Key ecosystem functions and processes in areas beyond national jurisdiction

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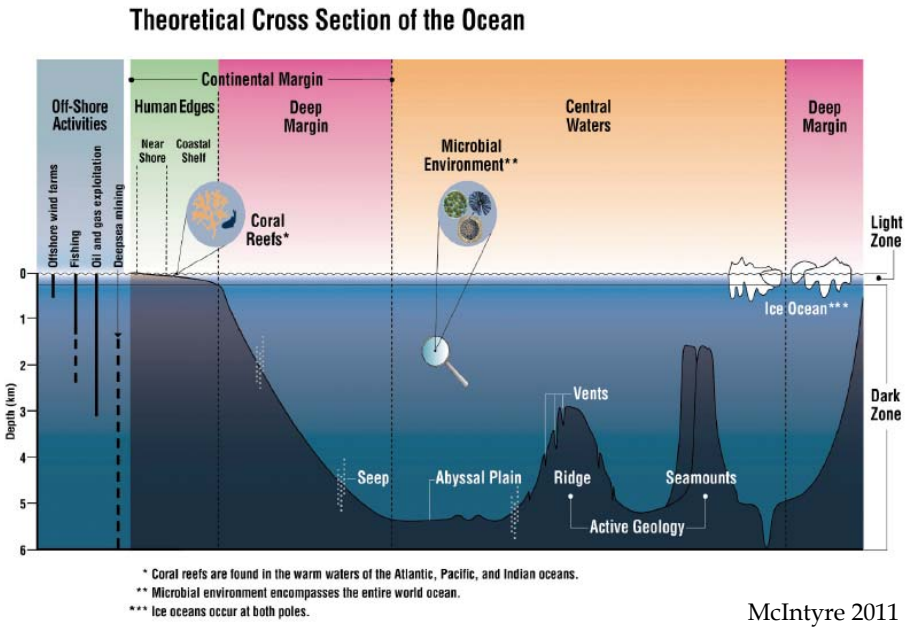
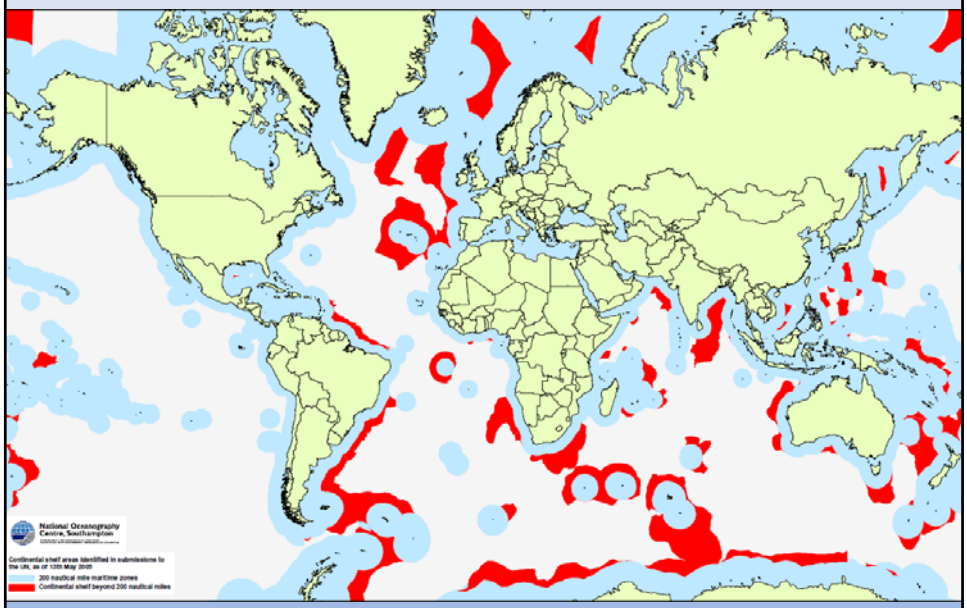


McIntyre 2011

Areas beyond national jurisdiction



National Oceanography Centre, UK

Continental margin

Pelagic central waters

Coral reefs

Cold seeps

Hydrothermal vents

Hadal trenches

Seamounts

Abyssal plains

Ecosystem function is the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly (de Groot et al 2002).

Ecosystem functions are conceived as a subset of ecological processes and ecosystem structures. Natural processes, in turn, are the result of complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy.

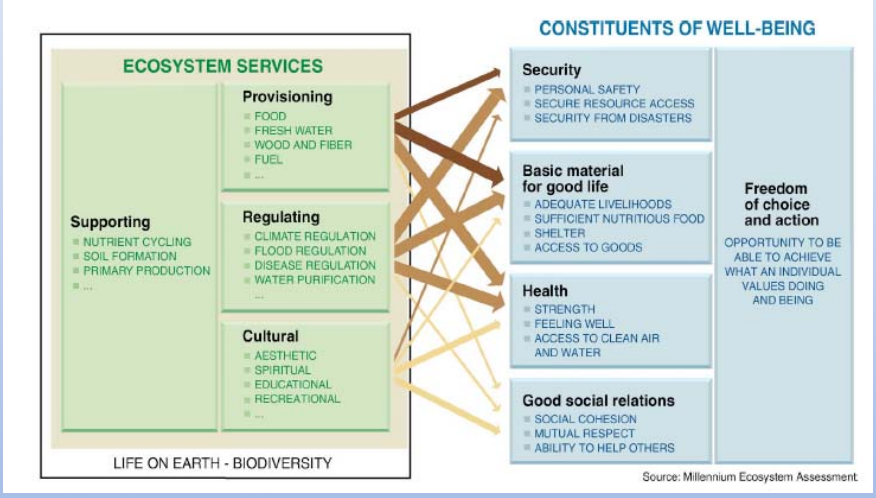
According to Pacala & Kinzig 2002, there are three classes of ecosystem functions:

- Stocks of energy and materials (for example, biomass, genes),
- Fluxes of energy or material processing (for example, productivity, decomposition
- Stability of rates or stocks over time (for example, resilience, predictability).

According to de Groot et al. 2002 there are four primary groups of ecosystem functions

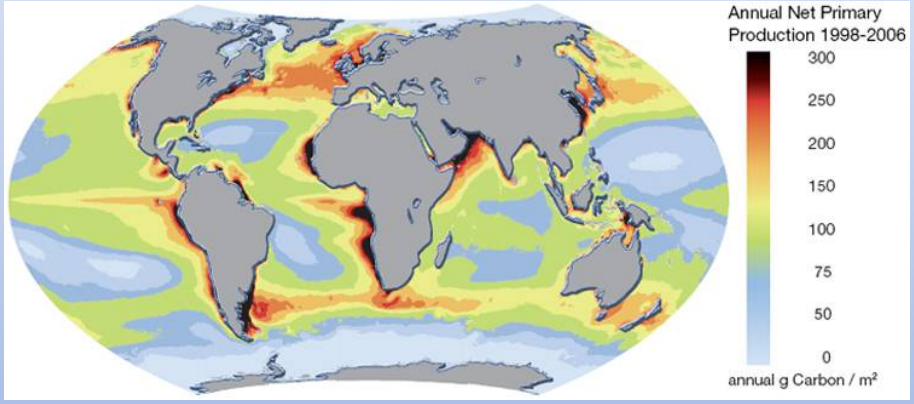
- Regulatory functions
- Habitat functions
- Production functions
- Information functions

What ecosystem functions and processes exist in areas beyond national jurisdiction?



MEA, 2005

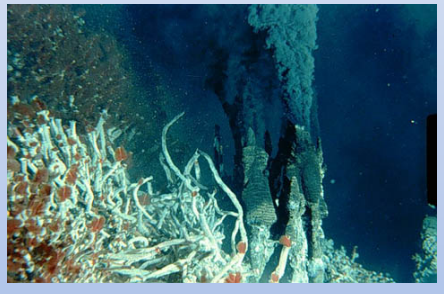
Supporting services



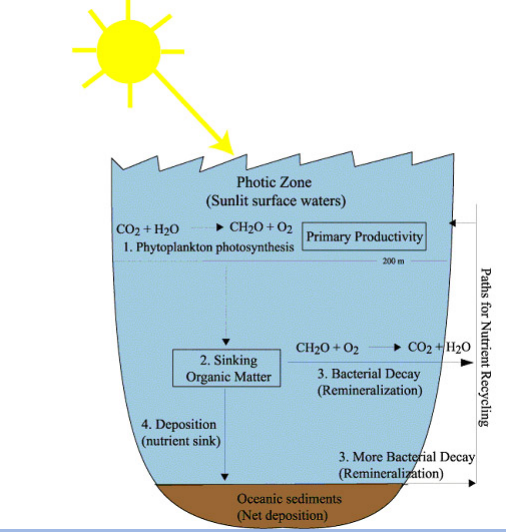
UNEP, 2003

Supporting services

Habitat

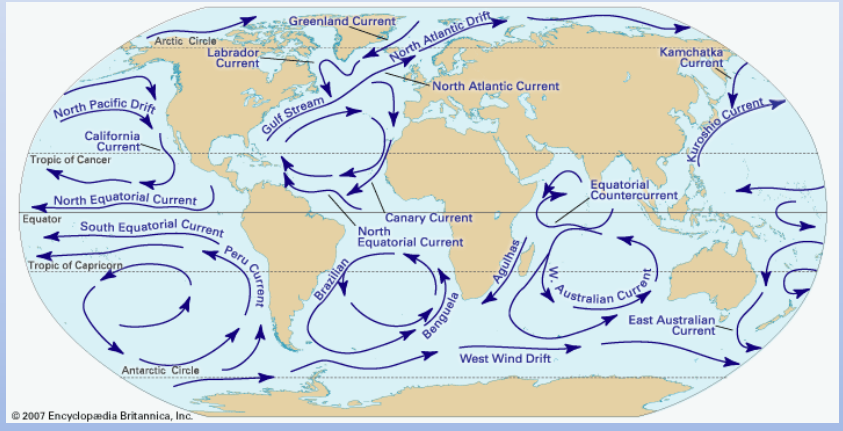


Nutrient cycling



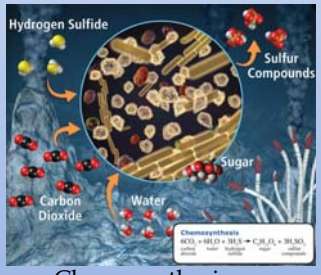
Carbon cycle

Water circulation and exchange



Primary production

Photosynthesis



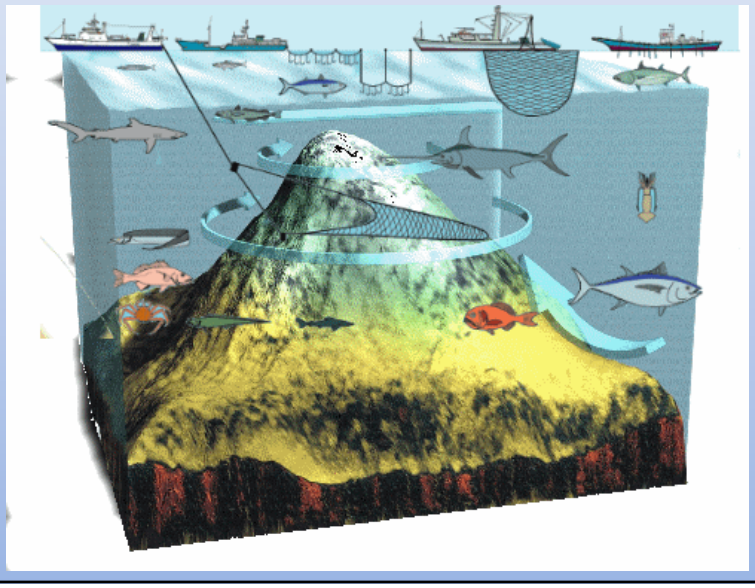
Chemosynthesis

Methanogenesis

Resilience

Provisioning services

Fisheries



Provisioning services

Oil, gas and minerals resources

Provisioning services

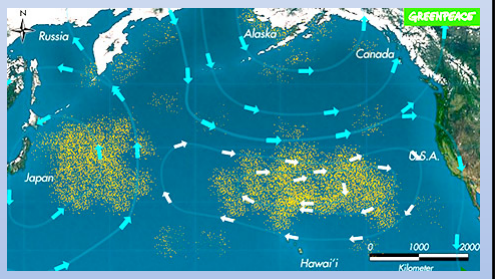
Chemical compounds for industrial and pharmaceutical uses

	Deep sea species	Function	Reference
Marketed	*T. thermophilus* enzymes - deep sea bacteria	Enzymes; Skin protection products (UV-resistant)	Arico (2005)
	T. thermophilus, Thermus aquaticus and *Thermatoga maritime* - deep sea bacteria	DNA polymerases; enzyme that builds new strands of DNA	Arico (2005)
Clinical trials	*Discodermia dissolute* - deep water sponge	Discodermolide; cancer treatment	Maxwell (2005)
	*Lissodenroyx sp** - deep sea sponge	E7389; lung cancer and other cancer treatment	Maxwell (2005)
	Salinospora tropica – deep sea bacteria	Salinosporamide-1; antibiotic and anti-cancer agent	Maxwell et al (2005)
Research	*Lithistida* (family: *Coalistadae*) - deep sea sponge	Dictyostatin-1; Cancer treatment	Maxwell (2005a)
	Spongosporites ruetzleri - deep sea sponge	Topsentin; Anti-inflammatory agent for arthritis and skin irritations	Isbrucker et al (2003)
	Isidae – deep sea bamboo corals	Bone grafts	Maxwell (2005)
	Vibrio diabolicus – deep sea hydrothermal vent bacteria	HE 800 Exopolysaccharide; bone grafts	Zanchetta et al (2003)

Table 2: Examples of products derived from deep-sea species and materials.

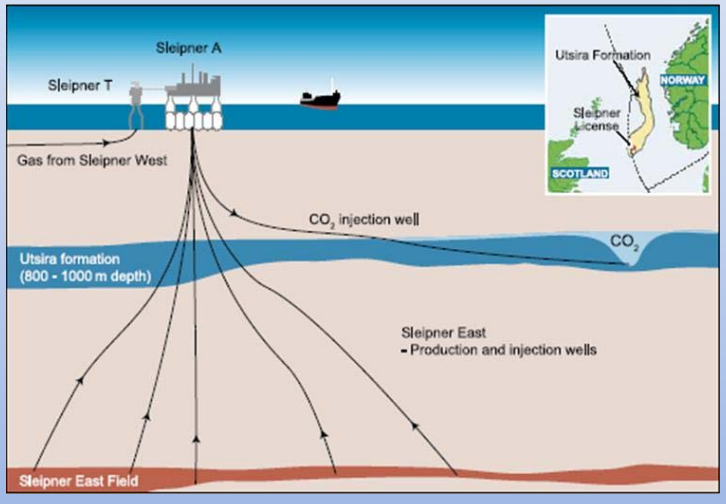
Armstrong et al 2010

Waste disposal sites

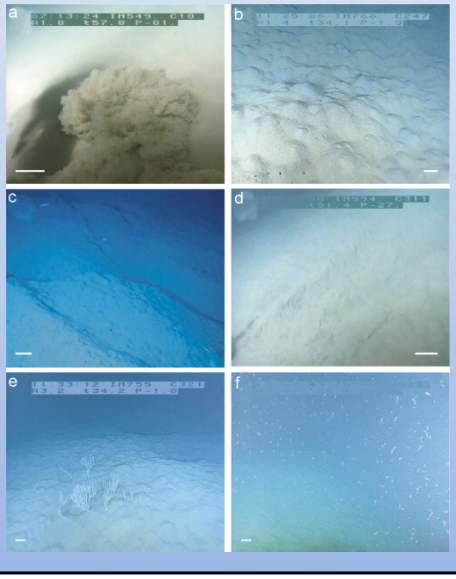


Garbage continent

CO_2 capture and storage



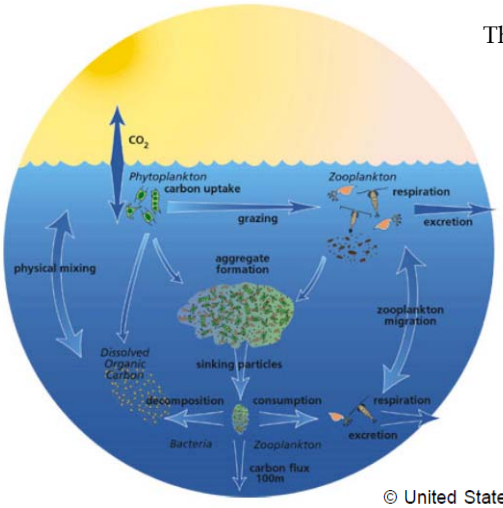
Regulating services



Sediment mixing and oxigenation (bioturbation)

Gas and climate regulation

The biological pump



Regulating services

Waste absorption and detoxification

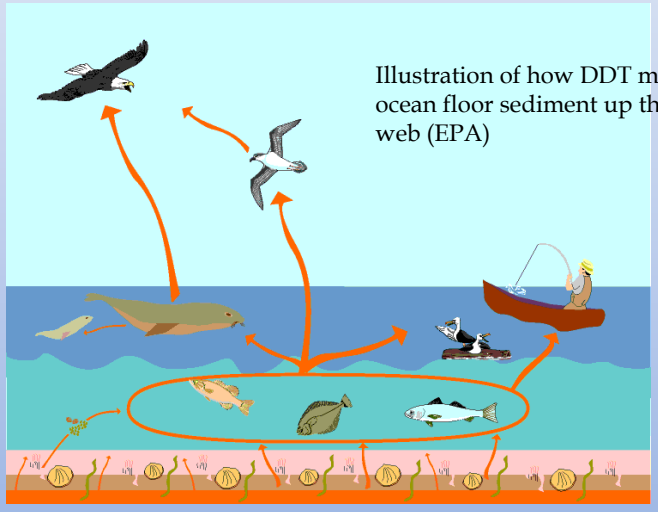
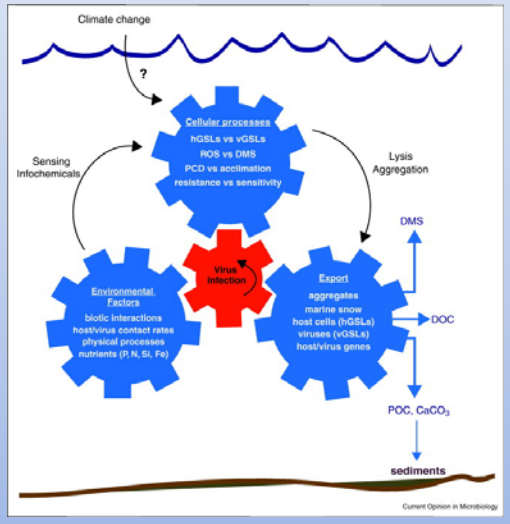


Illustration of how DDT may move from ocean floor sediment up through the food web (EPA)

Regulating services

Biological control

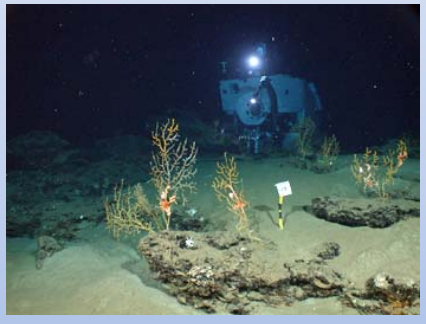


Virus infection

Bidle & Vardi, 2011 . Current opinion in Microbiology

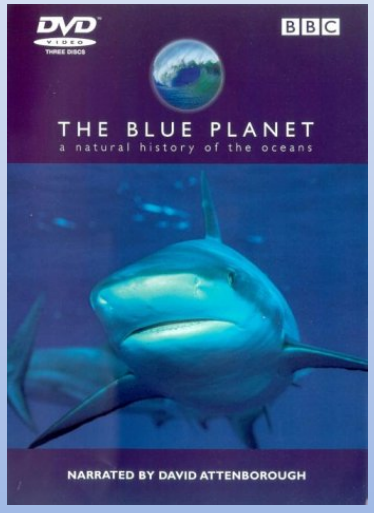
Cultural services

Scientific



Recreation

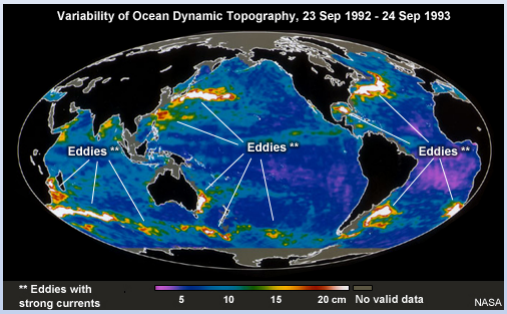
Aesthetic



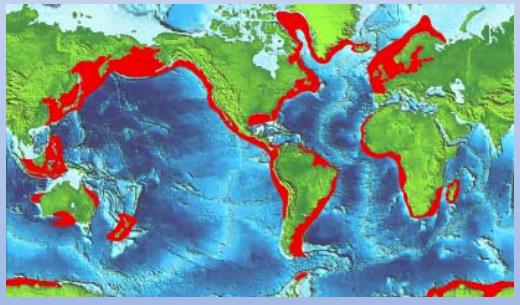
Among these,
what are key functions and processes?

Planet Regulating Ecosystem Functions
- Climate regulation
- Oxygen production (primary production)
- Soil formation
- Evolutionary processes
- Nutrient regeneration
- Marine living resources (fisheries)

Are they unique and how do they differ from those ecosystem functions and processes in areas within national jurisdiction?



Eddies



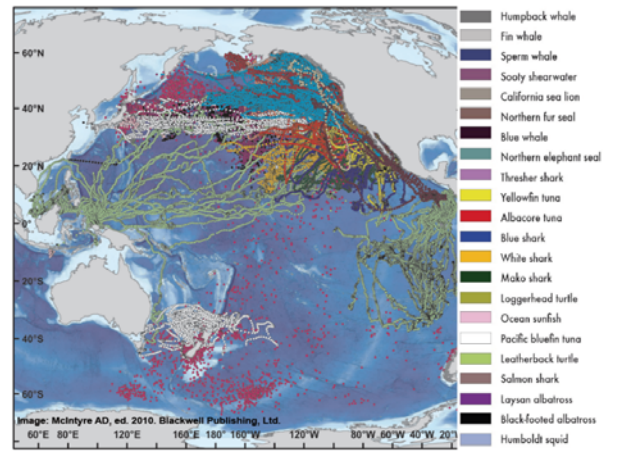
Upwelling

Do ecosystem functions and processes have a regional or a global scale?

Both.

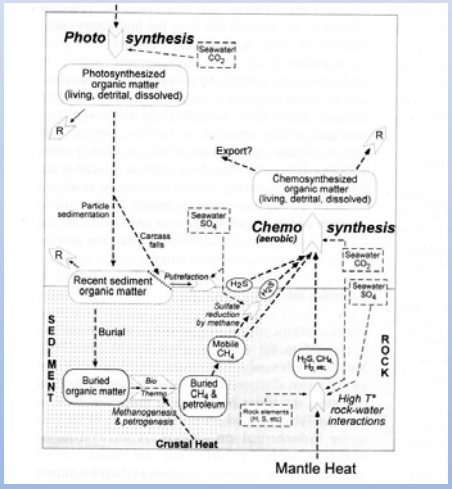
Scale	
Regional	**Global**
Chemosynthesis	**Photosynthesis**
Formation of non-fuel mineral resources	***Sediment formation***
Fisheries	***Pelagic migration***

Are there linkages or interactions between the ecosystems functions and processes in areas beyond national jurisdiction and within areas of national jurisdiction?
Of course.



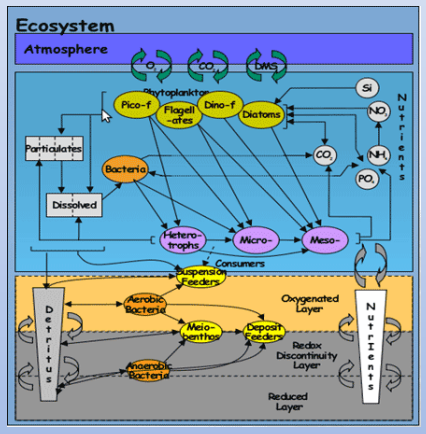
Migration routes

Are there significant differences between ecosystem functions and processes on the seabed and those in the water column?

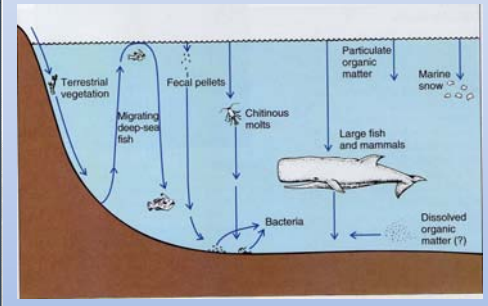


Tunnicliffe et al 2003

How do they interact?



Benthic-pelagic coupling



Food supply inputs to the seabed

What are the gaps in our knowledge of these ecosystem functions and processes?

Understanding the structure and functioning of marine ecosystems by relating the processes that shape them to their productivity, diversity and complexity

Characterising ecosystem changes (e.g., impacts of climate change and variability, stability and resilience) at various temporal and spatial scales

Evaluating an ecosystem's capacity to provide goods and services such as food sources, nutrient recycling, industrial raw materials and new biotechnology

Determining the effects of direct and indirect human impact on deep-sea biodiversity and ecosystem functioning

Integrating socio-economic activities into management and governance strategies to promote sustainable use of these resources

Acknowledgements

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