

Ecosystem goods and services from European protected habitats and species

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Agenda

- 1. Ecosystem services
- 2. Classification of marine ecosystem services
- 3. Identifying MES for MCZ habitats and species
- 4. Role of ecosystem services in coastal management

1. Ecosystem services

Ecosystem services can be defined in a variety of ways, including:

- "the benefits human populations derive, directly or indirectly, from ecosystem functions" (Costanza *et al* 1997).
- "the benefits people obtain from ecosystems" (MEA 2003).
- "services provided by the natural environment that benefit people" (Defra 2007).
- "the direct and indirect contributions of ecosystems to human well-being" (TEEB 2009).

The common emphasis is:

- *the beneficial role played by ecosystems in enhancing or maintaining aspects of human well being and thereby human society* e.g. food production, climate regulation, flood protection, pollution sinks, and recreational and aesthetic benefits.
- This information can be used to place an economic value on ecosystems.

2. Classification of ecosystem services

- There are multiple classifications of ecosystem services.
- The most well-known and widely applied classification of ecosystems services was developed by the Millennium Ecosystem Assessment (2003).



The MEA mixes ecological processes and services and so risks double counting.

'The Economics of Ecosystems and Biodiversity' (TEEB) project.

 The TEEB (2009) ecosystem service classification distinguishes between ecological processes and the benefits experienced by humans.

The TEEB (2009) classification has three components:

- Core ecosystem processes: these describe the basic ecosystem processes supporting ecosystem functions.
- **Beneficial ecosystem processes:** these are the specific ecosystem processes that directly underpin benefits to people.
- **Beneficial ecosystem services:** these are the products of ecosystem processes that directly impact human wellbeing.

Classification of ecosystem services (TEEB, 2009)

CORE ECOSYSTEM

PROCESSES

Production

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Decomposition

Nutrient cycling

Water cycling

Weathering/

Interactions

erosion

Ecological

Evolutionary

processes

BENEFICIAL ECOSYSTEM PROCESSES

- Biomass production: primary
- Biomass production: secondary
- Pollination
- Biological control
- Other ecological Interactions
- Formation of species habitat
- Species diversification
- Genetic diversification
- Waste assimilation
- Soll formation
- Erosion regulation
- Formation of physical barriers
- · Formation of pleasant scenery
- Air quality regulation
- Regional and local climate regulation
- Water regulation (timing)
- Water purification (quality)
- Water provisioning (quantity)
- Global climate regulation
- Currently unknown beneficial processes

BENEFITS

- Food
- o Crops
- o Livestock
- Capture fisheries
- Aquaculture
- Wild foods
 ...
- Fresh water
- o Drinking
- o Industry
- 0
- Raw materials
 - o Timber
 - Fibres from crops/livestock
- o Fibres from wild species
- Synthetic materials
- o ...
- Energy
- Biofuels
- Coal/firewood
- o Dung
- Working animals
- Hydroelectric energy
- o ...
- Property
- Private property
- Infrastructure
- o ...
- Physical wellbeing
- Synthetic medicines
- o Cultivated medicines
- Medicines from wild species
- Avoidance of injury
- Avoidance of pollution
- Avoidance of infection
- Physical exercise
- o ...
- Psychological wellbeing
- o Tourism
- Recreation
- Spiritual/cultural wellbeing
- Aesthetic benefits
- Nature watching
- Pets, garden plants
- o
- Knowledge
- Research
- Education
- o ...
- ...
- Currently unknown benefits



3. Ecosystem services from European protected habitats and species

This work was undertaken as part of a project funded by Natural England, completed in partnership with ABPmer.

TITLE:

Description of the ecosystem services provided by broad-scale habitats and features of conservation importance that are likely to be protected by Marine Protected Areas in the Marine Conservation Zone Project area.

The MPA network includes:

Special Areas of Conservation
Special Protection Areas
Sites of Special Scientific Interest
Ramsar sites
Marine Conservation Zones

Method

The review is focused upon marine species and habitats collectively known as 'marine features'.

Broad-scale habitats to be protected within MPAs of the MCZ Project area

High energy intertidal rock

Moderate energy intertidal rock

Low energy intertidal rock

Intertidal coarse sediment

Intertidal sand and muddy sand

Intertidal mud

Intertidal mixed sediments

Coastal saltmarshes and saline reedbeds

Intertidal sediments dominated by aquatic angiosperms

Intertidal biogenic reefs

High energy infralittoral rock

Moderate energy infralittoral rock

Low energy infralittoral rock

High energy circalittoral rock

Moderate energy circalittoral rock

Low energy circalittoral rock

Subtidal coarse sediment

Subtidal sand

Subtidal mud

Subtidal mixed sediments

Subtidal macrophyte-dominated sediment

Subtidal biogenic reefs

Deep-sea bed

Marine habitats listed in Annex I the EC Habitats Directive not listed elsewhere

Saline lagoons Submarine Structures made by leaking gases Submerged or partially submerged sea caves

Habitats of conservation importance to be protected within MPAs of the MCZ Project area

Blue mussel beds Cold-water coral reefs Coral Gardens Deep-sea sponge aggregations Estuarine rocky habitats File shell beds Fragile sponge and anthozoan communities on subtidal rocky habitats Intertidal underboulder communities Littoral chalk communities Maerl beds Modiolus modiolus beds Mud habitats in deep water Sea-pen and burrowing megafauna communities Ostrea edulis beds Peat and clay exposures Sabellaria alveolata reefs Sabellaria spinulosa reefs Seagrass beds Sheltered muddy gravels Subtidal chalk Subtidal sands and gravels Tide-swept channels

Low or limited mobility species of conservation importance to be protected within the MCZ Project area

Anotrichium barbatum Cruoria cruoriaeformis Dermocorynus montagnei Lithothamnion corallioides Padina pavonica Phymatolithon calcareum Alkmaria romijni Armandia cirrhosa Gobius cobitis Gobius couchi Hippocampus guttulatus Hippocampus hippocampus Osmerus eperlanus Anguilla anguilla Victorella pavida Amphianthus dohrnii Edwardsia timida Eunicella verrucosa Funiculina quadrangularis Haliclystus auricular Leptopsammia pruvoti Lucernariopsis campanulata Lucernariopsis cruxmelitensis Nematostella vectensis Gammarus insensibilis Gitanopsis bispinosa Mitella pollicipes Palinurus elephas Arctica islandica Atrina fragilis Caecum armoricum Ostrea edulis Paludinella littorina Tenellia adspersa Raja undulata

Bearded Red Seaweed Red seaweed Red seaweed Coral Maërl Peacock's tail Common Maërl Tentacled Lagoon-Worm Lagoon Sandworm Giant Goby Couch's goby Long snouted seahorse Short snouted seahorse Smelt European eel Trembling sea mat Sea-fan Anemone Timid Burrowing Anemone Pink Sea-fan Tall sea pen Stalked jellyfish Sunset Cup Coral Stalked jellyfish Stalked jellyfish Starlet sea anemone Lagoon sand shrimp Amphipod Shrimp Gooseneck Barnacle Spinv lobster Ocean quahog Fan Mussel Defolin's Lagoon Snail Native Oyster Sea snail Lagoon sea slug Undulate rav

Method

The review is focused upon marine species and habitats collectively known as 'marine features'.

A specific classification of marine ecosystem services was developed based on the TEEB classification.

A literature review was undertaken for each marine feature to identify:

•Beneficial ecosystem processes

•Beneficial ecosystem services

CORE ECOSYSTEM PROCESSES	BENEFICIAL ECOSYSTEM PROCESSES	BENEFICIAL EC SERVICES	OSYSTEM
Production	Primary production	Fisheries	Food
Decomposition	Secondary production	Other wild harvesting	
Nutrient cycling	Larval/Gamete supply	Aquaculture	
Hydrological processes	Biological control	Fertiliser / Feed	
Ecological interactions	Food web dynamics	Salt	Raw materials
Evolutionary processes	Species diversification	Ornamental materials (shells)	
Water cycling	Genetic diversification	Biofuels	Energy
	Waste assimilation	Medicines	Physical wellbeing
	Erosion control	Natural hazard protection	
	Formation of species habitat	Environmental Resilience	
	Formation of physical barriers	Regulation of pollution	
	Formation of pleasant scenery	Tourism	Psychological/ Social
	Climate regulation	Recreation / Sport	wellbeing
	Air quality regulation	Spiritual/cultural wellbeing	
	Biogeochemical cycling	Aesthetic benefits	
	Water cycling (regulation)	Nature watching	
	Water purification (quality)	Aquaria	
		Research and	Knowledge

Education

Intertidal mud



Solid line: indicates evidence is UK related, feature specific and peer reviewed **Thin line:** indicates UK related but grey literature **Dashed line:** indicates overseas papers or expert evidence

Coastal saltmarshes and saline reedbeds



Solid line: indicates evidence is UK related, feature specific and peer reviewed **Thin line:** indicates UK related but grey literature **Dashed line:** indicates overseas papers or expert evidence

Broadscale
Habitats

Key Peer-reviewed literature Grey literature Expert opinion Assumed beneficial services	Intertidal rock	Intertidal coarse sediment	Intertidal sand, muddy sand and mixed sediments	Intertidal mud	Coastal saltmarshes	Intertidal sediments dominated by aquatic	Intertidal biogenic reefs	Infralittoral rock	Circalittoral rock	Subtidal sediment	Subtidal macrophyte- dominated sediment	Subtidal biogenic reefs	Deep-sea bed
Beneficial Ecosystem Processes													
Primary production													
Secondary production													
Larval/Gamete supply													
Biological control													
Food web dynamics													
Species diversification													
Genetic diversification													
Waste assimilation													
Erosion control													
Exercises habitat													
Formation of physical barriers													
Formation of pleasant scenery													
Climate regulation													
Water quality regulation													
Biogeochemical cycling													
Water cycling													
Water purification (quality)													
Beneficial Ecosystem Services													
Fisheries													
Other wild harvesting													
Aquaculture													
Fertiliser / Feed													
Salt													
Ornamental materials (shells)													
Biofuels													
Medicines													
Natural hazard protection													
Environmental Resilience													
Regulation of pollution													
Tourism													
Recreation / Sport													
Spiritual/cultural wellbeing	///	///	///	///	///	777							
Aesthetic benefits	~ ~ ~										~ ~ ~		~~
Nature watching													
Aquaria													
Research and Education		///			///	///	///	///	///		///	////	///

Habitats of Conservation Importance

Кеу	Saline	Submai made b	Submer	Blue Mi	Cold wa	Coral g	Estuari	File She	Fragile anthozo	Intertida commu	Intertida commu	Maerl b	Horse N	Mud ha water
Peer-reviewed literature	ago	rine y le	Geo	USS	ater	arde	ner	ell b	spc	nitie	al cl	eds	Nus	bita
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Expert opinion	•	ng g	par a ca	eds	alro		y ha		nmu	rbot			bed	n de
Assumed beneficial services		Ires	tiall		eefs		abita		niti	llde			S	ëp
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Beneficial Ecosystem Processes														
Primary production														
Secondary production														
Larval/Gamete supply														
Biological control														
Food web dynamics														
Species diversification														
Genetic diversification														
Waste assimilation														
Erosion control														
Formation of species habitat														
Formation of physical barriers														
Formation of pleasant scenery														
Climate regulation														
Water quality regulation														
Biogeochemical cycling														
Water cycling														
Water purification (quality)														
Beneficial Ecosystem Services														
Fisheries														
Other wild harvesting														
Aquaculture														
Fertiliser / Feed														
Salt														
Ornamental materials (shells)														
Biofuels														
Medicines														
Natural hazard protection														
Environmental Resilience														
Regulation of pollution														
Tourism														
Recreation / Sport														
Spiritual/cultural wellbeing					///	///								
Aesthetic benefits														
Nature watching														
Aquaria													_	
Research and Education				\square										\square

Subtidal sands and gravels Deep-sea sponge aggregations Peat and clay exposures Sabellaria Reefs Seagrass beds Sheltered muddy gravels Subtidal chalk Tide swept channels Seapens and burrowing megafauna Native oyster (Ostrea edulis) beds Key conservation Peer-reviewed literature (continued) Grey literature Expert opinion Assumed beneficial services **Beneficial Ecosystem Processes** Primary production Secondary production Larval/Gamete supply **Biological control** Food web dynamics Species diversification Genetic diversification Waste assimilation Erosion control Formation of species habitat Formation of physical barriers Formation of pleasant scenery Climate regulation Water quality regulation **Biogeochemical cycling** Water cycling Water purification (quality) **Beneficial Ecosystem Services** Fisheries Other wild harvesting Aquaculture Fertiliser / Feed Salt Ornamental materials (shells) Biofuels Medicines Natural hazard protection Environmental Resilience Regulation of pollution Tourism Recreation / Sport Spiritual/cultural wellbeing Aesthetic benefits Nature watching Aquaria Research and Education

Habitats of

importance

Species of conservation importance

Key Peer-reviewed literature Grey literature Expert opinion Assumed beneficial services	Sea-fan anemone Amphianthus dohrnii	Stalked jellyfish Haliclystus auricula	Stalked jellyfish Lucernariopsis	Stalked jellyfish Lucernariopsis	Starlet sea anemone Nematostella vectensis	Sunset cup coral Leptopsammia pruvoti	Timid burrowing anemone Edwardsia timida	Lagoon sandworm Armandia cirrhosa	Tentacled lagoon-worm Alkmaria romijni	Amphipod shrimp Gitanopsis bispinosa	Gooseneck barnacle Mitella pollicipes	Lagoon sand shrimp Gammarus insensibilis	Spiny lobster Palinurus elephas	Defolin's lagoon snail Caecum armoricum
Beneficial Ecosystem Processes														
Primary production														
Secondary production												9		
Larval/Gamete supply														
Biological control														
Food web dynamics														
Species diversification														
Genetic diversification														
Waste assimilation														
Erosion control														
Formation of species habitat														
Formation of physical barriers												0		
Formation of pleasant scenery														
Climate regulation												· · · · · · · · · · · · · · · · · · ·		
Water quality regulation														
Biogeochemical cvcling														
Water cycling														
Water purification (quality)														
Beneficial Ecosystem Services														
Eisborios														
Salt														
Ornamental materials (snells)														
BIOTUEIS														
Natural hazard protection														
Regulation of pollution														
lourism														
Recreation / Sport						_	~~~				~~~	~~~		~~~
Spiritual/cultural wellbeing														
Aesthetic benefits														
Nature watching														
Aquaria										~~~		~~~		
Research and Education														

Species of conservation importance (continued)

Кеу	Fan mus Atrina pe	Lagoon : Tenellia	Ocean q islandica	Pink Sea	Tall sea quadran	Couch's Gobius c	Europea Anguilla	Giant go Gobius c	Long sno Hippoca	Short sn Hippoca	Smelt Osmerus	Undulate Raja unc	Bearded Anotrich	Burgund
Peer-reviewed literature	sel	sea ads	n ah	a-fa	pen gula	gob	n ee ang	by	oute	oute	s ep	e ray dula	red	y m
Grey literature	nata	slu	Bol	n E	Fu	ay Shi	el Juilla	tis	s p	s pe	erla	ta	se	aën
Expert opinion		g	Arc	Inic	nicu		Ω.		eah	ear	snus		awe	apa
Assumed beneficial services			tica	ella	line				orse	lors	0,		um	Ĩ.
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Beneficial Ecosystem Processes														
Primary production														
Secondary production														
Larval/Gamete supply														
Biological control														
Food web dynamics												_		
Species diversification														
Genetic diversification														
Waste assimilation														
Erosion control														
Formation of species habitat														
Formation of physical barriers														
Formation of pleasant scenery							1							
Climate regulation														
Water quality regulation														
Biogeochemical cycling														
Water cycling														
Water purification (quality)														
Beneficial Ecosystem Services														
Fisheries														
Other wild harvesting														
Aquaculture														
Fertiliser / Feed														
Salt														
Ornamental materials (shells)														
Biofuels														
Medicines														
Natural hazard protection														
Environmental Resilience														
Regulation of pollution														
Tourism														
Recreation / Sport														
Spiritual/cultural wellbeing											\langle / \rangle			
Aesthetic benefits														
Nature watching														
Aquaria														
Research and Education				$\langle / / \rangle$	///	///								

Species of conservation importance (continued)

Key Peer-reviewed literature Grey literature Expert opinion Assumed beneficial services	Common maërl Phymatolithon calcareum	Coral maërl Lithothamnion corallioides	Grateloup's little-lobed weed Grateloupia montagnei	Peacock's tail Padina pavonica
Beneficial Ecosystem Processes				
Primary production				
Secondary production				
Larval/Gamete supply				
Biological control				
Food web dynamics				
Species diversification				
Genetic diversification				
Waste assimilation				
Erosion control				
Formation of species habitat				
Formation of physical barriers				
Formation of pleasant scenery				
Climate regulation				
Water quality regulation				
Biogeochemical cycling				
Water cycling				
Water purification (quality)				
Beneficial Ecosystem Services				
Fisheries				
Other wild harvesting				
Aquaculture				
Fertiliser / Feed				
Salt				
Ornamental materials (shells)				
Biofuels				
Medicines				
Natural hazard protection				
Environmental Resilience				
Regulation of pollution				
Tourism				
Recreation / Sport				
Spiritual/cultural wellbeing				
Aesthetic benefits		~~~		
Nature watching				
Aquaria				
Research and Education				

Key findings:

- The evidence base is inconsistent as some marine features offer relatively strong conclusions whereas others have little or no evidence.
- The evidence base for ecosystems was stronger than for species.
- For marine species, the evidence base for beneficial ecosystem processes and services was very limited.
- There was more evidence for beneficial ecosystem processes than beneficial ecosystem services.
- **Commercial fisheries** are the beneficial ecosystem service with the strongest evidence base.
- **NOTE:** Insufficient evidence should not be equated with insignificant ecosystem value, therefore a precautionary view of is needed.

4. The <u>potential</u> role of ecosystem services in the management of coastal and marine space

Marine ecosystem services can help to:

- Connect socio-economic choice with ecological well-being.
- Connect ecological management to socio-economic priorities.
- Provide a driver for stakeholder involvement.
- Facilitate the choice between competing management options.
- Understand the implications of ecosystem change on humans.
- Can be used to identify triggers for management intervention.

Full report will be available from NE.