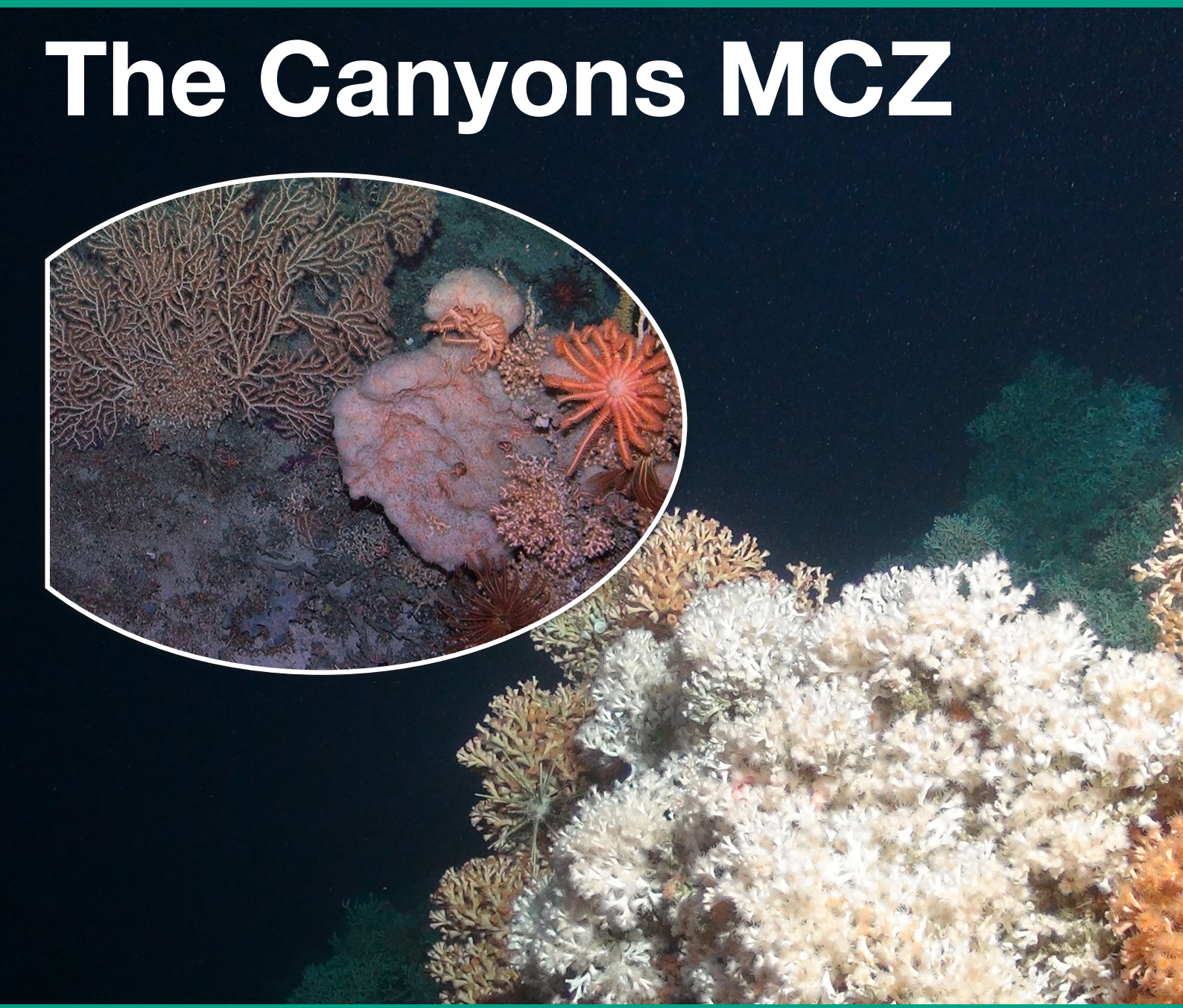
MPA Climate Profile

The Canyons MCZ



The Canyons is a Marine Conservation Zone (MCZ) located on the far south-west corner of the UK's continental shelf, more than 330km from Land's End, Cornwall. It encompasses an area of 661km^2 and covers a depth range of 100m to 2000m below sea level. This site contains two large canyons that indent the shelf break and add to the topographic complexity of the seafloor. This MCZ includes protection for four features: cold-water coral reefs, coral gardens, sea-pen and burrowing megafauna communities and the deep-sea bed.

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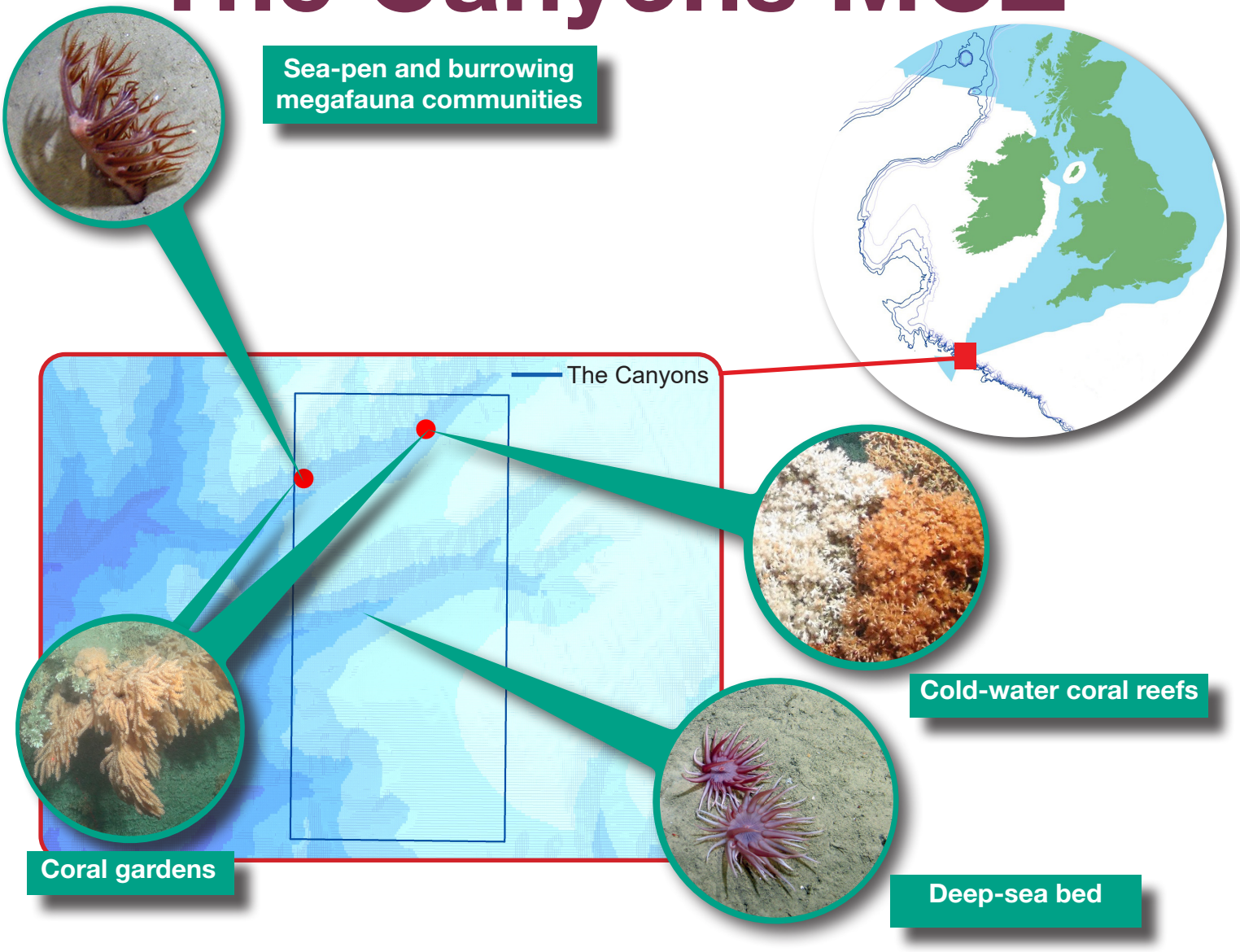
The Canyons MCZ



The Canyons MCZ protected features and climate-change mitigation services

Feature	Ecosystem services
Deep-sea bed and its biological communities	**Carbon sequestration:** The deep sea, particularly deep-sea mud, acts as a long-term sink for algae particles containing locked up atmospheric carbon[1]. Much of the deep-sea bed in The Canyons MCZ consists of deep-sea mud and therefore contributes towards this climate change mitigating service.
Sea-pen and burrowing megafauna communities	**Carbon sequestration:** Sea-pen and burrowing megafauna communities thrive in deep-sea mud habitats which act as a store for atmospheric carbon. The burrowing communities that typify this habitat contribute to carbon sequestration through the bioturbation of sediments, resulting in burial of organic carbon already stored within the deep-sea sediments[2].
Cold-water corals and Coral gardens	**Carbon sequestration:** There are studies which suggest that cold-water corals and coral gardens may contribute to carbon sequestration. However, the evidence is conflicting and suggests that this may vary over different localities, timescales, composition of the wider biological communities present and is dependent upon the balance between calcium carbonate ($CaCO_3$) production (necessary for the hard corals to form skeletons), dissolution and respiration[3,4].

The Canyons MCZ

Potential response of The Canyons MCZ protected features to climate change

The biotopes (a habitat and its commonly associated community of species) present within the MPA were assessed and scored for sensitivity[5] to pressures associated with climate change, at different emission scenario benchmark levels. The pressures assessed were:

(i) ocean warming (covering sea surface, near bottom and surface (air) temperatures); and,
(ii) ocean acidification.

There are other pressures related to climate change which may impact the protected features of The Canyons MPA, for example water column stratification which can lead to deoxygenation and reduction in food supply to deeper waters[6]. However, as these pressures are interrelated, assessment of sensitivity is more challenging so has not been possible to consider at this time. Other climate-related pressures, including sea level rise and marine heatwaves, are not considered relevant to deep-sea waters due to their depth and therefore the site would not be considered to be exposed to these pressures.

The sensitivity information for MPA protected features is summarised in the table below, including confidence scores for the assessments. Biotope sensitivity scores at the high emission scenario benchmark level were aggregated for MPA features, and the most precautionary (highest) score of the component biotopes was applied as the overall MPA feature sensitivity score. Full sensitivity assessments for each biotope for all emission scenarios, with associated references, are available at https://www.marlin.ac.uk.

Climate change pressure (high emission scenario)	***MPA protected feature***			
	Deep-sea bed	**Seapen and burrowing megafauna communities**	**Cold-water coral reefs**	**Coral gardens**
Ocean warming (1°C increase in ocean temp. by end century)	Medium	Not sensitive	Not sensitive	Medium
	Q (**L**) A (**L**) D (**L**)	Q (**M**) A (**L**) D (**H**)	Q (**H**) A (**H**) D (**M**)	Q (**H**) A (**M**) D (**H**)
Ocean acidification (0.35 decrease in annual mean pH)	Medium	Not sensitive	High	High
	Q (**L**) A (**L**) D (**L**)	Q (**M**) A (**M**) D (**L**)	Q (**H**) A (**H**) D (**H**)	Q (**H**) A (**H**) D (**M**)

Confidence assessment categories		**Confidence scoring**	
Q	Quality of evidence (information sources)	H	High
A	Applicability of evidence	M	Medium
D	Degree of concordance (agreement between studies)	L	Low

The Canyons MCZ

Discussion

- Under the high emission scenario benchmark:
  - Cold-water coral reefs and coral gardens are highly sensitive to the effects of ocean acidification because they rely on calcium carbonate for skeletal growth and stability. As ocean acidity increases, calcium carbonate saturation decreases, resulting in negative impacts on coral growth, metabolism and survival[7].
  - Coral gardens have a high sensitivity score to ocean warming because increasing ocean temperatures may affect the composition of coral communities by replacing certain coral species with those that are more tolerant to warmer waters[8].
  - The deep-sea bed has a medium sensitivity score to ocean warming and acidification due to the negative effect these pressures have on the function and survival of several characterising species.

- Deep-sea mud and associated burrowing communities provide a global carbon sink and therefore play a vital role in climate regulation through the storage of atmospheric carbon[1,2]. Although coral gardens and cold-water coral reef contribution towards this service is less well understood, they are a complex part of the marine carbon cycle and therefore have a role in climate regulation.

- Deep-sea ecosystems are often slow to recover from disturbance so management commonly consists of removal or prevention of activities which may impact them such as deep-sea trawling bans which apply to protect Vulnerable Marine Ecosystems below 800m depth.

Further information

To find out more about this project, please see: **https://jncc.gov.uk/our-work/climate-smart-mpas/**

Sensitivity assessments were conducted for the following biotopes which make up The Canyons MPA protected features:

1. **Cold-water coral reefs:** Atlantic upper bathyal live *Lophelia pertusa* reef (biogenic structure).
2. **Coral gardens:** Discrete *Lophelia pertusa* colonies on Atlantic upper bathyal rock and other hard substrata, discrete *Lophelia pertusa* colonies on Atlantic mid bathyal rock and other hard substrata, mixed coral assemblage on Atlantic mid bathyal *Lophelia pertusa* reef framework (biogenic structure) and mixed coral assemblage on Atlantic upper bathyal *Lophelia pertusa* reef framework (biogenic structure).
3. **Deep-sea bed:** *Leptometra celtica* assemblage on Atlantic upper bathyal coarse sediment, Squat lobster assemblage on Atlantic upper bathyal coarse sediment (*Lophelia* rubble), Cerianthid anemones and burrowing megafauna in Atlantic mid bathyal mud.
4. **Seapen and burrowing megafauna communities:** *Kophobelemnon* fields on Atlantic upper bathyal mud, *Kophobelemnon* fields on Atlantic mid bathyal mud.

The full list of references underpinning these sensitivity assessments are available at:
https://www.marlin.ac.uk/habitats/az

References

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