consumption (g protein/year or g protein/year/head or per household)	Goods and Benefits
	Fish landed for human consumption (landings data at particular times and places in tonnes)	Goods and Benefits
Food not for human consumption	Nutrition from non-human seafood consumption (g protein/year)	Goods and Benefits
	Fish landed not for human consumption (landings data at particular times and places in tonnes)	Goods and Benefits
	Bait landed for angling (tonnes)	Goods and Benefits
	Quantity of bait collected by type	Goods and Benefits
Healthy climate	Physical damage avoided through net GHG sequestration and effects on climate parameters	Goods and Benefits
	Bodily harm avoided (lives saved and injuries not incurred) through net GHG sequestration and effects on climate parameters	Goods and Benefits
Housing	Proportion of the population who are homeowners in the geographical area (%)	Goods and Benefits
	Average rent cost (£) ratio to the average income in the geographical area	Goods and Benefits
Human health benefits	% cover of coastal and marine environments	Goods and Benefits
	% cover of designated coastal and marine spaces (SACs, SPAs, EMS, MPAs, MCZs)	Goods and Benefits
	Time spent in the coastal/marine environment (hours)	Goods and Benefits
	Participation in particular activities in the coastal/marine environment (type and duration)	Goods and Benefits
Human wellbeing	Sites with cultural heritage/well-being (usage rates by people, degree of importance)	Goods and Benefits
	Sites with spiritual and/or religious significance/well-being (number of people who attach significance, degree of significance attached)	Goods and Benefits
Income and Employment	Changes in the gender pay gap (%)	Goods and Benefits
	Trends in job role dominance between marine sectors by sex, age, race, and persons with disabilities in the geographical area (%)	Goods and Benefits
	The difference in part-time and full-time workers between sectors by sex, age, race, and persons with disabilities in the geographical area (%)	Goods and Benefits
Medicines and blue biotechnology	Contribution to medicines (number of medicines, improvements in mortality rates and quality of life, etc.)	Goods and Benefits
	Total amount of useful substances that can be extracted (kg/ha)	Goods and Benefits

	Quantity of specific blue biotechnologies (e.g., biocatalysts)	Goods and Benefits
Movement of goods and services	Imports of goods and services (% of GDP)	Goods and Benefits
	Exports of goods and services (% of GDP).	Goods and Benefits
Ornaments aquaria and aquaculture	Ornamental use (tonnes) by type	Goods and Benefits
	Number of people/ businesses who rely on ornamental artefacts (no.)	Goods and Benefits
Use of places and seascapes	Number of designated sites the geographical area	Goods and Benefits
	Number/area of specific seascape features the geographical area	Goods and Benefits
	% of total natural seascape.	Goods and Benefits
Prevention of coastal erosion	Number of prevented hazards (number per yr)	Goods and Benefits
	Quantity of risk prevention (quantity of assets affected adjusted for risk)	Goods and Benefits
	Amount of man-made infrastructure not required (length/width/height in m)	Goods and Benefits
Sea defence and Flood control	Number of natural disaster-related casualties and economic losses	Goods and Benefits
	Amount of man-made infrastructure no longer required	Goods and Benefits
	Businesses and people protected from flooding	Goods and Benefits
	Number of households/Number of people protected from flooding	Goods and Benefits
	Number of flood related mortalities	Goods and Benefits
	Flooding days per year (combined with rainfall indicator)	
Waste burial removal and neutralisation	Quantity of degradable waste deposited (tonnes by type)	Goods and Benefits
	Quantity of non-degradable waste deposited (tonnes by type)	Goods and Benefits
	Pollution damage avoided by not disposing degradable and non- degradable waste elsewhere (type and extent)	Goods and Benefits
	Treatment and engineering works not required (type and capacity)	Goods and Benefits
	Changes in activity not implemented due to capacity to immobilise waste (quantity and/or other characteristics of activity)	Goods and Benefits

MARINE
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