Oxford Cambridge and RSA

For issue on or after: Monday 24 April 2023

Level 3 Cambridge Technical in Applied Science

05874 Unit 23: Scientific research techniques

Pre-release material

To prepare candidates for the examination taken on Friday 16 June 2023 – Afternoon

Please write clearly in black ink.

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

Date of birth | D | D | M | M | Y | Y | Y | Y |

INSTRUCTIONS

- **Seven** days before the exam, hand in this booklet to your teacher. This booklet will be given back to you at the start of the exam.
- Do **not** take any other notes into the exam.
- At the end of the exam, hand in this booklet with your exam paper.

INFORMATION

- This document has **8** pages.

Source A

Trawl fishing ban off Sussex coast aims to restore seaweed forests.

Bylaw supported by David Attenborough protects large area of seabed to allow kelp to regrow

Adapted from: PA Media article – The Guardian – Monday 22 March 2021

https://www.theguardian.com/environment/2021/mar/22/trawl-fishing-ban-off-sussex-coast-aims-to-restore-seaweed-forests

The trawl fishing ban affects more than 100 square miles of seabed to enable kelp, which has huge environmental and marine diversity benefits, to grow back.

Damaging trawl fishing has been banned in more than 100 square miles of seabed off Sussex to help once vast kelp forests recover.

A new bylaw has been approved to prohibit trawling year round over large areas along the entire Sussex coast closest to the shore, to help habitats regenerate and improve fisheries, Sussex Inshore Fisheries and Conservation Authority (IFCA) said.

Wildlife groups hope that the move, which they said will protect 117 square miles (304 square kilometres) of coastal seabed, will help with “rewilding” the sea by allowing the underwater seaweed forests to regenerate.

It follows a campaign to protect kelp, supported by Sir David Attenborough, who has described the approval of the new bylaw as a “landmark decision” for the management of UK coastal waters.

Attenborough said: “Sussex’s remarkable kelp forests will now have a chance to regenerate and provide a home for hundreds of species, creating an oasis of life off the coast, enhancing fisheries, and sequestering carbon in our fight against climate change.”

The broadcaster and naturalist also described the new protection as a “vital win” in the fight against the nature and climate crises before the major international climate summit, COP 26, being hosted by the UK this year.

The long seaweeds that grow in forests in the coastal sea provide a vital habitat, feeding ground and nursery for seahorses, cuttlefish, lobster, sea bream and bass, increasing both wildlife and commercial stocks.

The kelp forests can also lock up huge amounts of carbon in the fight against climate change, improve water quality and reduce coastal erosion by absorbing the power of the waves.

As recently as the 1980s, extensive, dense kelp beds stretched 25 miles (40 km) along the West Sussex coast between Shoreham-by-Sea and Selsey Bill and at least 2.5 miles (4 km) out to sea.

But campaigners warned they have dwindled to almost nothing as a result of storm damage, trawling and the dumping of sediment by dredging boats.

Although a number of factors could be stopping the kelp from regrowing, the implementation of the near-shore trawling bylaw relieves that pressure on the area where the kelp grows, giving it a chance to recover, they said.

The bylaw has been approved by the Department for Environment, Food and Rural Affairs after it was first agreed by the Sussex IFCA in January 2020, following a public consultation.

The deputy chief fisheries and conservation officer for Sussex IFCA, Dr Sean Ashworth, said: “We are delighted that the local community and central government have recognised the critical importance of looking after Sussex marine wildlife and the local fisheries that critically depend upon it.”

Dr Ashworth also noted, “We look forward to seeing a regeneration of the lost kelp forests and an associated improvement of the inshore fishery.”

The move is being hailed as a milestone for the Help Our Kelp partnership, whose campaign was supported by Attenborough as well as MPs and members of the public.

Henri Brocklebank, chairman of the Help Our Kelp partnership and director of conservation at Sussex Wildlife Trust, said: “The support of Sussex communities and our elected representatives has been inspirational.”

“It shows us the passion that exists for restoring our marine ecosystems and recognising the value that they give to all of us, from food to the protection of our coastline.”

Charles Clover, executive director of the Blue Marine Foundation, said: “We welcome the signing of the Sussex bylaw, as it is a recognition by government that rewilding the sea is a way to protect marine biodiversity, invest in inshore fisheries and store carbon at a single stroke.”

“We believe the Sussex kelp forest will now show the benefits of removing damaging fishing gears from vast areas around the UK coastline and offshore.”

Scientists and volunteer divers have been collecting baseline data on the remaining small pockets of Sussex kelp, to enable measurement of the positive changes that could come out of the bylaw, experts said.

Further information.

1. Help Our Kelp film narrated by David Attenborough.
   https://www.youtube.com/watch?app=desktop&v=JpZ1zkkFsTE&feature=youtu.be
2. Help Our Kelp: Rewilding the Sussex Kelp Forest [24 Mar 2021]
   https://www.youtube.com/watch?v=zXnu4bCeVcQ
3. Restoring Sussex’s Magical Underwater Forests: Help Our Kelp’s One Year Anniversary
   https://brightonjournal.co.uk/restoring-sussexs-magical-underwater-forests-help-our-kelps-one-year-anniversary/

Source B

Remote sensing of kelp: novel methods for mapping and monitoring wild kelp resources.

The executive summary from a report for The Crown Estate, piloting novel methods for mapping and monitoring kelp resources in the northeast Atlantic.

Adapted from: an article written by Matthew Bennion, Macroalgal Research Group, Thursday 16 November 2017.

https://macroalgalresearchgroup.com/2017/11/16/remote-sensing-of-kelp-novel-methods-for-mapping-and-monitoring-wild-kelp-resources/

Executive summary

Kelp (*Laminariales*) are large, brown, habitat-forming macroalgal (seaweed) species. Their large biogenic structure and 'forest-like' nature provide nursery and feeding grounds for a rich diversity of associated flora and fauna, many of which are critical to ecosystem functioning and commercial fisheries.

Kelp, like many other macroalgal species worldwide are under threat: climate change, ocean acidification, anthropogenic pollution, overfishing and invasive species are just some of the pressures that have been reported to negatively impact these and other macroalgae.

Kelp are also under an old, but growing threat: wild harvesting. Harvesting of seaweeds from natural populations has been in practice for hundreds of years, particularly in the northeast Atlantic. Now, however, the rate at which kelp are harvested from the wild is increasing due to rising consumer demand for seaweed and seaweed derived products.

Currently, kelp resources are under-studied, largely due to the logistics of trying to access the kelp forest habitat in the shallow, rocky sublittoral fringe.

In the light of these shortcomings, there is a need for a standardised, rapid monitoring protocol to obtain baseline data on wild kelp resources, and ensure sustainable harvesting of said resources.

Remote sensing technologies in the form of satellite and aerial imagery, underwater imagery, LiDAR (Light detection and ranging) and sonar (sound navigation and ranging) have been applied to monitoring submerged aquatic flora, including kelp, with varied degrees of success.

The present study used a combination of multibeam sonar information and species distribution modelling to map kelp distribution and abundance along a 35 km^2 stretch of the Dorset coast. Using data obtained from United Kingdom Hydrographic Office [1] (collected as part of their regular surveys), ground-truth information (**Fig.1.1**) gained from field surveys and species distribution modelling, we pilot a novel monitoring and mapping methodology for kelp. In addition, we have identified several complications, which currently limit the expansion of the method outlined in this study, but offer remedies to these potential pitfalls.

We found the high resolution acoustic data very effective for mapping kelp distribution. A critical component of this acoustic data is a measure of the amount of acoustic energy being received by the sensor (also known as backscatter).

The importance of backscatter information for mapping and monitoring kelp resources has been highlighted as a crucial component of the predictive model. While choosing suitable study sites we found many areas were absent of backscatter information, despite being a typical component of multibeam sonar data. Additionally, while attempting to expand the coverage of the predictive model, difficulties were encountered as backscatter information from different vessels / echo-sounders could not be harmonised.

Fig. 1.1

Ground-truthing

All remotely sensed data require verification via ground-truthing (Humborstad et al., 2004; Ehrhold et al., 2006).

For our study, ground-truthing was carried out in order to gain training data (presence/absence of kelp) for the predictive model. In May and August 2017 field surveys were carried out at Lulworth Cove, Dorset and Kimmeridge Bay, Dorset respectively.

Kayaks and a GoProTM camera with underwater housing were used to capture footage of the seabed. The video camera was lowered from the kayak on a rope or pole until it reached the seabed.

Footage was captured at regular intervals along a predetermined transect line, designed to cover areas where kelp was known to be present and absent. A GPS was used to record the survey track-line. Every instance the camera was re-deployed from the kayak, it was time-stamped by recording the time and GPS co-ordinates.

Ground-truth data were graded into two classes: 1) presence of kelp, 2) absence of kelp. Presence was based on c. >30% coverage of kelp in the video footage frame.

An inability to combine backscatter data from different sources limits the transferability of the model. A standardised data collection protocol is therefore required to ensure harmonisation of backscatter information and transferability of the predictive model. The method piloted in this study exhibits a potential low-cost solution to the data deficit of kelp resources, offering a rapid assessment technique which could be used to inform sustainable management of wild stocks.

Citation

Bennion, M., Yesson, C., Brodie, J. (2017) Remote sensing of kelp: novel methods for mapping and monitoring wild kelp resources. A report for The Crown Estate. (PDF [2])

Further information.

[1] https://www.gov.uk/government/organisations/uk-hydrographic-office

[2] https://macroalgalresearchgroup.com/project-reports/

Research notes: