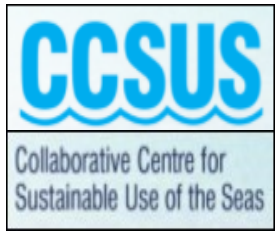
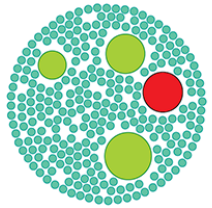
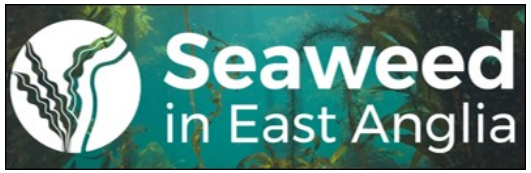
Regeneration: Aquaculture
(with mention of seabed regeneration)

Gill Malin
University of East Anglia



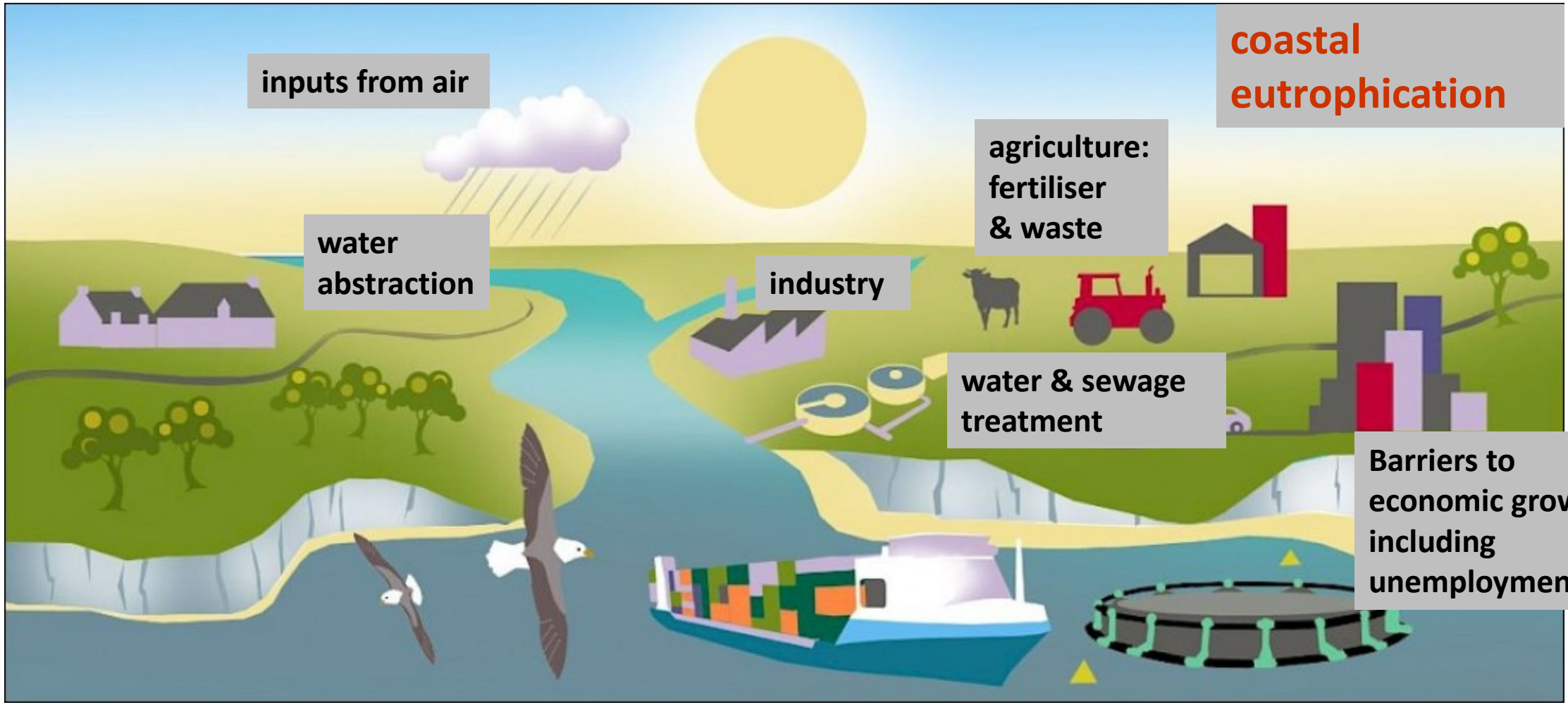


British Phycological Society
Understanding and using algae



Marine Science and Technology Sector Council and East of England Energy Group:
"The Next Generation for Energy in the East of England"
11/05/2023 10:00 am - 4:00 pm Norwich City Football Club

Regeneration of coastal regions



www.ospar.org/work-areas/hasec/eutrophication - annotation added

Regenerate / expand aquaculture

Population growth and global food and nutrition security

"Aquaculture is currently the fastest-growing food production sector globally and a sustainable option for attaining food security"

Azra et al (2021) Contributions of Shellfish Aquaculture to Global Food Security: Assessing Its Characteristics From a Future Food Perspective. Front. Mar. Sci. 8:654897. doi: 10.3389/fmars.2021.654897

How to save the world with seaweed. New Scientist 19/4/2023

As Vincent Doumeizel (senior adviser on oceans to the UN Global Compact) reveals in his book *The Seaweed Revolution*, the potential of seaweed, or marine algae, to transform our world is huge. If we could grow it sustainably, he writes, "seaweed could feed people, replace plastic, decarbonize the economy, cool the atmosphere, clean up the oceans".

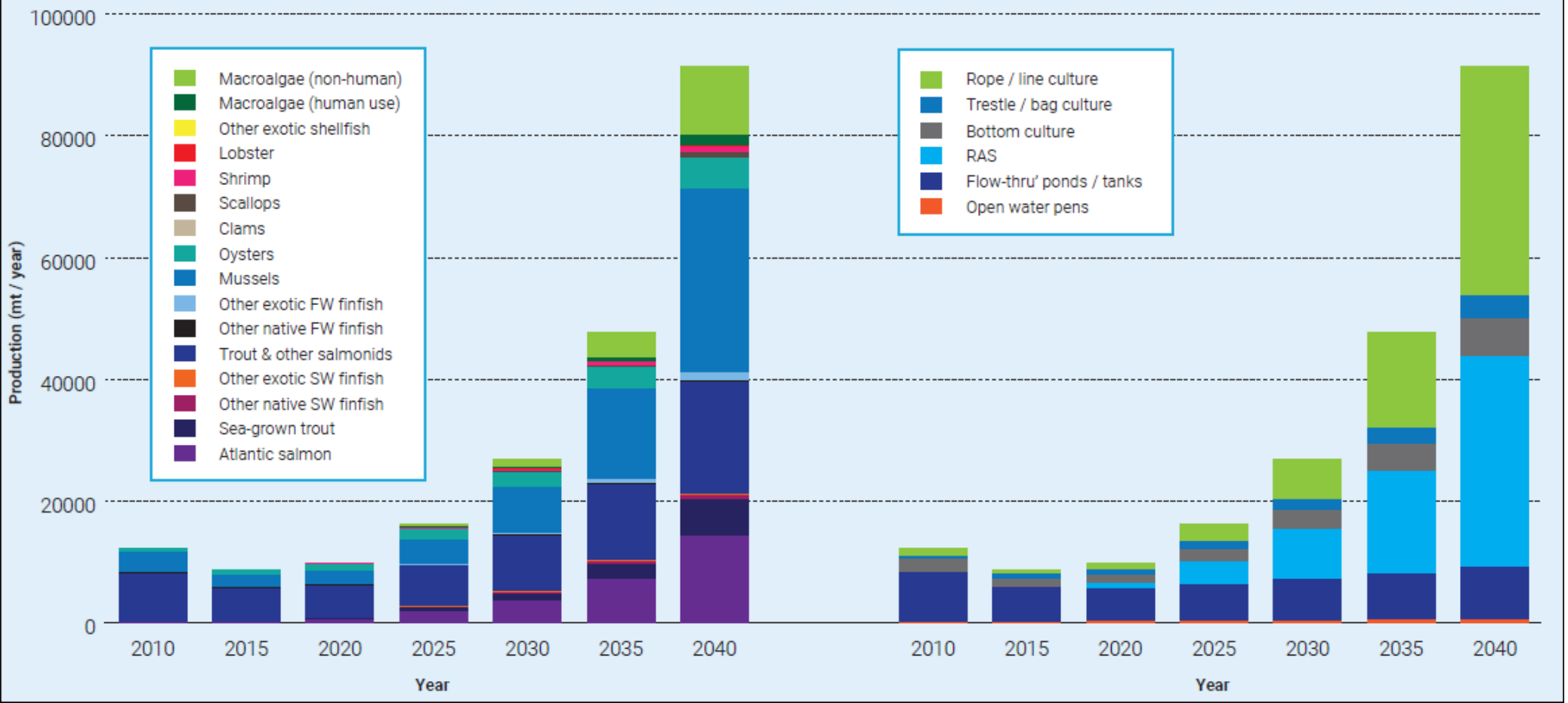
https://www.newscientist.com/article/2369210-the-seaweed-revolution-review-how-to-save-the-world-with-seaweed/

Growth aspirations for English Aquaculture by 2040

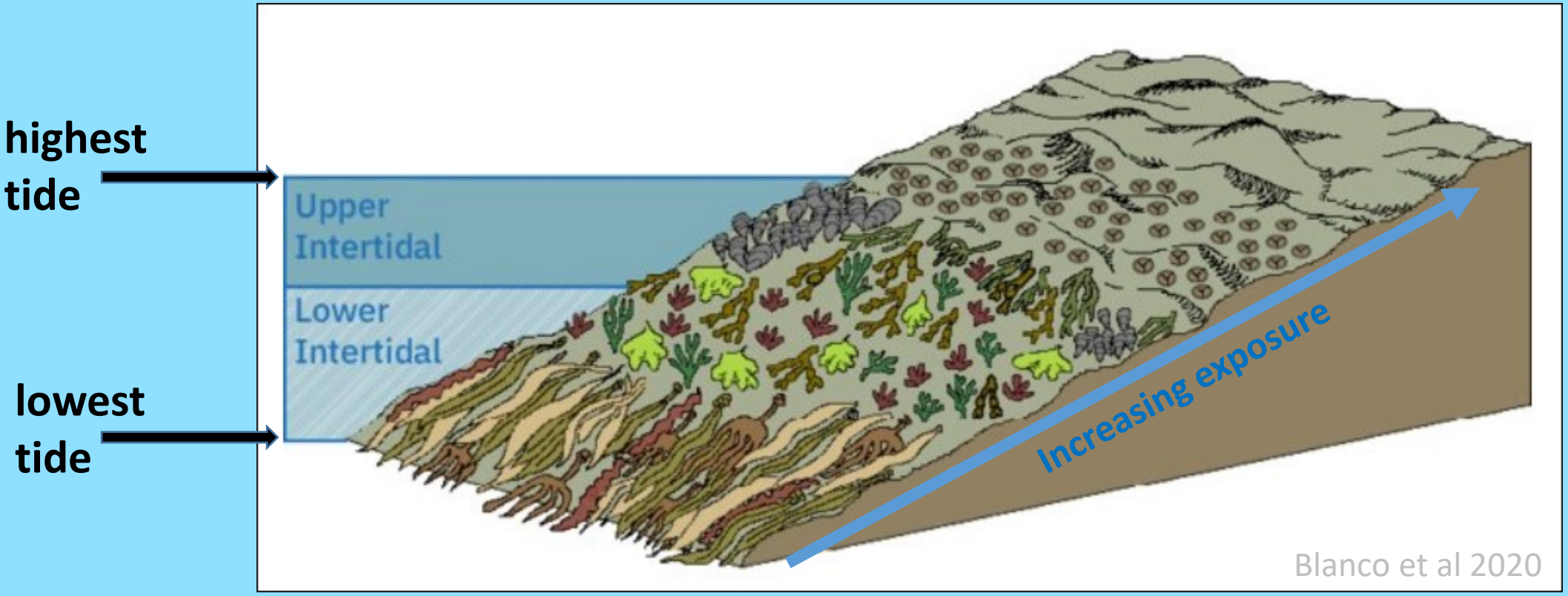
The Strategy includes evidence-based growth aspirations for the next 20 years, developed in consultation with the SF2040 Aquaculture Leadership Group (ALG). They are realistic given the prevailing difficulties and uncertainties, however, if the delivery plan is fully implemented, there is every reason to believe they can be surpassed.

By species

By system



Huntington & Cappell 2020 English Aquaculture Strategy Final Report. Summary



Seaweed zonation relative to tidal zones on rocky shores

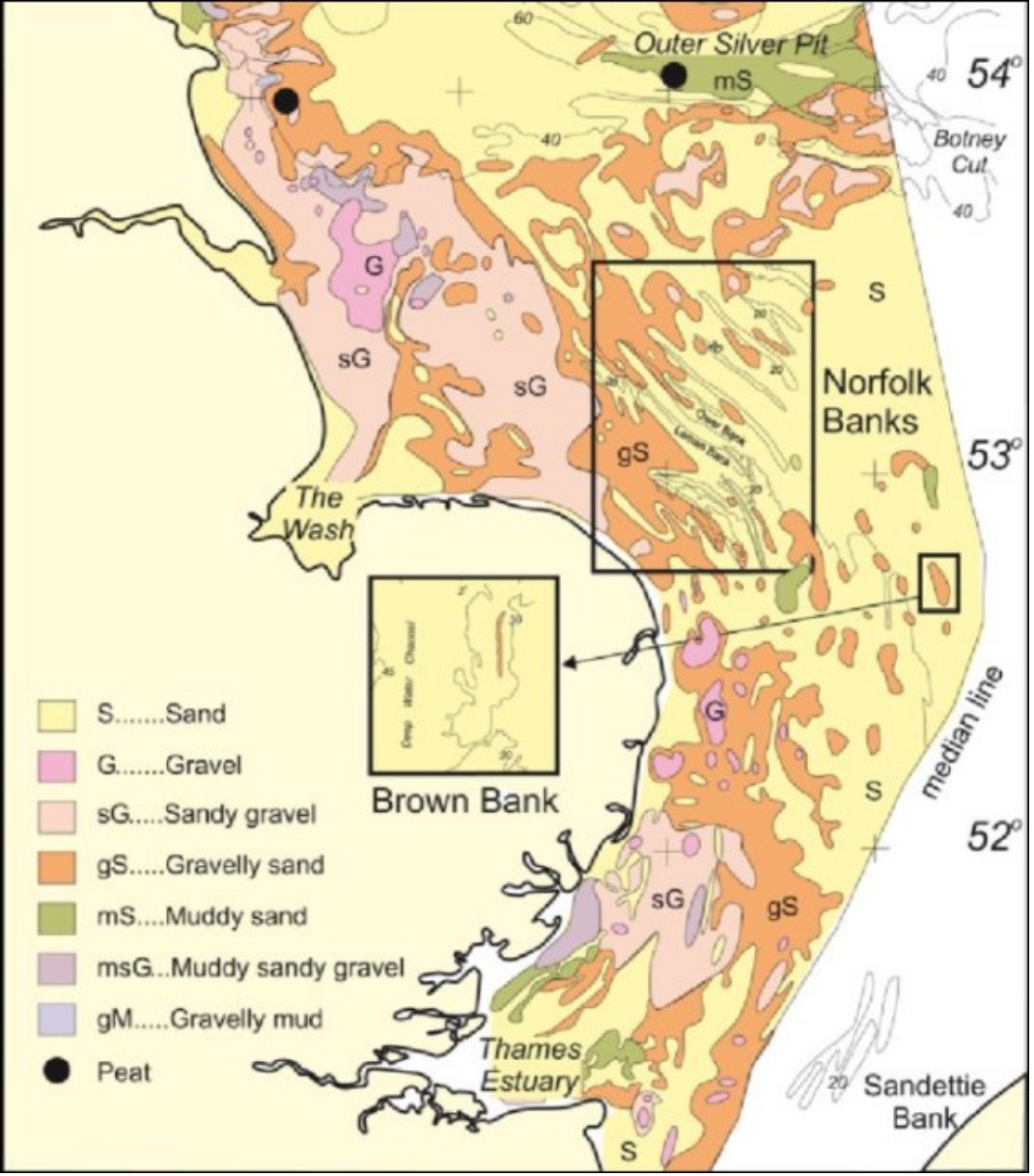


Figure 1 Seabed sediment map for southern North Sea.

Ward and Larcombe 2008 Environmental Archaeology 13(1):59-83

10.1179/174963108x279229

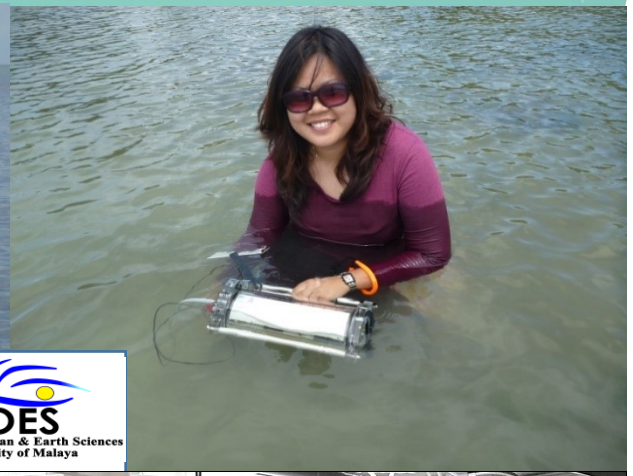
Hard Substrates for Attachment

Seaweed on Groyne.
Wikimedia Commons,
by Christine Matthews

West Runton Shore
Trip Adviser Seaview Beach Cafe
by 200PTC

Malaysia

Cultivation on ropes and in outdoor and indoor tanks



COAS Centre for Ocean and Atmospheric Sciences

IOES Institute of Ocean & Earth Sciences University of Malaya

USA

Wales

Europe and the Americas

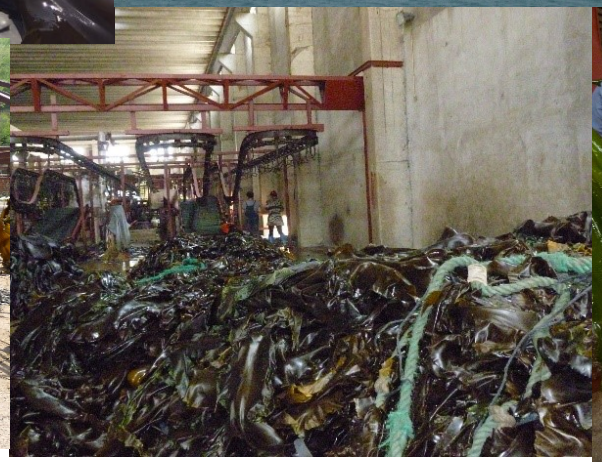
Tanzania Africa

gcrf global Seaweed

Industrial Scale Sugar Kelp Cultivation in China

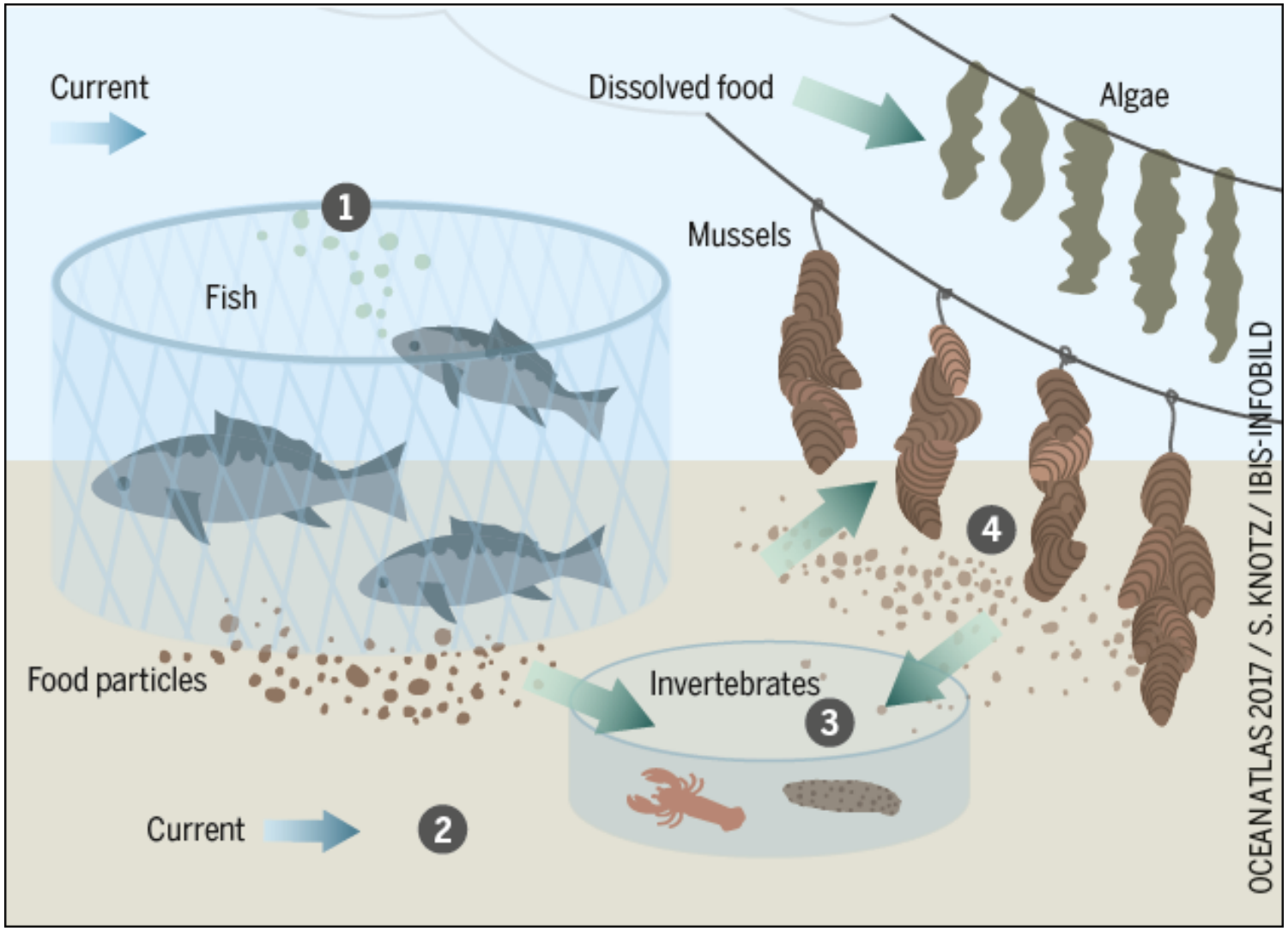





COAS
Centre for Ocean and Atmospheric Sciences

Aquaculture Co-location



Integrated multi-trophic aquaculture (IMTA)

Waste from fish and shellfish production becomes food or fertiliser for production of other species.

Target species should be local

Brown
(~2000 species)
Phaeophyceae

Saccharina latissima
Sugar kelp or kombu

seaweedsolutions.com

Alaria esculenta
Ribbon kelp

Dankworth et al
2020 J.Phycol. 56(5)

Laminaria digitata
Oar weed

Red (>7500 species)
Porphyra
Rhodophyceae
Laver or nori

www.seaweed.ie

Green
(~1500 species)
Ulva lactuca
Chlorophyceae
Sea lettuce

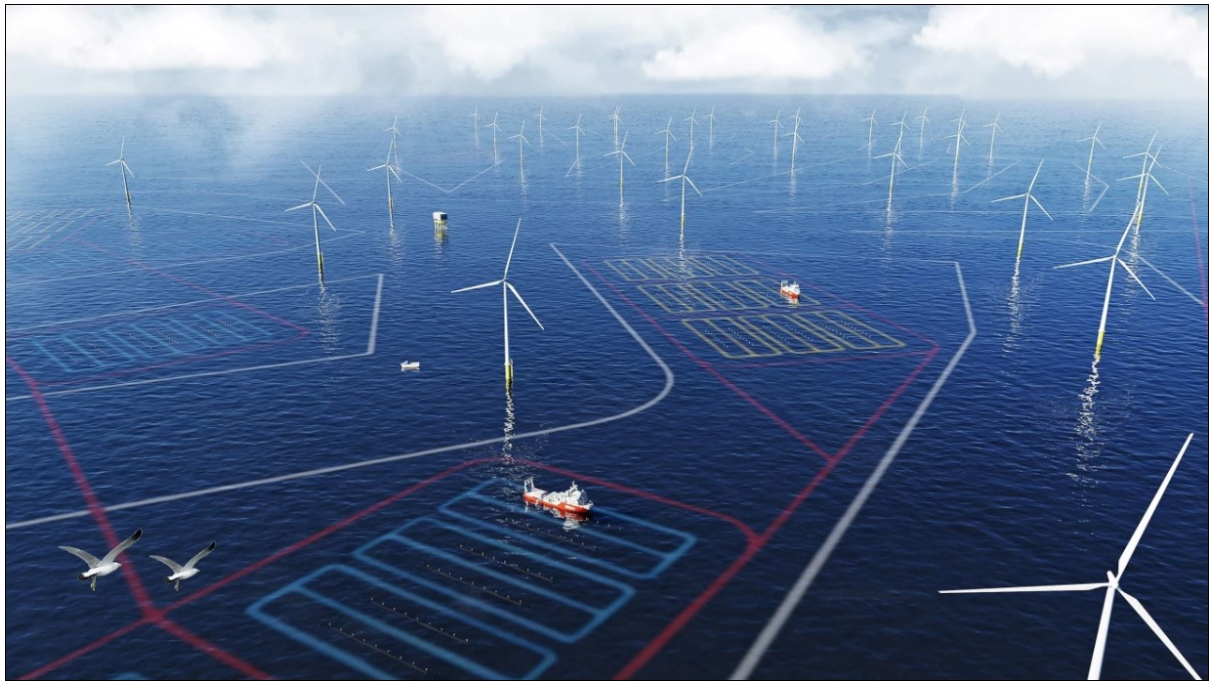
www.algaebase.org

Mussels
Oysters

www.intermas.com

Co-location with wind turbines

The world's first commercial-scale seaweed farm located between offshore wind turbines



https://www.aboutamazon.eu/news/sustainability/introducing-the-worlds-first-commercial-scale-seaweed-farm-located-between-offshore-wind-turbines

Amazon funding of €1.5 million

Consortium from seaweed industry and researchers. Led by North Sea Farmers

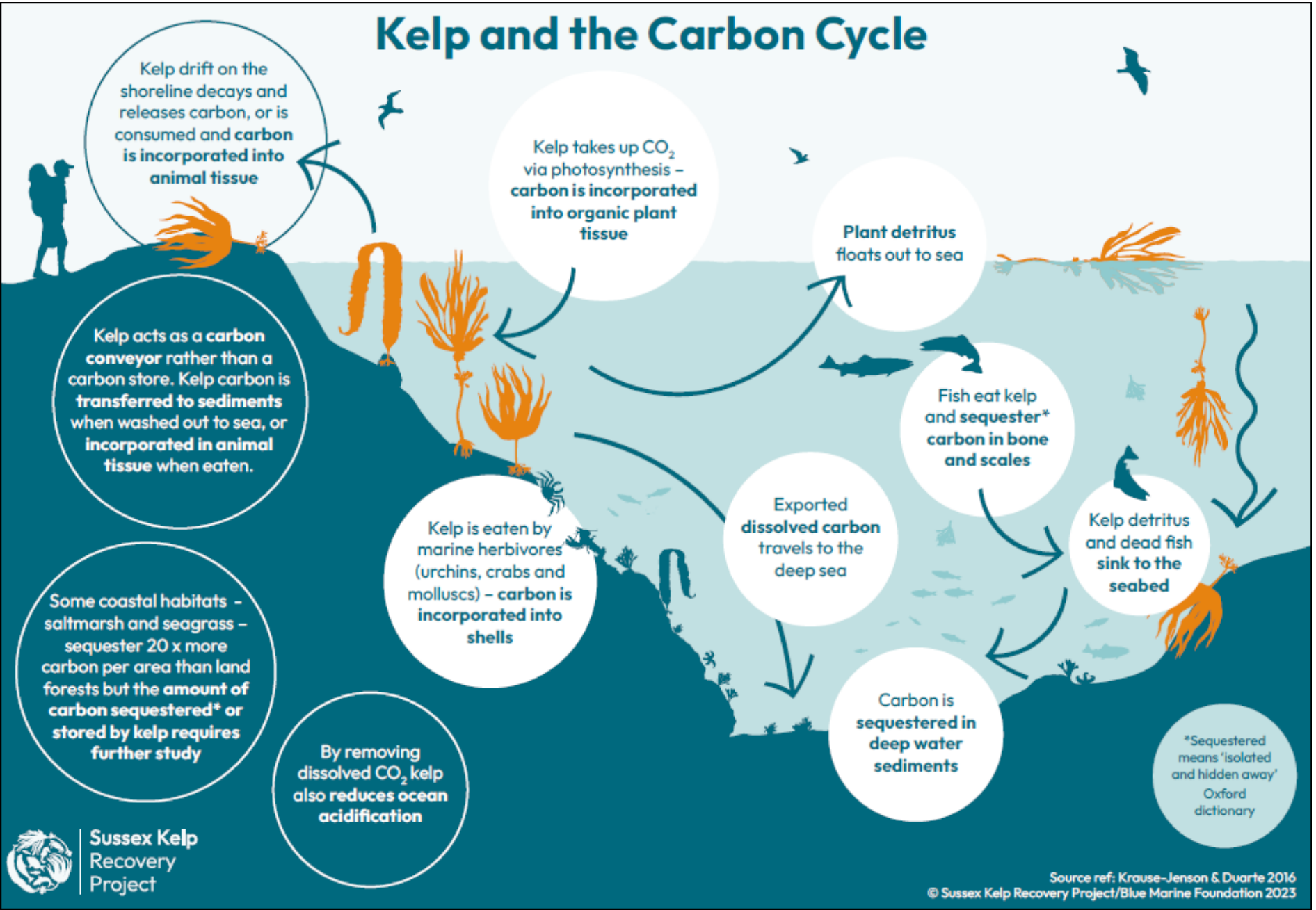
'North Sea Farm 1' located in 'untapped' space within a wind farm off the NL coast. Operational by end of 2023.

To test and improve methods of seaweed farming – a blueprint for seaweed farming across the world.

Research the potential of seaweed to sequester carbon - Hot debate on this especially re carbon credits!

Regeneration ~ Rewilding

https://sussexwildlifetrust.org.uk/helpourkelp



Ban on bottom trawling

Seaweeds regenerate on rocky sea bed

Photosynthesise using CO_2 and other nutrients (eutrophication) and incorporate them into biomass.

Detrital food web – on shore and offshore

Food for herbivores like crabs and molluscs

Shelter for juvenile herbivores and fish

Regeneration of the seabed with aquaculture?

Regeneration implies change to an earlier state – unlikely that there were large natural seaweed populations in the past but oysters were much more common (Willie Athill talk).

Seaweed farming in the SNS would introduce a large seaweed biomass where it was minimal/absent before.

Seaweeds have an associated attached flora and fauna, so biodiversity would alter and increase.

*Some seaweed will be lost during cultivation (dissolved and particulate). Fragments that reach the seabed become food for herbivores e.g. crabs and molluscs. The dissolved fraction is broken down by microbes – likely changes in speciation.

*Impacts will depend on the seabed substrate type. Changes in seabed bacterial and fungal speciation are likely.

*Physical impacts on seabed due to anchoring seaweed farming infrastructure e.g. concrete blocks or other anchor systems. Both can attract their own flora and fauna.

*Seaweed can reduce the light penetration to the seabed

Monitoring possible/necessary for most of these potential changes.

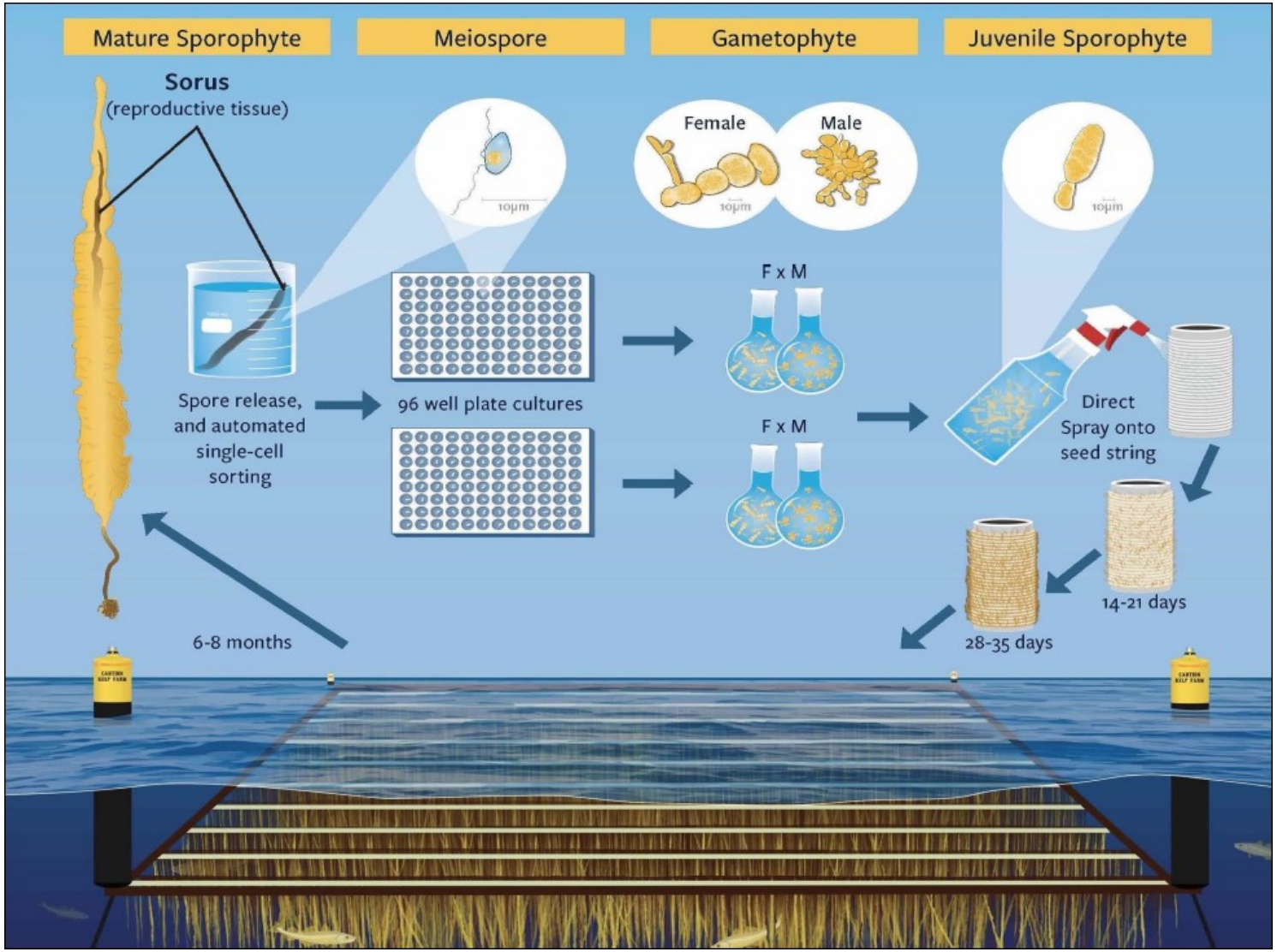
*https://sift.scot/wp-content/uploads/2021/03/SIFT-Seaweed-Guide.pdf

Social Regeneration: aquaculture value chains

For example:

Seaweed farming starts in a hatchery lab onshore – currently no local hatchery facilities in East Anglia.

Seaweed processing will require further close-by onshore facilties



The hatchery process or breeding pipeline
Fig 1 Huang et al bioRxiv preprint 2021

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https://research-portal.uea.ac.uk/en/persons/gill-malin