



The importance of UK kelp forests for fisheries habitat, biodiversity, carbon cycling and regional economies

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Coastal Futures, London, 16th January 2020



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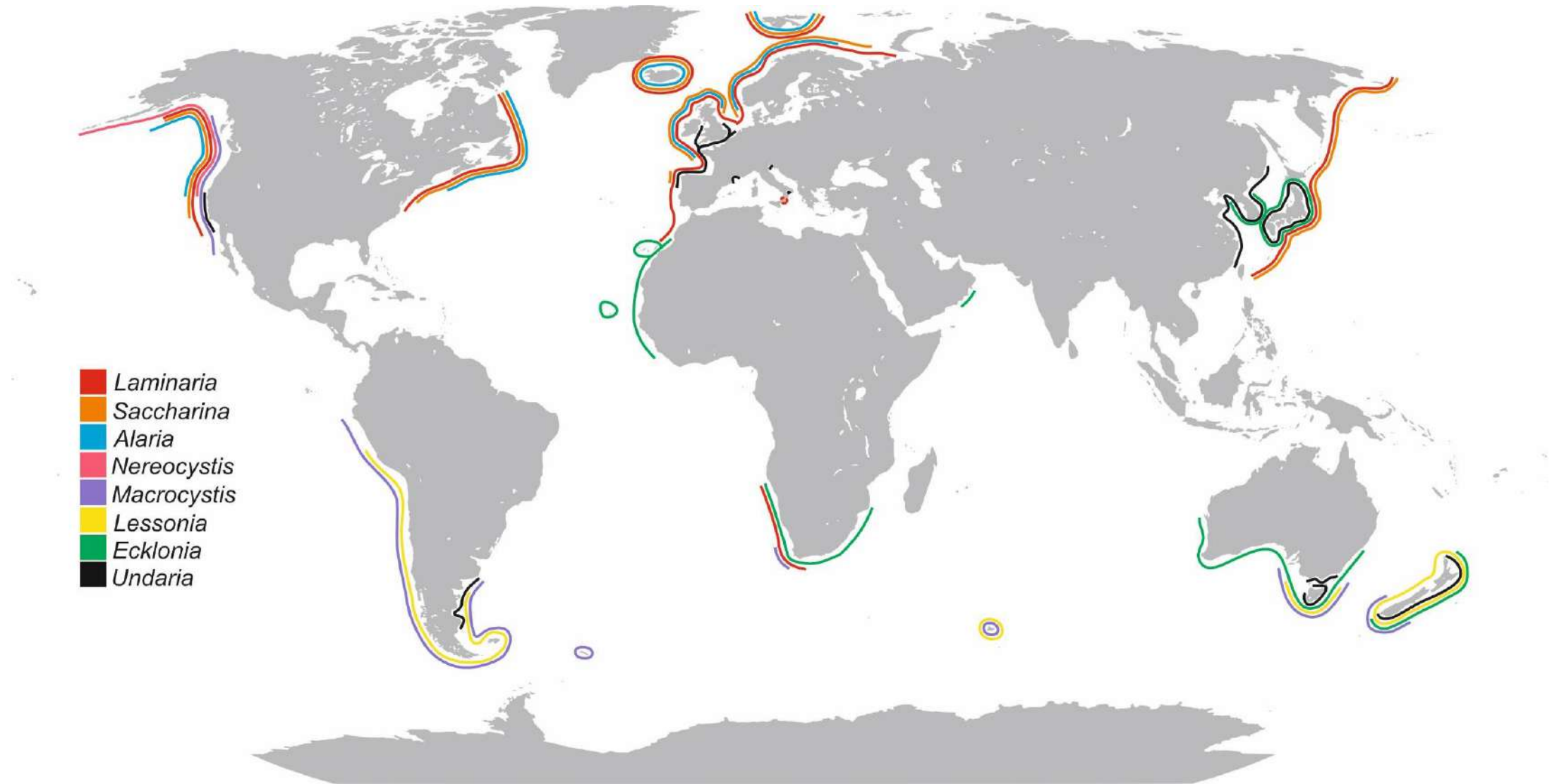
What is kelp?!?!

- Taxonomically speaking, a species of the order Laminariales
- Ecologically speaking, a large brown canopy-forming seaweed
- Bi-phasic life cycle with microscopic gametophyte stage and macroscopic sporophyte phase

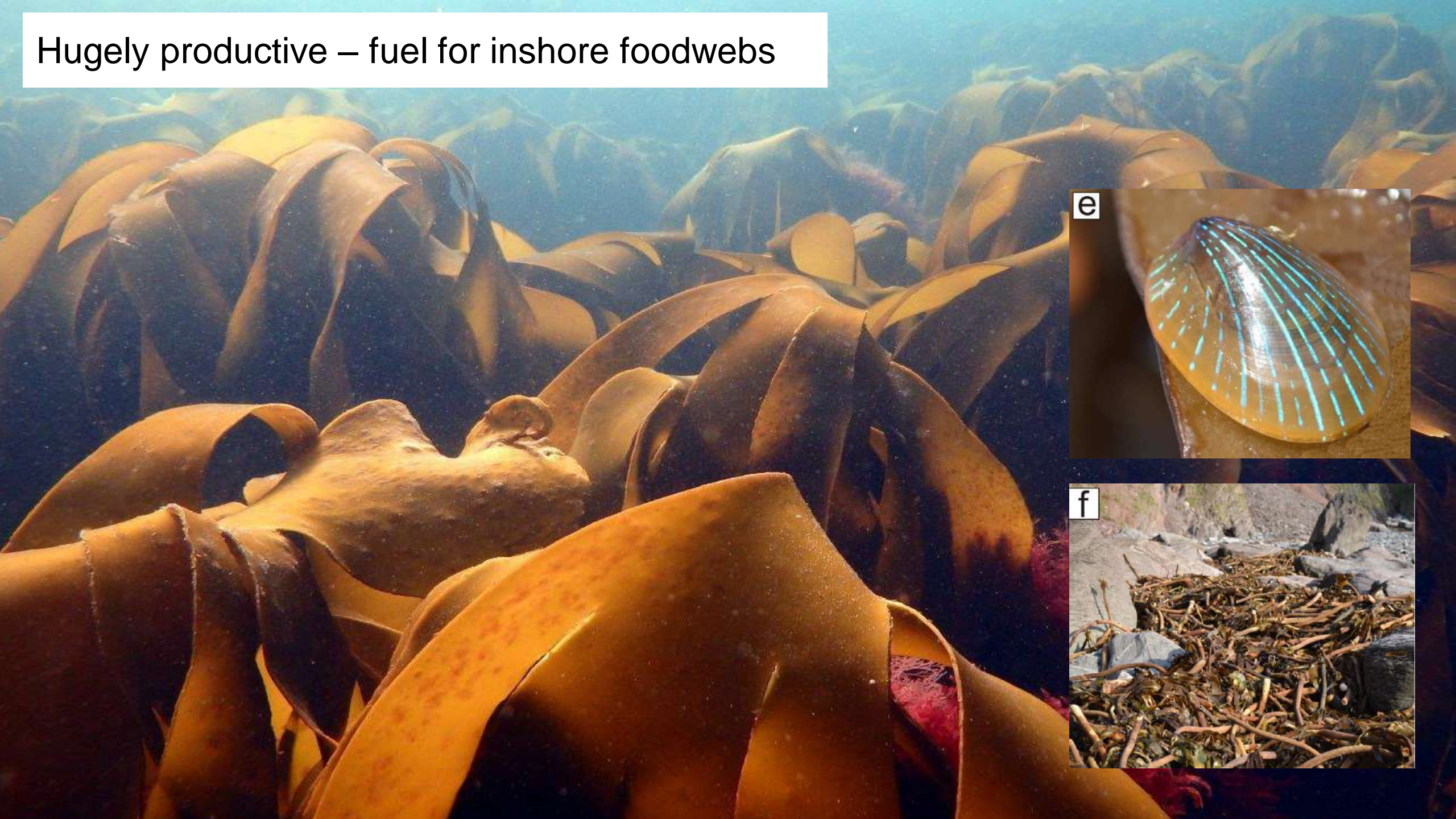


Why kelp?

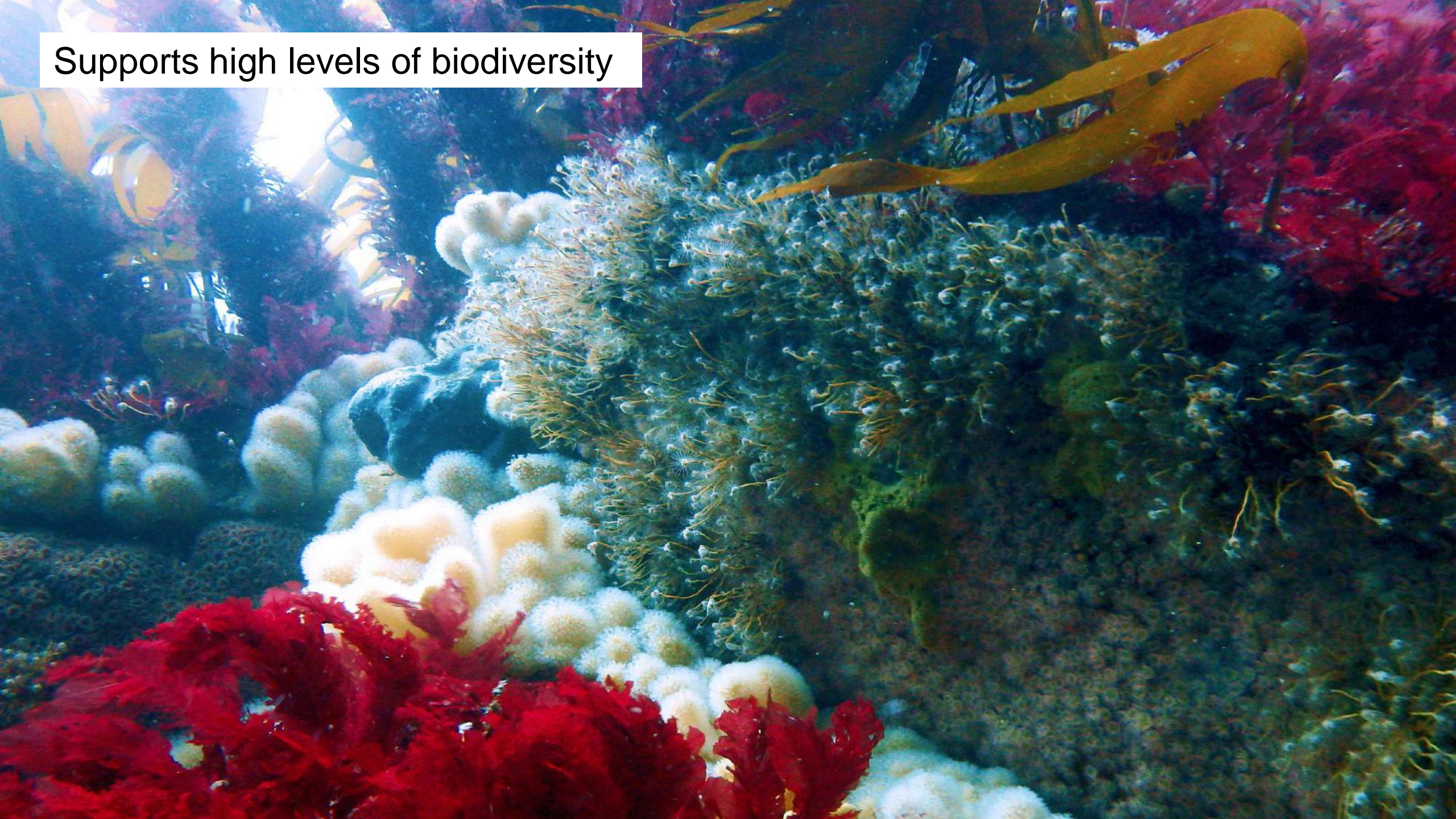
Geographically widespread



Hugely productive – fuel for inshore foodwebs



Supports high levels of biodiversity





K. HISCOCK



T. WERNBERG



T. WERNBERG



T. WERNBERG



D. REED



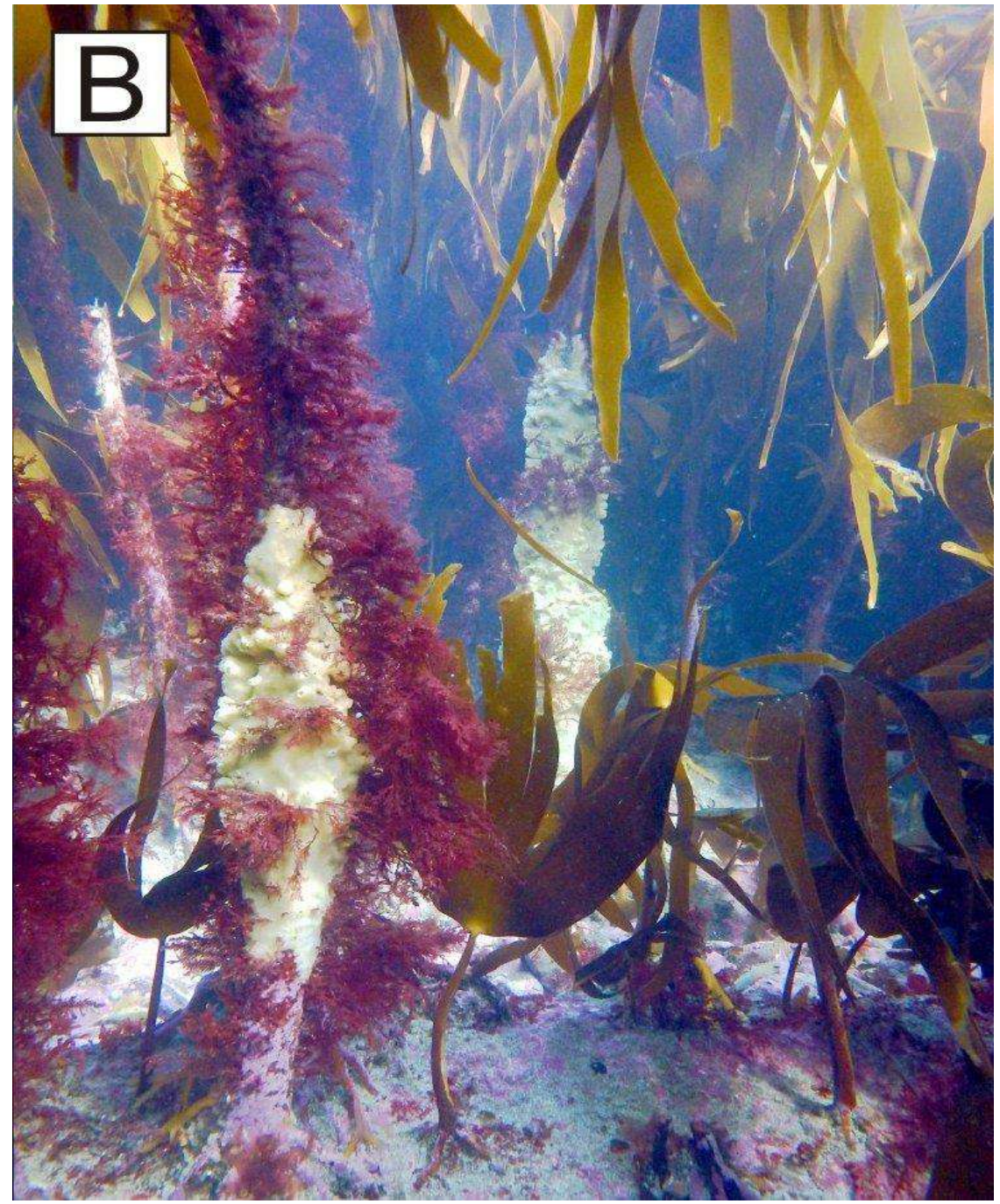
K. HISCOCK



M. THOMSEN



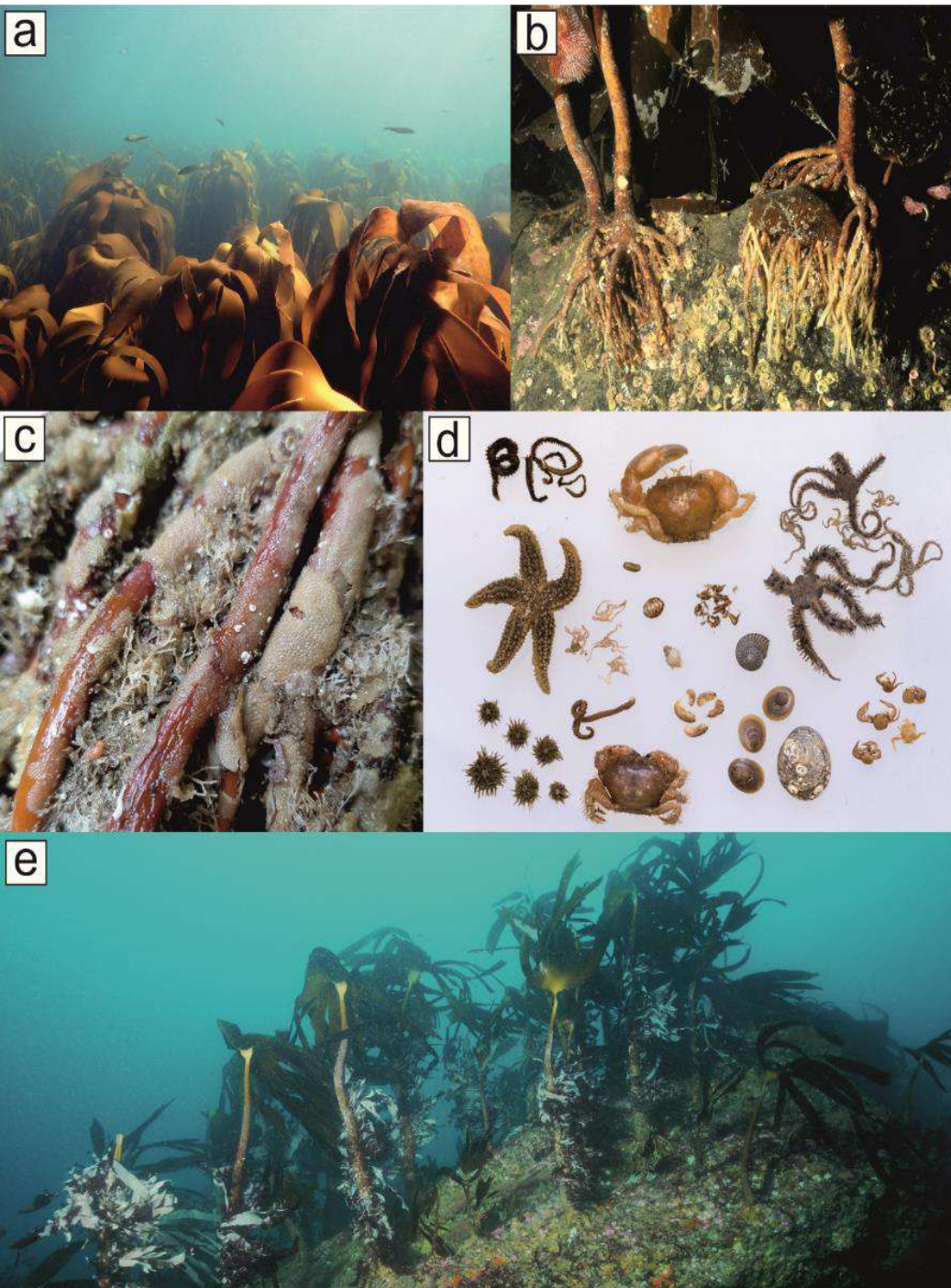
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- A single kelp holdfast may support >50 species
- A single kelp plant may support >80,000 individuals
- Kelp forests are critical foraging and nursery habitat for fish, shellfish, mammals, birds





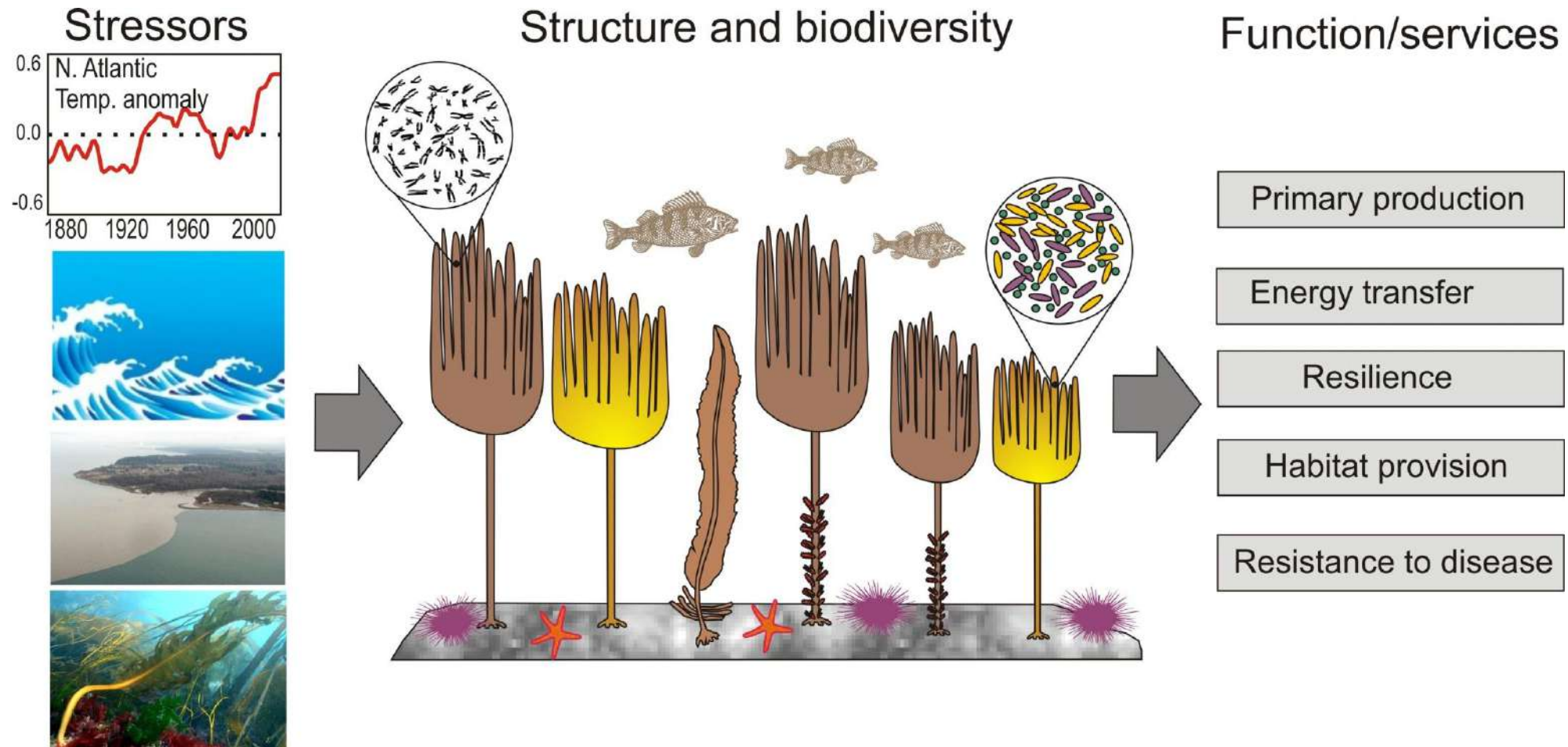
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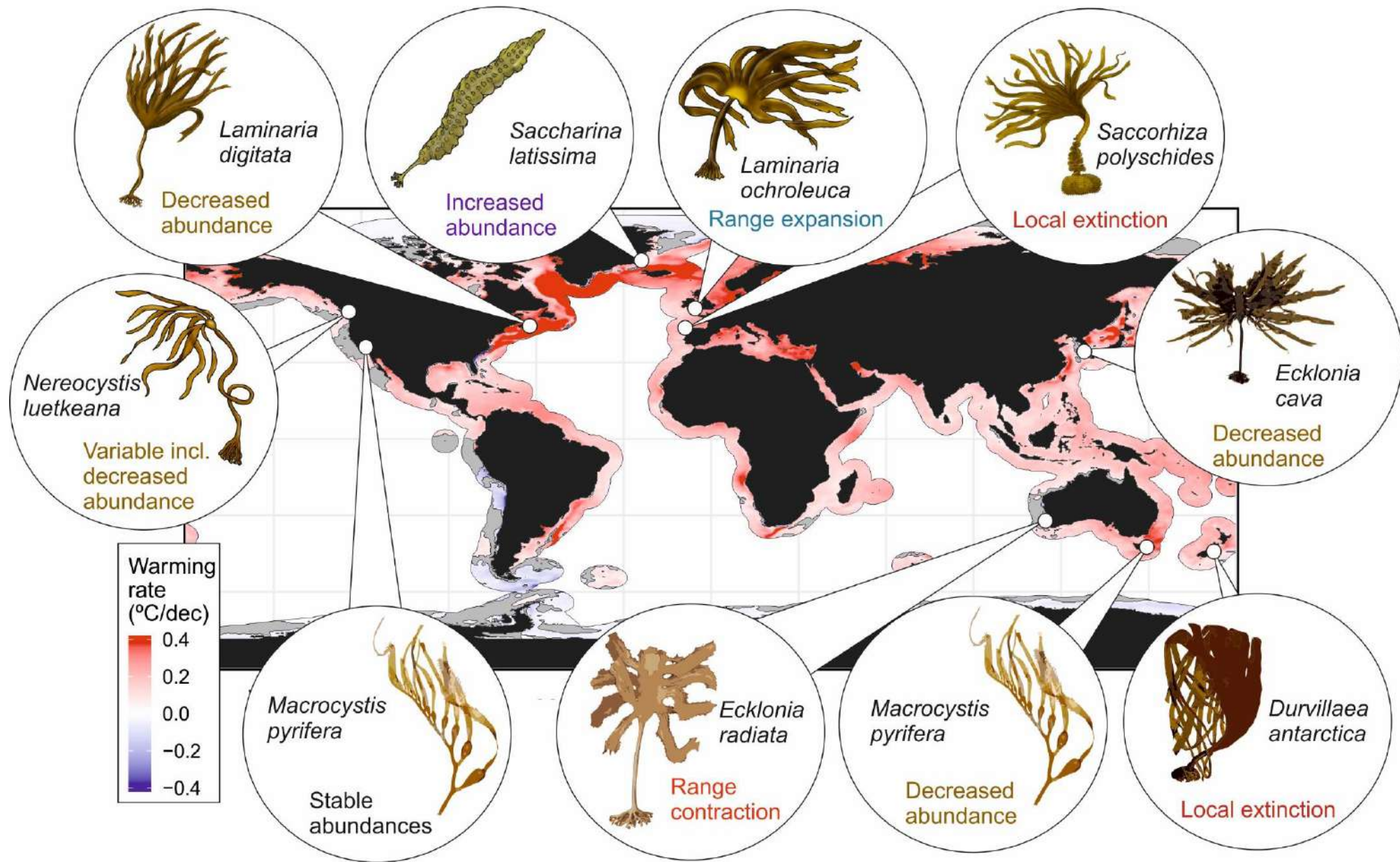
Other ecosystem services (biogenic coastal defence, nutrient cycling, Blue Carbon)



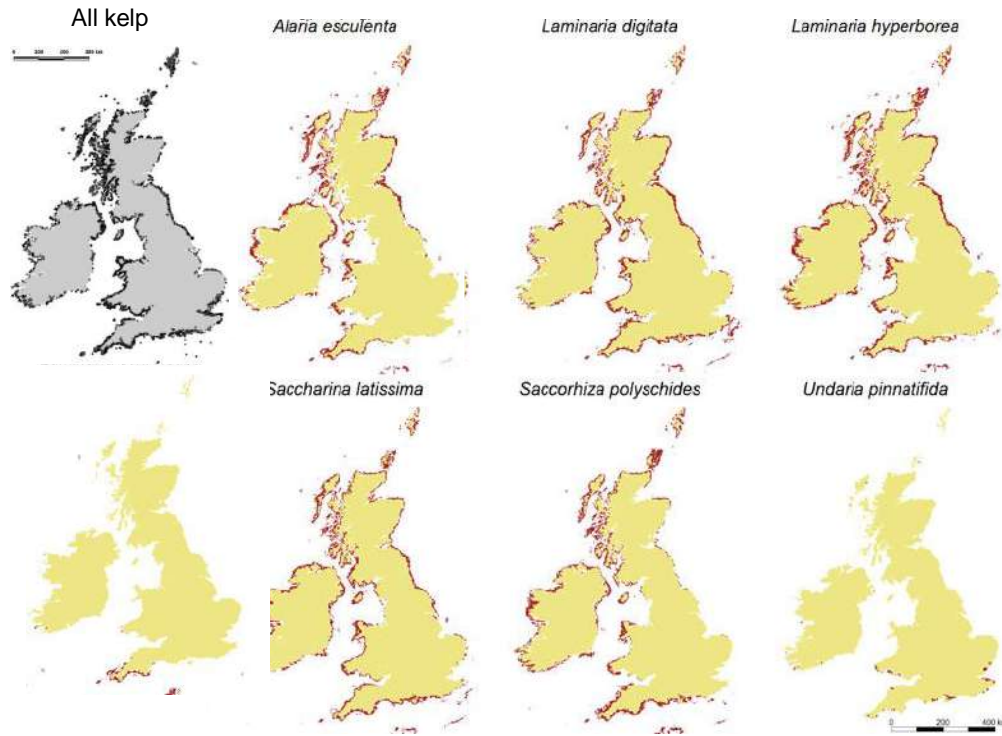
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- Kelp populations and the ecosystems they underpin are structured by many processes operating over varying spatiotemporal scales!
- Contemporary stressors can alter structure/functioning and goods/services



Kelp forests in UK



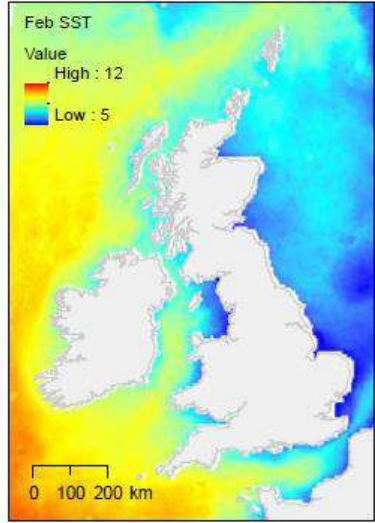
- Kelps found along ~12,000 km of UK coastline
- Found from +1 m depth to ca. -40 m depth
- Areal extent of kelp populations in UK and Ireland range from ~9000 to 19000 km²
- Total standing stock in UK and Ireland = ~20m t fresh weight



4 X

Key drivers of structure and distribution of UK kelp forests

- Temperature



- Wave exposure



- Light availability (depth, turbidity)



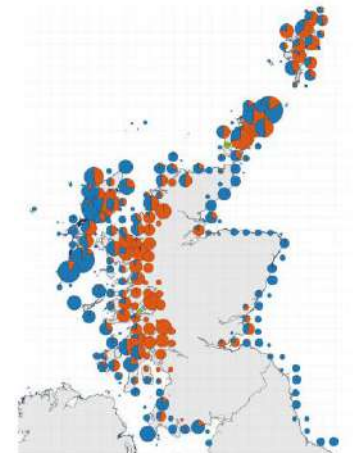
- Rocky substrate



- Other (nutrients, tidal flow/height, grazing, competition)



- Predict distribution/ biomass/ abundance



Alaria esculenta



Lifespan: 4-7 yrs
Depth: 0-10m
Size: 1-3m
Iceland-France
Change: ↓

Saccharina latissima



Lifespan: 2-4 yrs
Depth: 0-30m
Size: 1-4m
Iceland-France
Change: ↓

Laminaria digitata



Lifespan: 4-6 yrs
Depth: 0-20m
Size: 2-3m
Iceland-France
Change: ↓

Laminaria hyperborea



Lifespan: 5-18 yrs
Depth: 0-30m
Size: 2-4m
Iceland-Portugal
Change: ↓

Laminaria ochroleuca



Lifespan: 5-18 yrs
Depth: 0-30m
Size: 2-4m
England-Morocco
Change: ↑

Saccorhiza polyschides



Lifespan: 1 yr
Depth: 0-35m
Size: 3-4m
Norway-Morocco
Change: ↑

Undaria pinnatifida



Lifespan: 1 yr
Depth: 0-15
Size: 1-3m
Global
Change: ↑

(a) *Alaria esculenta*

(b) *Laminaria digitata*

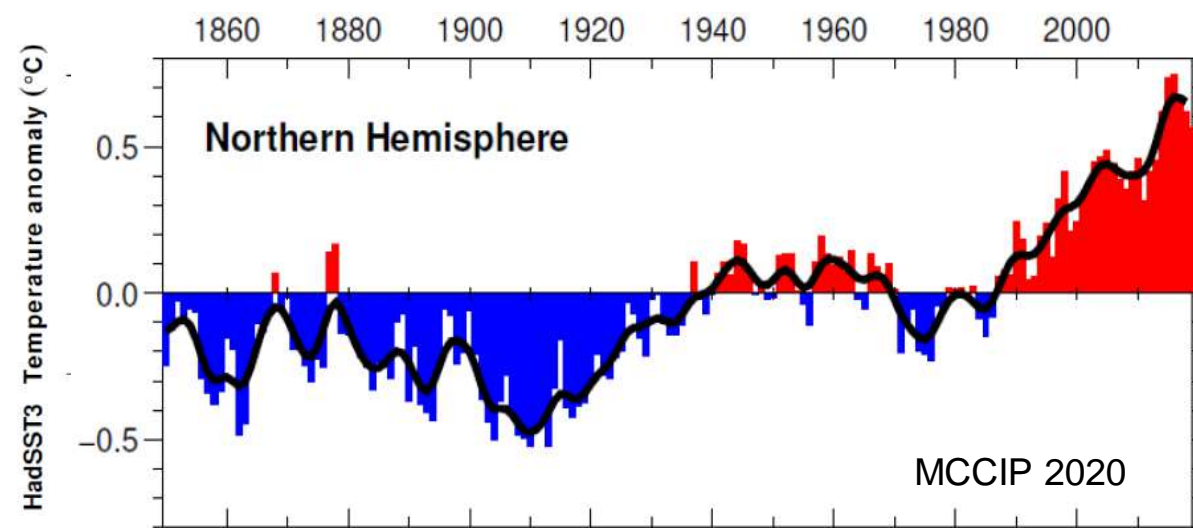
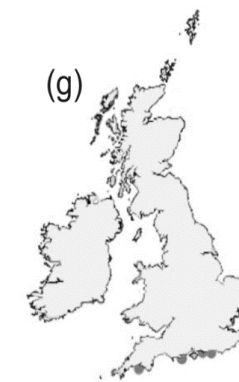
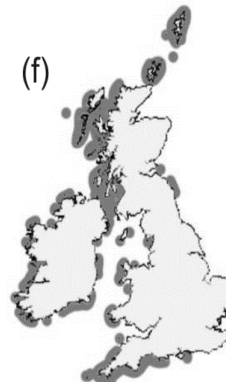
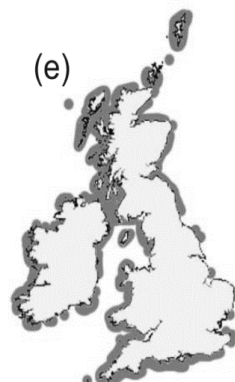
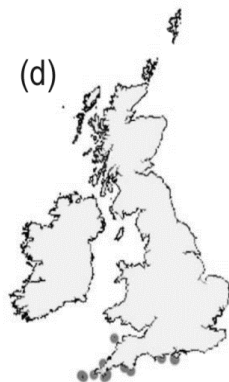
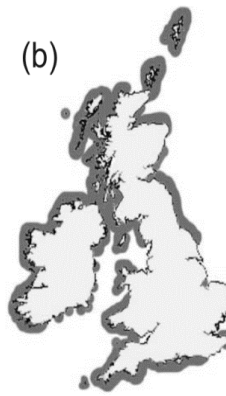
(c) *Laminaria hyperborea*

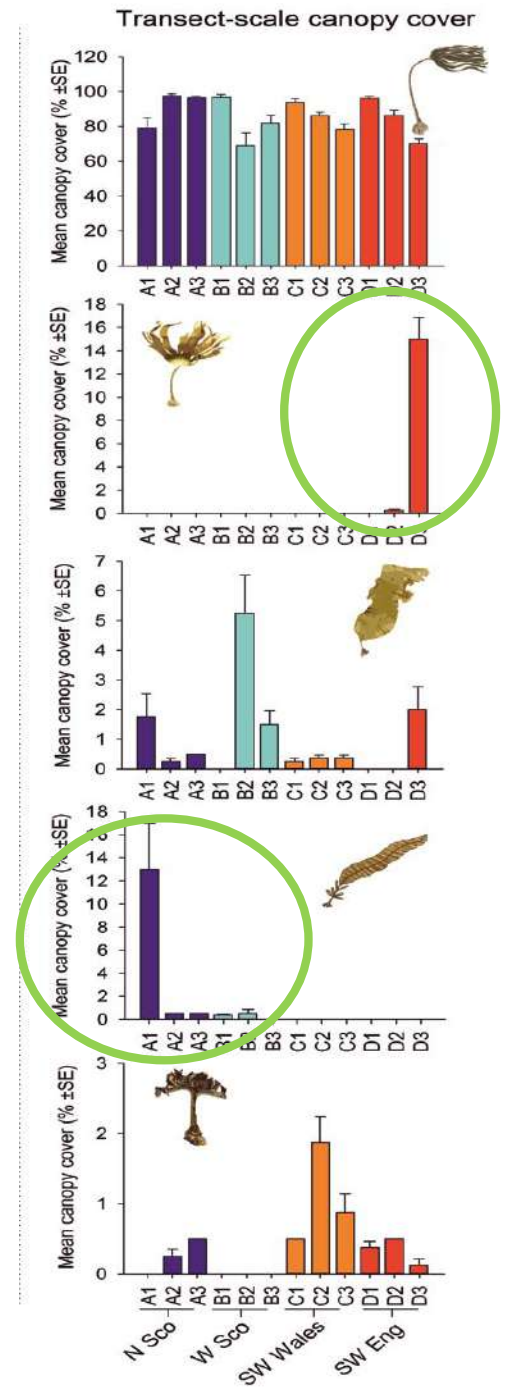
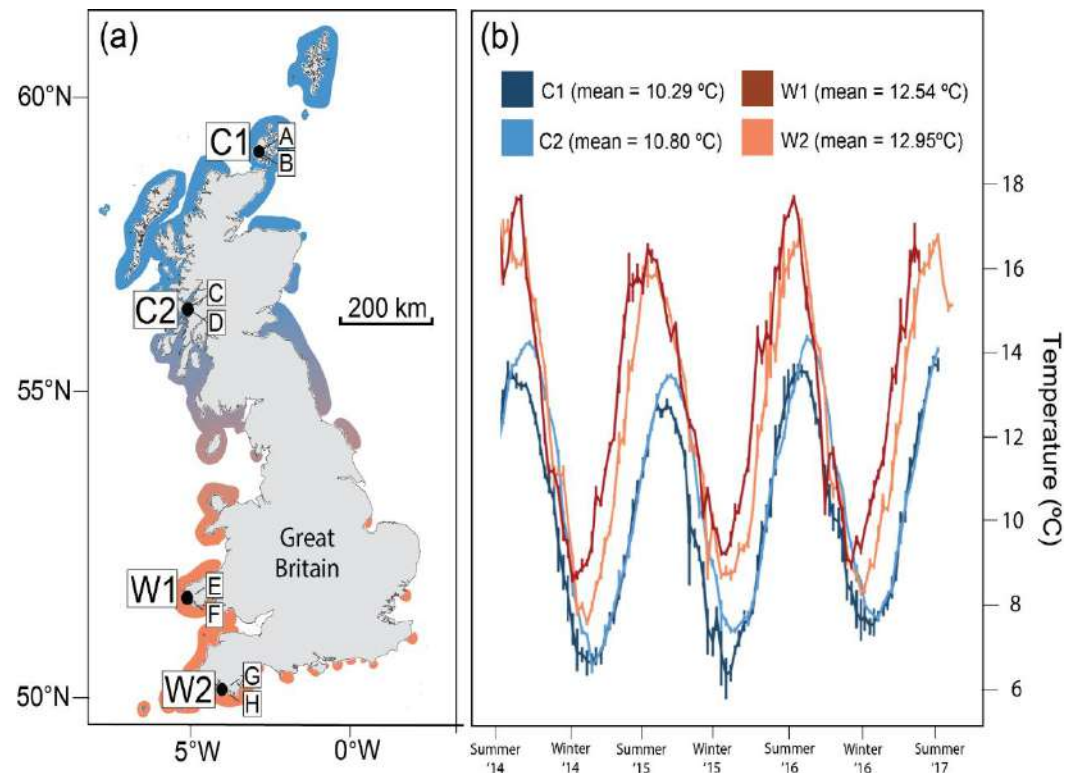
(d) *Laminaria ochroleuca*

(e) *Saccharina latissima*

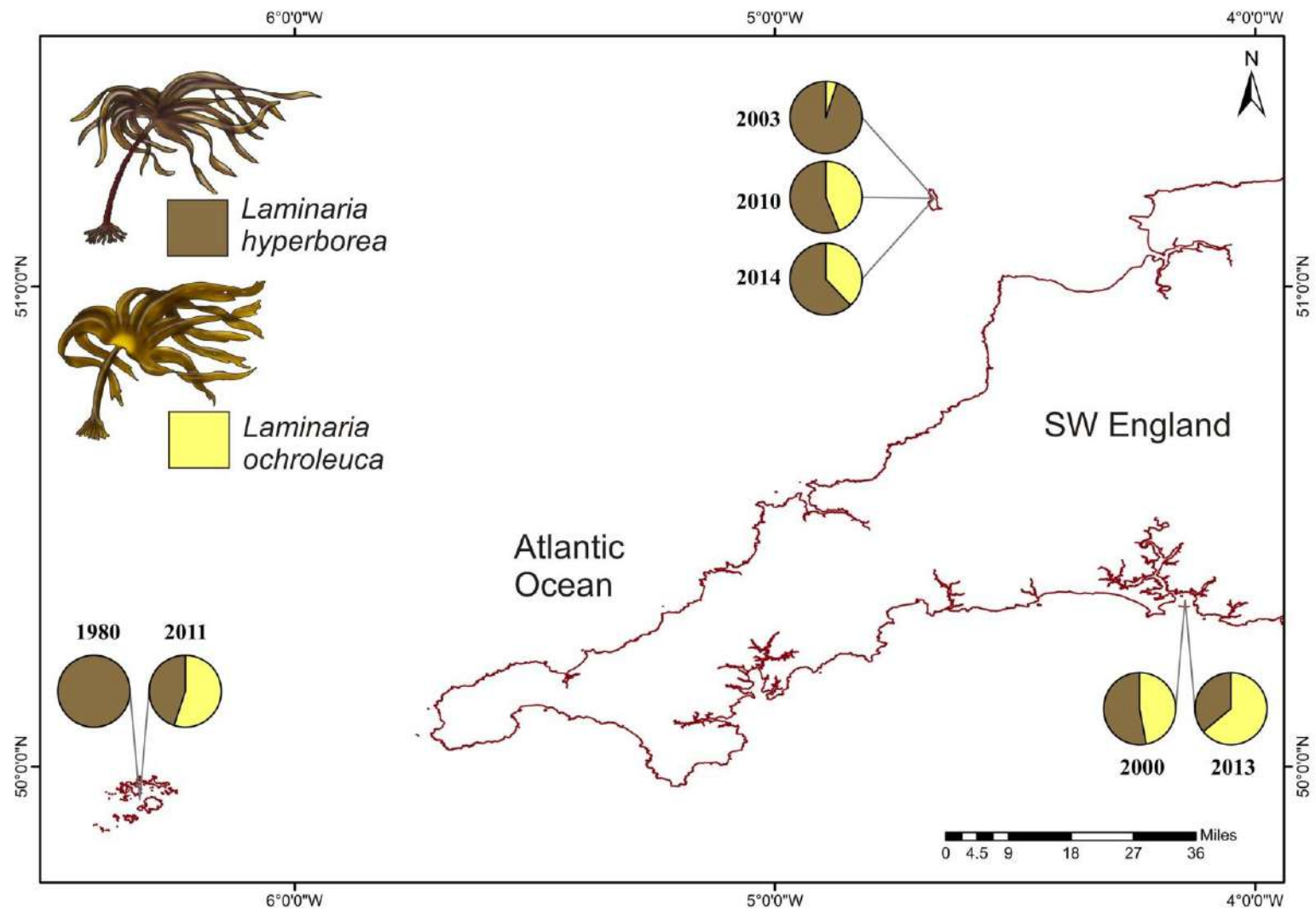
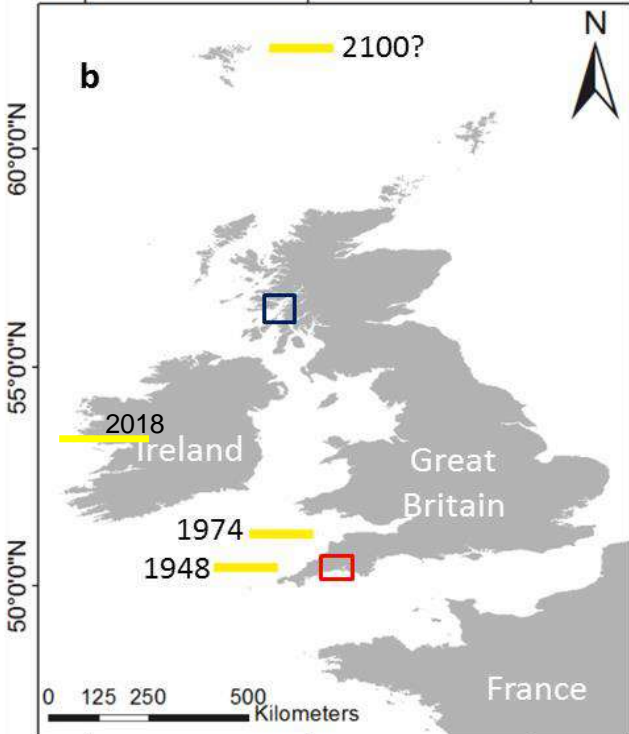
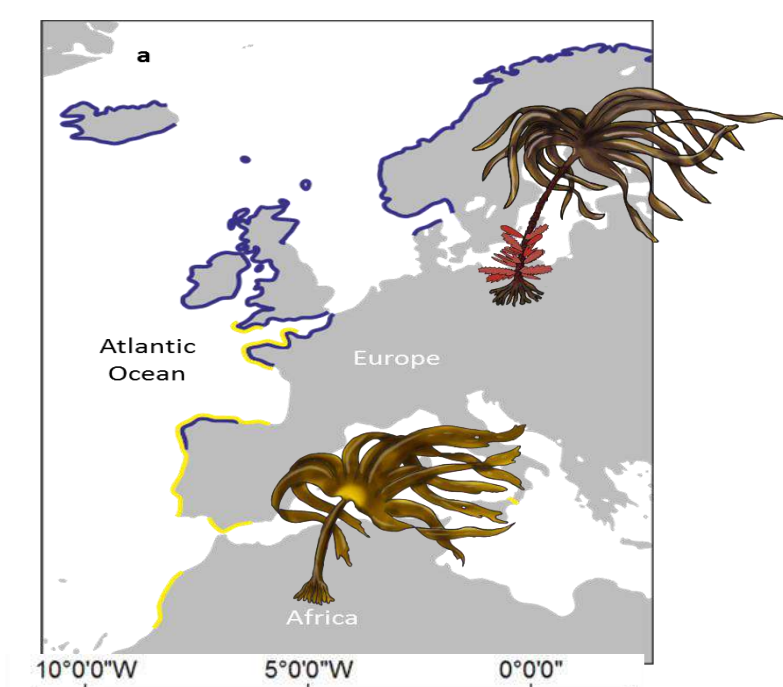
(f) *Saccorhiza polyschides*

(g) *Undaria pinnatifida*





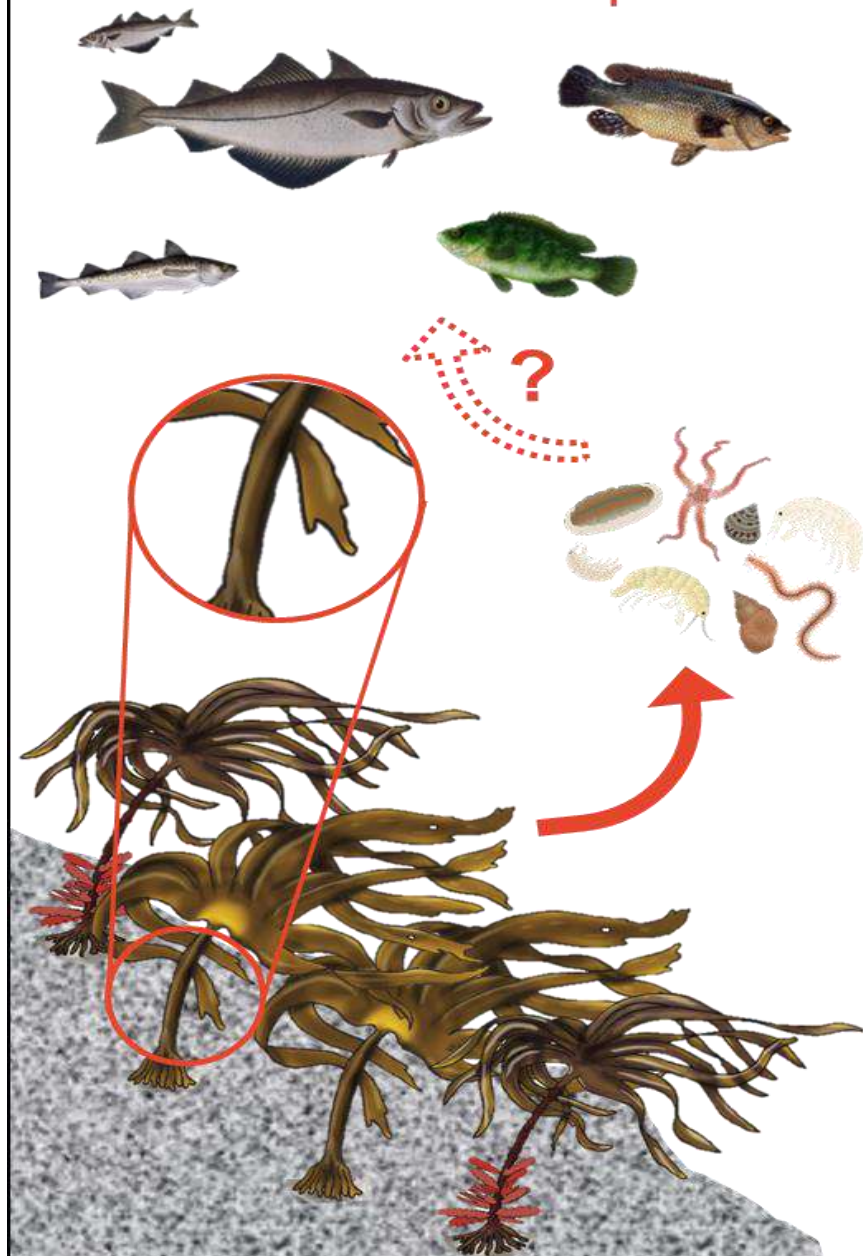
- UK kelp forests on open coastlines dominated by *L. hyperborea*
- Warm water species (*L. ochroleuca*) found in southern locations
- Cold water species (*A. esculenta*) common in northern locations



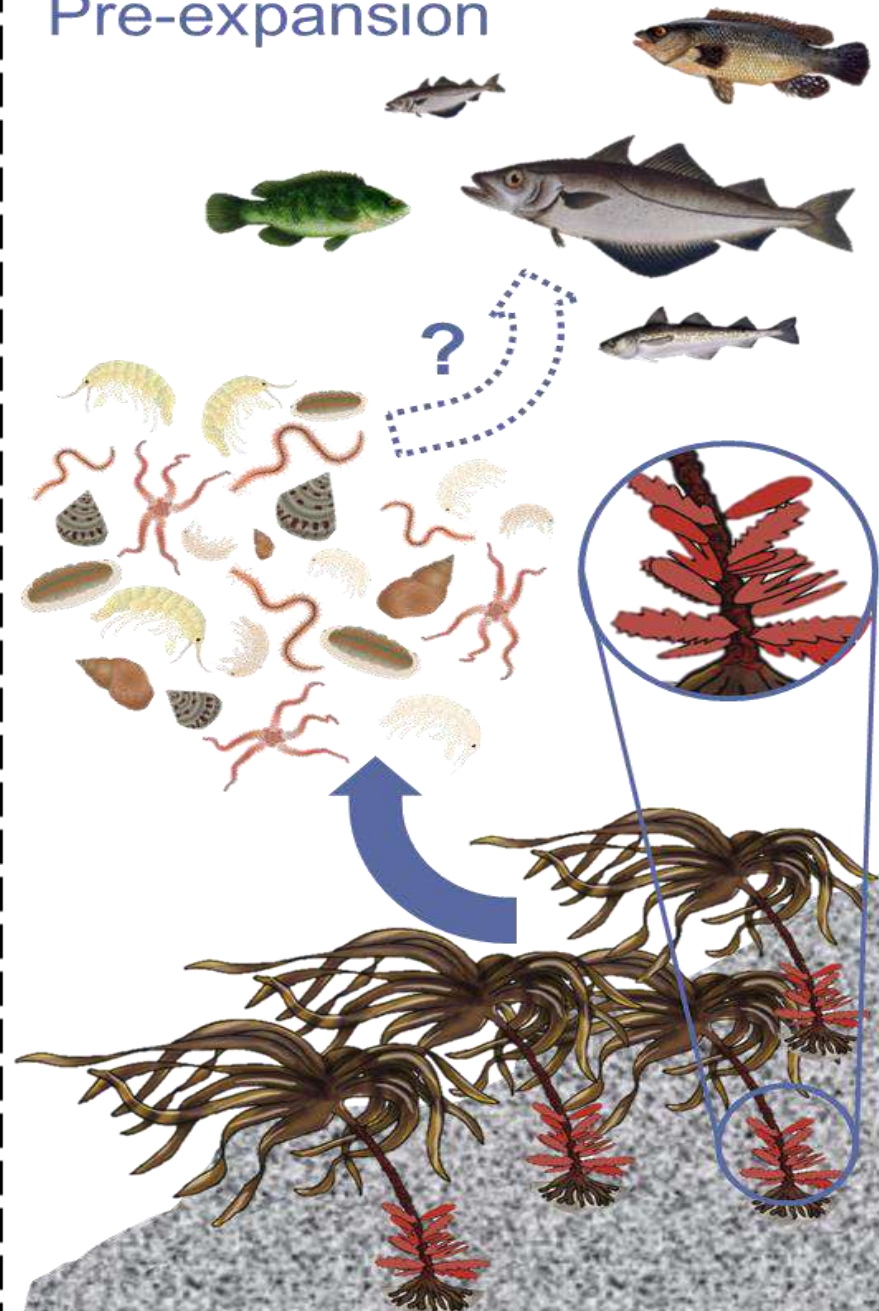
Warm/cold kelp species support different communities and levels of biodiversity



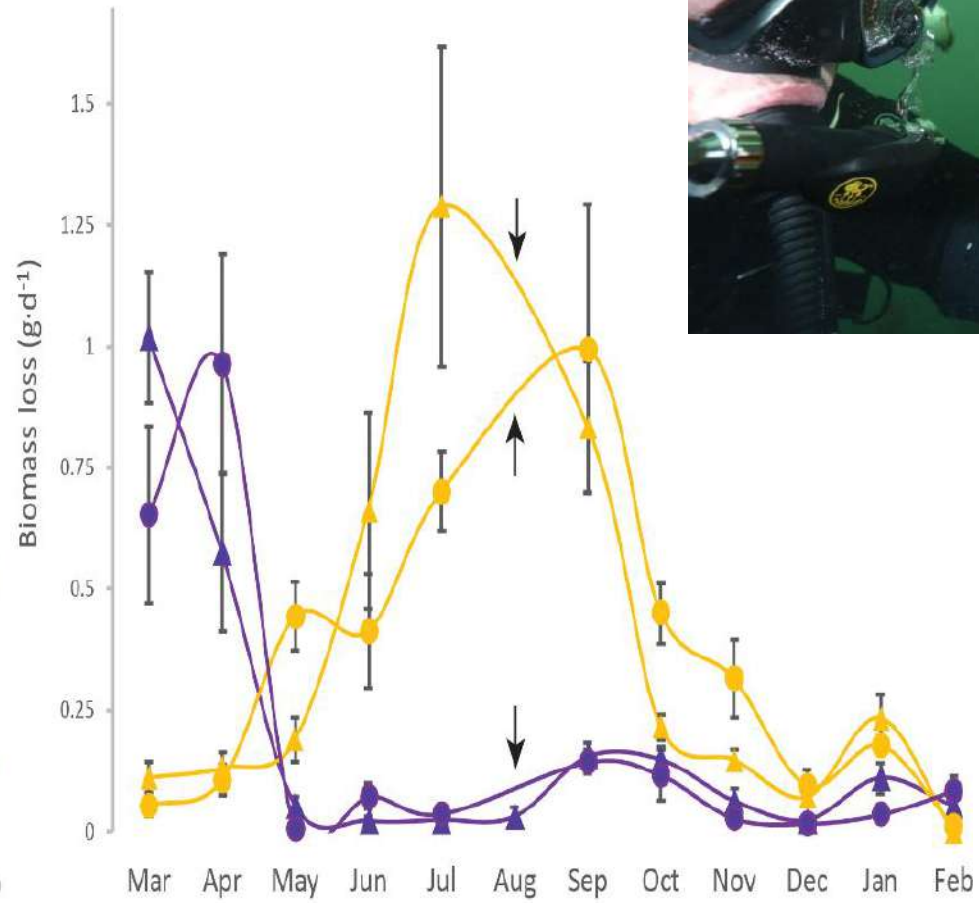
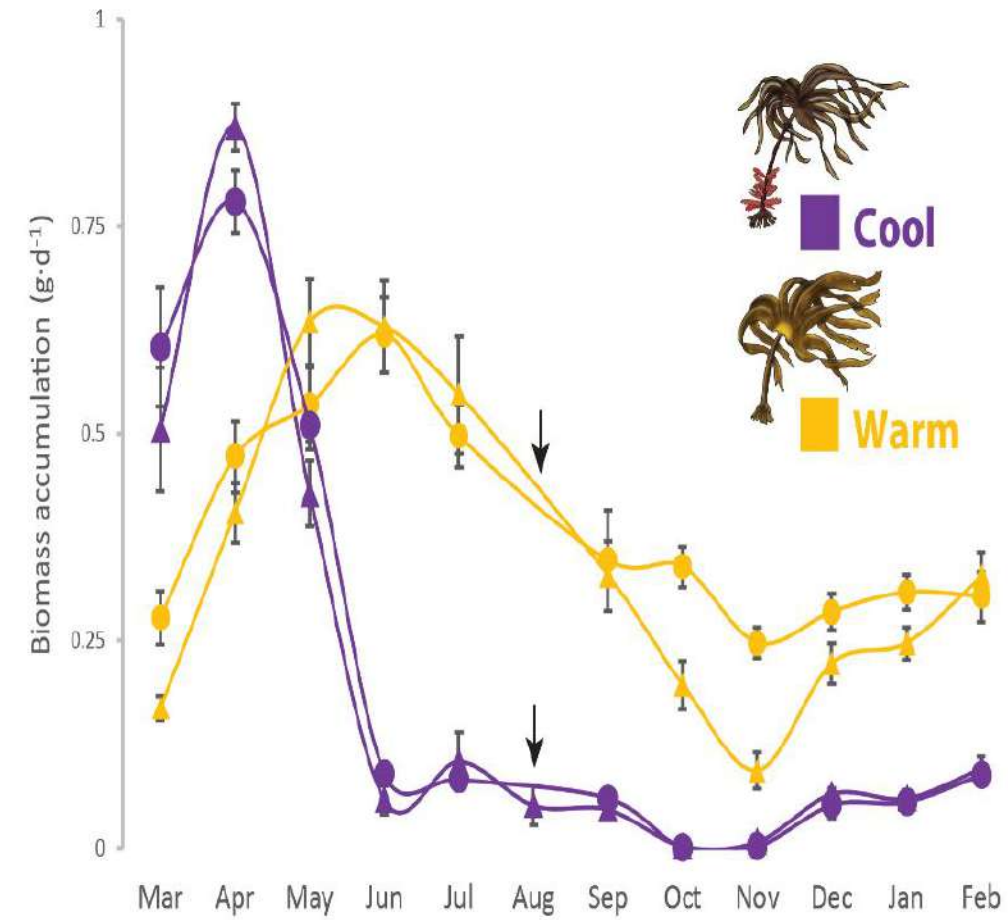
Post-expansion



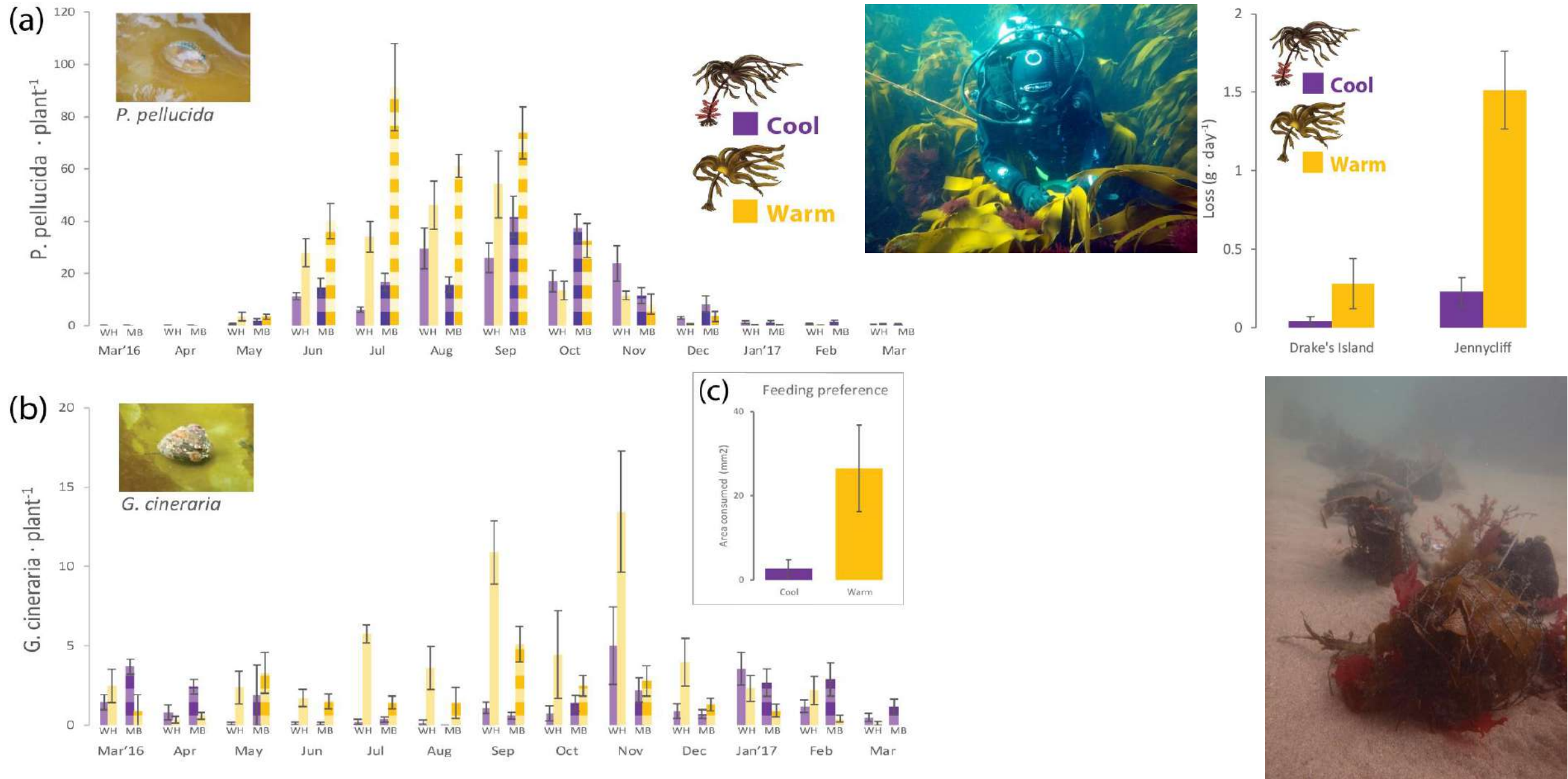
Pre-expansion



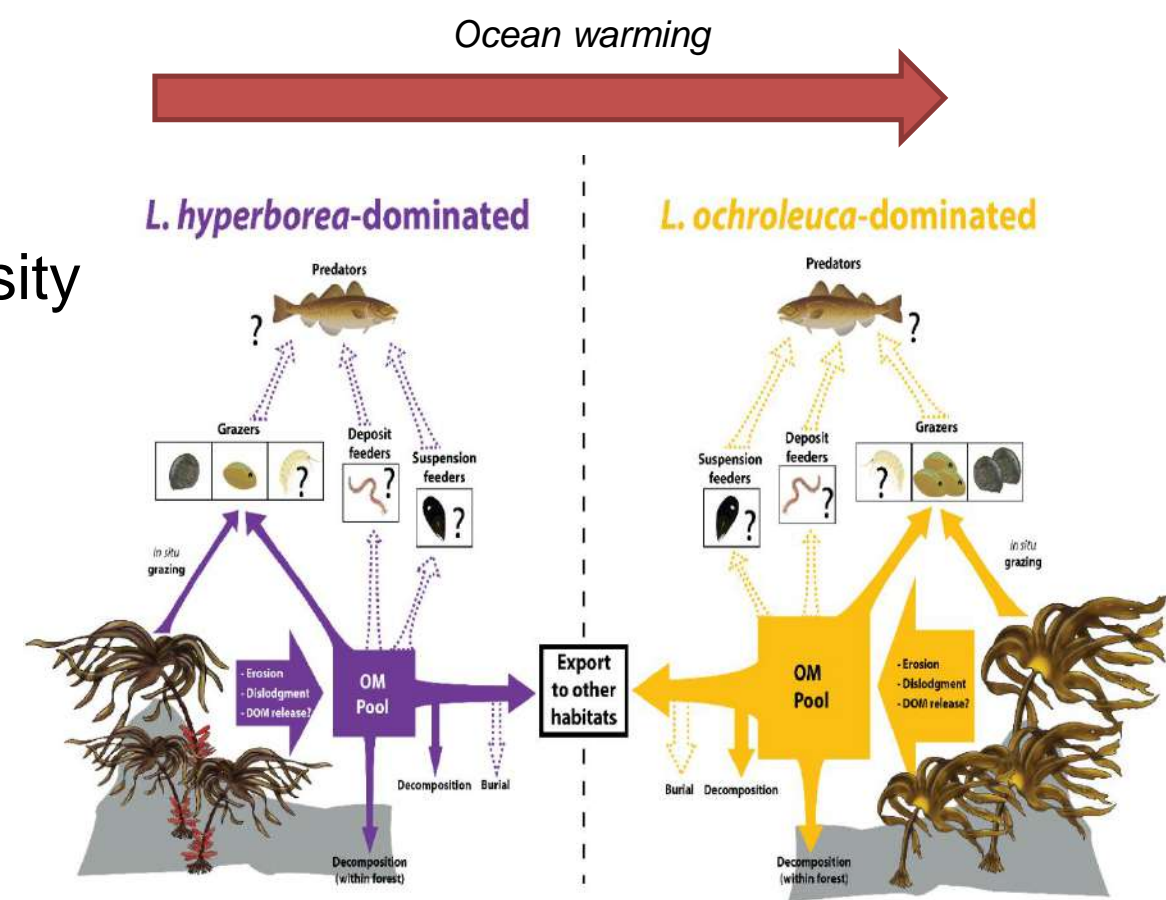
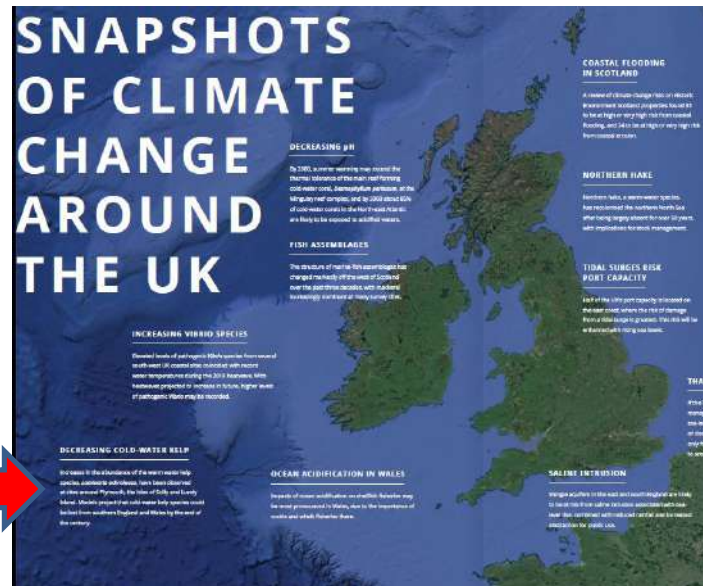
Warm/cold kelp species have different rates/timings of growth

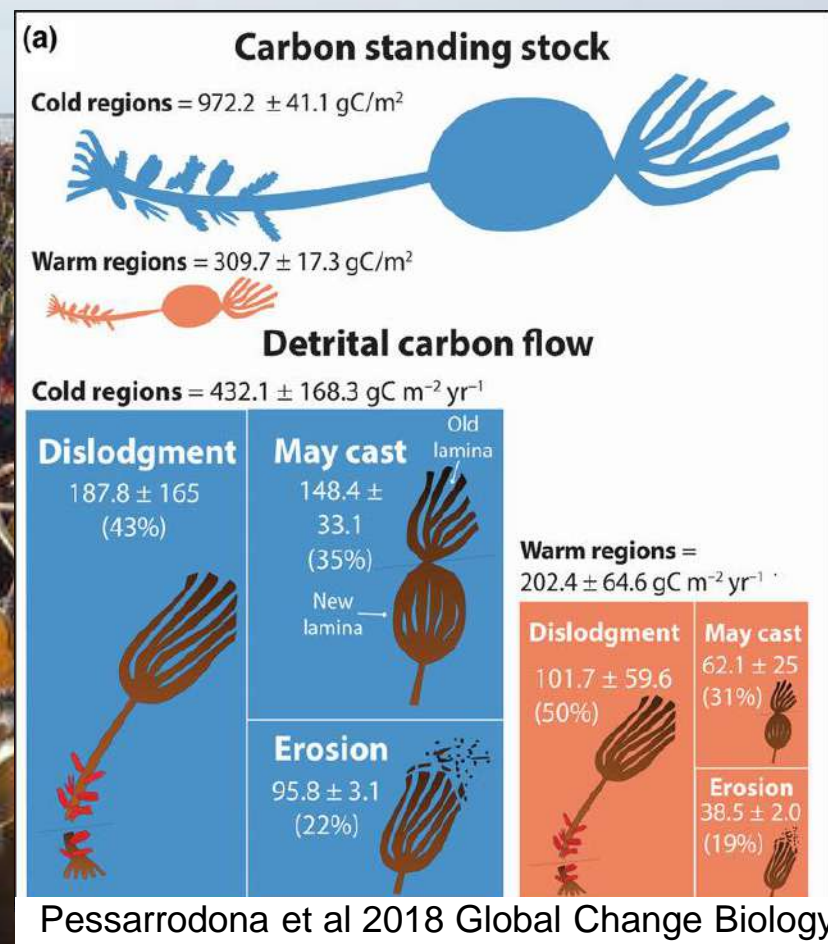
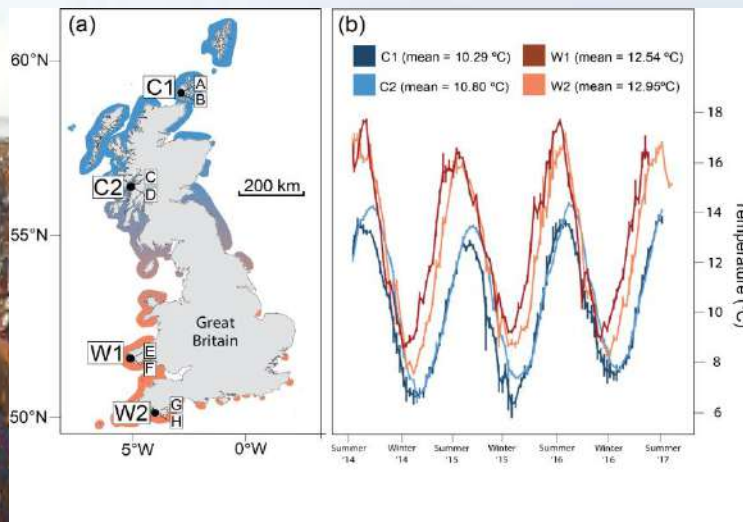


Warm/cold kelp species have are consumed and recycled differently



- Warming is driving subtle but important changes in UK kelp forest structure
- A warm-adapted species supports less diversity and exhibits different rates and timings of production
- Wider implications are poorly understood
- Useful case study of climate change impacts





- Kelps in UK waters store >5 Tg C
- Kelps fix and release >3 Tg C per year
- Rate of C transfer higher than other vegetated systems
- Greatest in cold, clear waters

Kelp is on the way....



News
Britain's 'underwater key to beating climate change' says David Attenborough



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Kelp dredging stories spar in Lochaber



THE SCOTSMAN
SCOTLAND'S NATIONAL NEWSPAPER

Seaweed farm to begin production off Argyll



es to SeaGrown



The Guardian
UK edition

criticised by S

m beds would



▲ Underwater sealife on the Isle of Barra, Scotland. 'Kelp habitats are vital ecosystems that absorb the power of waves along stormy coasts, lock up millions of tonnes of carbon every year and provide shelter for hundreds of species,' said Calum Duncan of the Marine Conservation Society. Photograph: Will Rose/Greenpeace

A proposal to mechanically dredge kelp forests off the coast of Scotland has led to an outcry from conservationists, who say it would destroy local ecosystems.

Recent increased attention on kelp due to:

- kelp-derived products: harvesting versus farming?
- Blue Carbon ecosystem services
- Habitat restoration



Historical lack of research on UK kelp forests has led to significant knowledge gaps.

Can kelp harvesting be sustainable? How long does it take for impacted populations and ecosystems to recover? Is it ethical/worthwhile?

Can kelp farming be commercially viable? How do we overcome the many technical challenges? What is environmental impact/benefit of farming

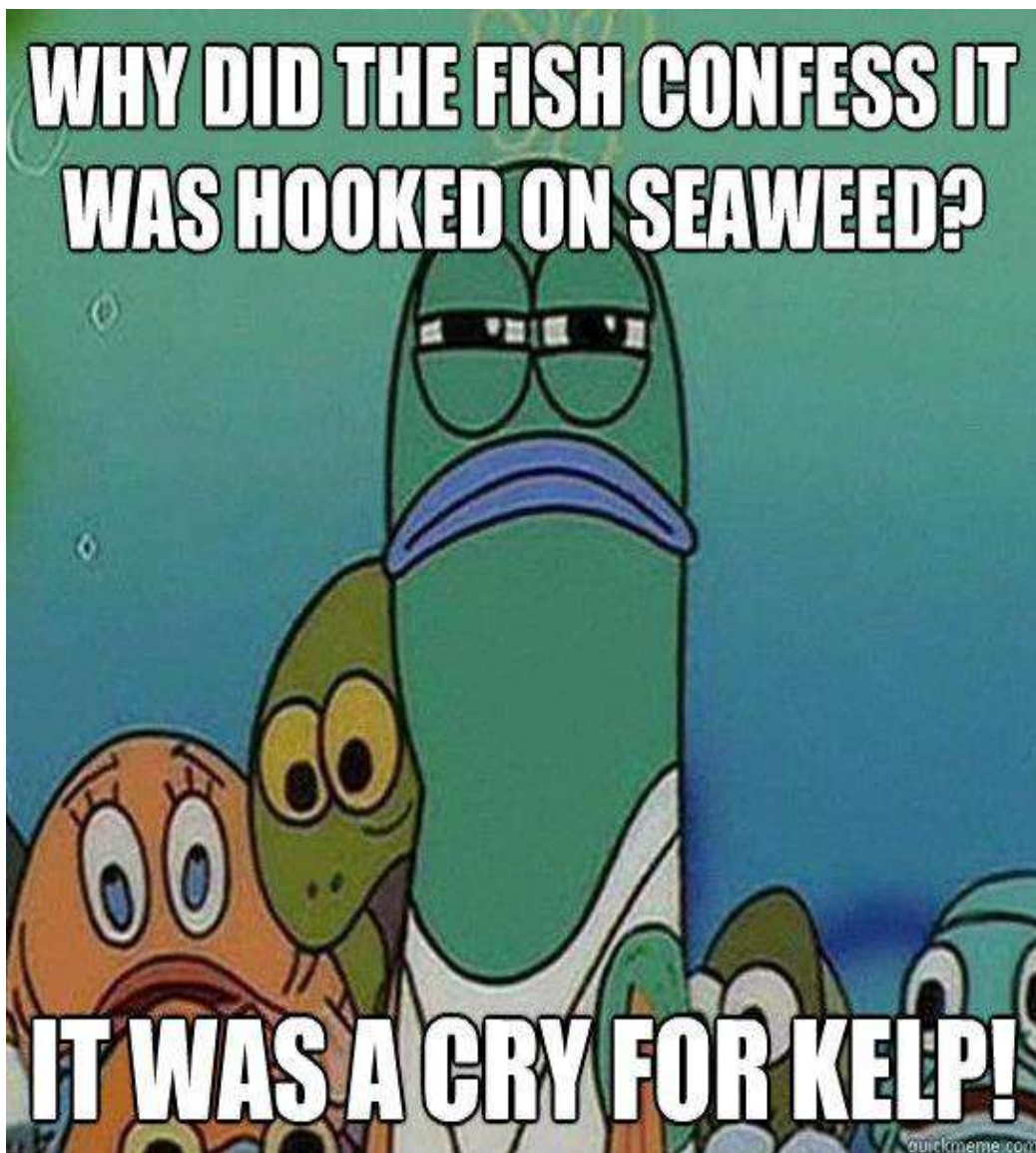
How long does kelp-derived carbon remain in the marine environment, is it an important Blue Carbon donor and does it significantly contribute to natural C sequestration

Is kelp habitat restoration possible and what are the benefits?



Take home messages

- UK kelp forests are extensive, diverse, highly productive and provide multiple ecosystem services and socioeconomic benefits
- **UK kelp forests are structured by various abiotic and biotic factors; changes in the marine environment are driving shifts in structure and function**
- **Increasing interest in exploitation, cultivation, restoration and protection; major knowledge gaps hinder management and conservation efforts**



Thanks to.....

Pippa Moore, Albert Pessarrodona, Harry Teagle, Graham Epstein, Thomas Vance, Steve Hawkins, Michael Burrows, Martin Sayer, Nathan King, Ally Evans, Helen Jenkins, Anna Yunnice, Cat Wilding, Richard Shucksmith, NERC National Facility for Scientific Diving, SAMS, Herriot Watt, Plymouth University, Southampton University, NERC, Marie Curie Actions. **ALL PARTICIPANTS OF TEAM KELP (UK DIVISION) FIELDWORK TOURS**

