Cromer Shoal MCZ Adaptive Risk Management

Research & Development Task & Finish Group Project Summary

2021- 2022

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EASTERN INSHORE FISHERIES AND CONSERVATION AUTHORITY
6 NORTH LYNN BUSINESS VILLAGE
BERGEN WAY
KING'S LYNN
NORFOLK
PE30 2JG

TELEPHONE 01553 775321
EMAIL mail@eastern-ifca.gov.uk
WEBSITE http://www.eastern-ifca.gov.uk/

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1.0 Background

When the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ) was first introduced, the financial impact on the local crab and lobster fisheries was considered to be negligible because at that time it was thought potting fisheries did not cause significant lasting impacts to rocky habitats. The MCZ potting assessment conducted by Eastern-IFCA in 2018 also drew the conclusion that the impact of the potting fishery would not prevent the Conservation Objectives of the MCZ from being achieved. However, shortly after its completion, underwater images taken within the site were presented to the Authority and Natural England that showed clear evidence of damage caused by potting gear to the chalk features.

In 2019, Natural England, in collaboration with the University of Essex, conducted a dive survey to examine the physical interactions between crab and lobster potting and the subtidal chalk features within the MCZ. This “Phase 1” study identified and described several different types of damage the fishing gear (pots and ropes) had been seen to have caused to the chalk structures. This damage was also quantified in a limited capacity, but due to the scale of this project, there is still a lot of uncertainty about the overall quantity of damage. A report from this study was published in 2020 (Tibbitt *et al.,* 2020).

The findings of the Phase 1 study subsequently informed Natural England’s updated advice to Eastern IFCA on the impacts of potting on subtidal chalk. This advice concluded:

- Active potting can damage raised chalk structures (described as “rugged chalk”, “chalk reef” or “complex, outcropping chalk”). Additionally, it could damage flat chalk but is unlikely to have a significant impact on its form and function.
- Stored pots and lost gear in proximity to rugged chalk can result in damage to that feature. There is also concern about gear stored or lost elsewhere drifting with the currents onto the rugged chalk.

Natural England advised Eastern IFCA to adopt an Adaptive Risk Management (ARM) approach to the fishery. Eastern IFCA agreed this was the best approach to addressing the issues of developing appropriate management measures and monitoring their effects.

The ARM approach is overseen by a Project Board, responsible for directing two Task and Finish groups associated with the project and, ultimately, to determine what management may be required. The Task and Finish groups include a Research and Development Group (R&D TF), responsible for providing the relevant scientific evidence required to inform ARM and a Management Group, tasked with developing any required management measures. In addition to these, a Stakeholder Group facilitates two-way communication between the wider stakeholders, the Project Board, and the Task and Finish groups.

The ARM approach is collaborative, involving the regulator, conservation advisers and fishery stakeholders working closely together. For the R&D TF group, the focus is on collaboration between scientific advisors from Eastern-IFCA, Natural England, Cefas

and the University of Essex, with technical advice about fishing gear and practices being provided by representatives from the local fishing community. Additional scientific support from other organisations is also utilised to enrich the overall knowledge available. This includes liaison with other universities, Seafish and evidence from diver reports and seabed imagery provided by the local SeaSearch diving group.

This document is aimed at summarising the research activities being undertaken by the R&D Task and Finish group. For more information about the activities of the other groups, please see EIFCA website (https://www.eastern-ifca.gov.uk/).

2.0 Aims and Objectives of the R&D TF Group

The purpose of the R&D TF group is to provide the Project Board with the scientific evidence required to inform the ARM approach. The group's Aims and Objectives are:

- Aim 1 - To ensure that the information required to implement an effective Adaptive Risk Management approach of the impacts from potting fishing activity on the rock (chalk) seabed of the Cromer Shoal MCZ is available.
- Aim 2 - To identify whether impacts are within an acceptable range, in respect of the conservation objectives of the site.
- Aim 3 - To identify viable alternatives to existing fishing methods (practices and/or gear) through an Adaptive Risk Management Approach.

- Objective 1 - Determination of the locations of the chalk feature which is sensitive to damage from potting -
    a) Definition / Description of what character of "chalk" renders it susceptible to effects from potting.
    b) Determination of the range of sensitivities of chalk to different types (characteristics – equipment and methods) of potting.
    c) Determination of effects that changes in the physical structure of the chalk caused by potting have on the species and ecology.
    d) Determination of the location of Chalk of varying sensitivities.
- Objective 2 - Characterisation of potting fishing activity within Cromer MCZ – where, when, how (methods, equipment), how much. Where feasible, identify the drivers for particular approaches to potting.
- Objective 3 - Determination of the effect of potting on the sensitive chalk feature -
    a) Determination and quantification of effects from potting, and how this varies within the range of potting activities conducted in Cromer Shoal MCZ and the varying sensitivities of chalk.
    b) Determination of the "acceptable" level of impact to be consistent with the conservation objectives of the site[1].
- Objective 4 - Identification whether there are viable alternative ways (equipment, techniques, methods, locations) of potting that will have an effect within the "acceptable" range.

These aims and objectives have been summarised into five workstreams shown in the schematic in figure 1

[1] MPAs are defined geographical areas of the marine environment established and managed to achieve long-term nature conservation and sustainable use. – JNCC (https://jncc.gov.uk/our-work/about-marine-protected-areas/)

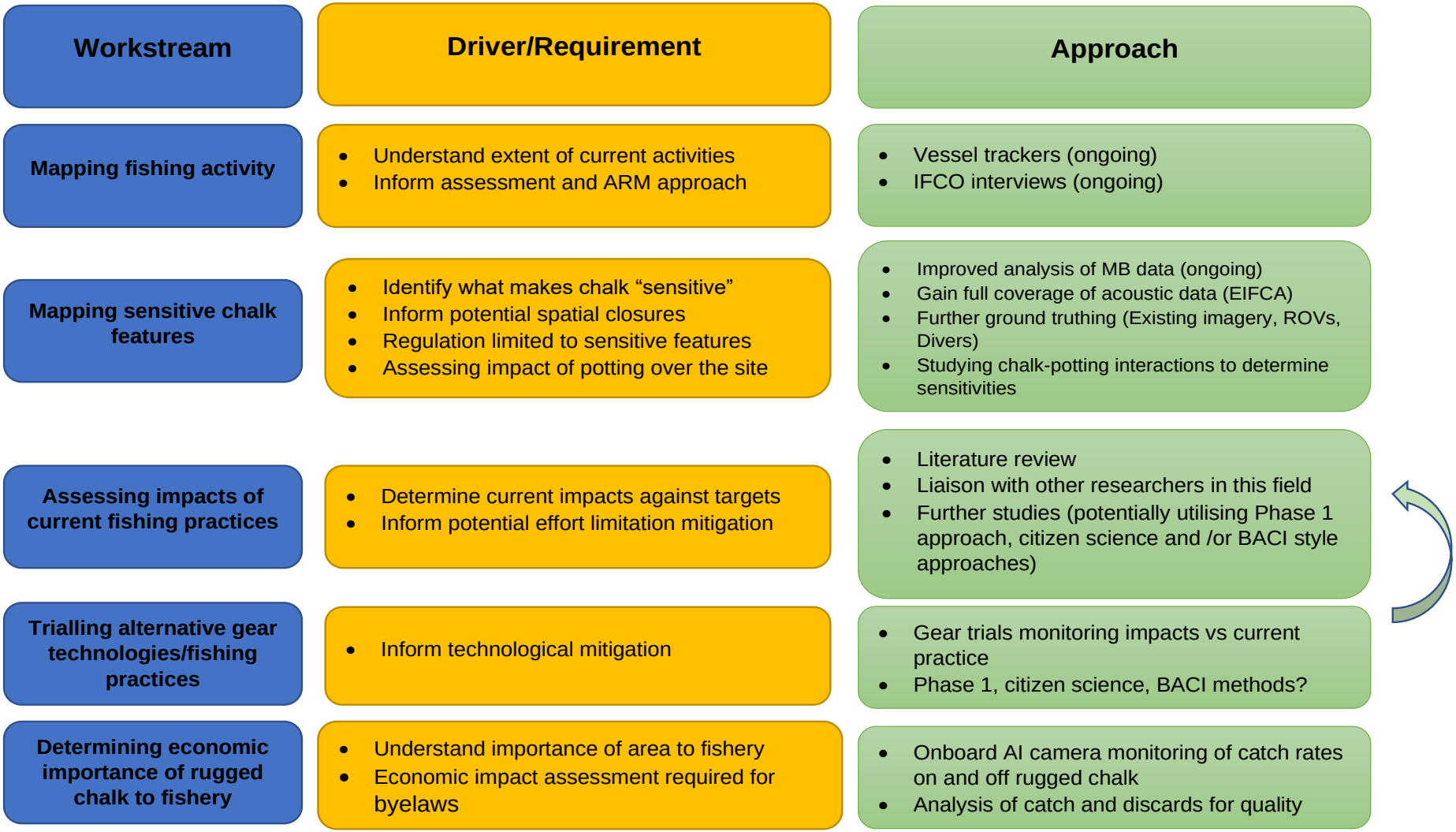

Figure 1 - Schematic summarising the five main workstreams for the R&D TF group to provide the evidence required to inform the ARM approach

3.0 Research Workstreams

3.1 Mapping Fishing Activity

Understanding and mapping potting effort is fundamental for informing the MCZ reassessment and for future Adaptive Risk Management. This information will enable EIFCA to refine the assessment of potential impacts the fishery may have on the MCZ features and in order to refine any future mitigation that might be required for specific features.

The local crab and lobster industry have historically recorded details of their fishing activities to the Marine Management Organisation (MMO) using Monthly Shellfish Activity Returns (MSAR) forms, which the MMO have recently replaced with an electronic data recording system. While these returns forms provide details of catches landed and the number of pots deployed, the spatial information required in them is only to the scale of ICES Statistical Sub-rectangles[2]. This level of spatial granularity is insufficient to accurately determine which activities are occurring within the MCZ, let alone specifically on the rugged chalk parts of it. The Authority, therefore, has developed a two-pronged approach for obtaining higher resolution spatial information about potting activities within the MCZ. The first has involved consulting with local fishermen, both with face-to-face interviews and a formal consultation questionnaire to ascertain details of where they target their potting activities and how many pots they deploy etc.

The second approach utilises vehicle trackers to track the spatial activities of a representative portion of the local fishing vessels that regularly fish with pots in the MCZ. One tracker was trialled on a single vessel over summer 2021, successfully demonstrating that the technology worked aboard boats at sea. This trial provided spatial information (pings) every 30 seconds, showing the vessel's movements. Subsequent analysis of these data successfully identified where shanks of pots had been deployed, their soak times and could also determine whether shanks had moved appreciably once deployed. Having successfully tested the feasibility of utilising these trackers for the project, 10 skippers volunteered to carry similar units on their own vessels for the duration of the project. Installed from late summer 2021, these trackers soon started providing a large amount of spatial data showing typical fishing practices within the MCZ. Ongoing monitoring will provide essential information on the spatial and temporal extents of the fishery, the amount of gear being deployed, soak times and also seasonal patterns. Eastern IFCA will work with fishery stakeholders to determine the representativeness of the tracked vessels compared to the wider fleet.

The quantity of data provided by the trackers is time-consuming to process. Eastern-IFCA, therefore, are currently liaising with researchers from St Andrews University who have been using similar technology to monitor the activities of their local potting fishery and have developed automated methods of analysing their data. Utilising similar automated methods will not only enable faster analysis, but can be used to more accurately recognise the fishing trends associated with individual vessels.

[2] For details about ICES Statistical rectangles, see https://www.ices.dk/data/maps/Pages/ICES-statistical-rectangles.aspx

3.2 Mapping Sensitive Chalk Features

The MCZ supports a variety of seabed features including shallow and deeper rocky seabed, subtidal chalk, coarse, mixed and sandy sediments, and peat and clay exposures. The subtidal chalk feature includes flat “pavement” bedrock, pebbles, cobbles and boulders, gullies and more prominent raised “rugged” structures. The Phase I study identified that some of these features are more susceptible to damage from fishing gear than others, with three chalk bed sites showing numerous occurrences of low, medium and severe damage, in comparison to one chalk/ flint cobble plain site where no damage was observed during the study. As the different types of chalk feature present within the site are likely to impacted differently by the various components of the fishing gear used, effective management will require understanding the sensitivities of the different features to the gear and knowing where these features are located. Although the rugged chalk features are believed to be more vulnerable to severe impacts from the gear than the abrasion caused to the flatter bedrock features, the cumulative abrasive impacts to the flatter features will also need to be considered.

Previous surveys conducted within the MCZ by various organisations have been collated to create a baseline chart of the rugged chalk features. These include three multibeam surveys that provide bathymetric information for approximately 70% of the inshore region of the MCZ where the rugged chalk is situated. It is planned to improve this chart with further work including:

a. In a project funded by Natural England, in 2021 Cefas reanalysed the raw data from one of the multibeam surveys using a higher resolution for the output than the existing product, thus providing a clearer definition of the features. This reanalysis also determined how rugose the seabed is, by examining the deepest and shallowest points of seabed within neighbouring 0.25m x 0.25 m cells. This analysis of rugosity will identify areas of rugged seabed from those of smooth or gently sloping / rolling seabed. Natural England are currently in discussion with Cefas to conduct similar reanalysis of the data from the remaining two multibeam surveys.
b. In addition to the reanalysis of the existing multibeam data to improve its resolution, Natural England also plan to commission work to analyse a time series of multibeam data from the site to gain a better understanding of site dynamics.
c. Conducting further broadscale acoustic surveys to fill the gaps in the areas of rugged chalk not currently covered by the three multibeam surveys. Eastern-IFCA do not have multibeam survey equipment, so instead plan to find and map the seaward edge of the rugged chalk using a side scan sonar.
d. Conduct transects using a towed Remotely Operated Vehicle (ROV) to capture video footage of the seabed. These videos will be used to verify the existing acoustic data and also to fill gaps in the current survey record. ROV trials conducted in July 2021 using a BlueROV2 (figure 2), successfully captured clear seabed imagery while being towed, demonstrating towed transects can be used to inform our mapping using this approach. Between July and September 2021, Eastern-IFCA conducted 87 dives using the BlueROV2 that

captured seabed imagery within the MCZ. The primary focus of the mapping surveys has been to find and map the edge of the “rugged chalk”, collect video footage from areas not covered by the multibeam data and help to add additional ground truth information that can be used alongside the reanalysed multibeam rugosity data where the existing ground truth data is sparse. The video footage captured during these surveys is yet to be fully analysed, but initial observations taken during the surveys indicate in many cases areas predicted from the original base maps to be “rugged chalk” have been found to contain a mix of elevated rugged chalk bedrock features and areas of relatively flat seabed with scattered boulders or mounds of cobbles and boulders. While these latter areas are thought to be less susceptible to some of the more severe types of damage identified in the Phase 1 study, they do include elevated features in which abrasion could impact the form and function of the chalk and, therefore, have the potential to be significant.

e. The group held two short workshops in December 2021 aimed at refining our working definition of rugged chalk and the criteria that can be used to describe it when seen from video data, and to agree criteria that could be used to describe the types of damage typically caused by gear impacts to the chalk. It is hoped these criteria describing rugged chalk can be applied to determine the threshold to be used in the multibeam rugosity layer for mapping the rugged chalk features.
f. Natural England have funded a project enabling an external consultancy to analyse the 87 videos taken to date by the ROV. This analysis will utilise the criteria agreed in the two workshops to evaluate habitat type, provide a description of biological communities and record any instances of damage to chalk observed in the videos. Further detailed analysis of the instances of chalk damage are also planned by Eastern-IFCA during to assess which aspects of the gear are most impactful on the site’s conservation features.
g. Further ROV dives and video analysis are planned for 2022.

Figure 2 – Eastern IFCA’s BlueROV2

3.3 Assessing Impacts of Current Fishing Activities

A number of past, current and future planned projects will help us to assess the impacts that current potting activities have on the MCZ features.

- A formal assessment of the potting fishery within the MCZ is aimed to be submitted to Natural England early in 2022. A literature review was undertaken in 2021 to help inform the assessment. This looked at comparable scientific studies in which the impacts of potting on seabed features had been assessed. In most cases, however, these studies had been conducted on substrates that are more resilient to damage than the soft rugged chalk features at Cromer Shoal or focus purely on the biological communities. While the paucity of existing information about the impacts of potting on soft chalk features will, by necessity, require the conclusions of the assessment to be more precautionary, these can be updated as new evidence is gained through the ARM process.
- The "Phase I" study, reported in Tibbitt *et al,* 2020, identified and described a variety of types of damage that current potting gear was observed to have caused to some of the subtidal chalk features. This study used divers to look at impacts from gear in situ, so was able to identify and describe the types of damage that could be attributed to specific parts of the gear. The project also utilised 3D photogrammetry that could describe the features using 3D modelling techniques.
- The University of Essex have subsequently taken the analysis of the Phase 1 study further to determine whether chalk elevation can be used as a complexity metric. This study investigates the relationship between biodiversity, human impacts and the complexity of rocky reefs through 3D photogrammetry.
- In addition to using an ROV to map seabed features, Eastern-IFCA also conducted ROV surveys in 2021 to look for impacts the potting activities were having on the size features. While ideally the Phase I approach of using divers and their capability of capturing high-resolution imagery would have been used for this work, the cost of chartering commercial divers for the scale of project required was considered prohibitive. Instead, a BlueROV2 ROV was used to capture video footage of deployed potting gear, plus instances of any damage that the gear might have caused to the seabed features. The main disadvantage of using an ROV compared with using divers was the loss of control diving allows. During the Phase I study, divers were able to precisely follow the ground line of a shank of pots in a controlled manner, enabling video and photo evidence to be captured in high-resolution. The same level of control is much harder to achieve utilising an ROV, which is more susceptible to currents and the manoeuvring of the vessel deploying it. However, the relative ease at which an ROV can be mobilised and deployed compared to divers, offers compensation by providing more survey opportunities and more time filming the seabed. The larger number of samples that the ROV provides also increases the statistical robustness of this method.

  During the latter half of 2021, trials were conducted filming potting gear with the BlueROV2 to identify and practise the best method for deploying it. These trials included towing the ROV between gear marker buoys with the intention of crossing over ground ropes to locate and then follow the gear. Trials were also conducted free-diving the ROV near gear, rather than towing it. This approach provided more

freedom and manoeuvrability for the ROV than towing it allowed but proved more difficult to conduct from an unanchored vessel than towing the ROV. It was also limited to slack water periods whereas towing the ROV could take place at any state of the tide. There were advantages and disadvantages to both methods. While manoeuvring close to pots and ropes was much harder when towing the ROV, towing allowed more ground to be covered during a survey, making it more suitable for ground truth and mapping surveys. By contrast, the better manoeuvrability achieved when free-diving the ROV made this a better approach for studying gear and their potential impact on the chalk features. Future surveys planned for 2022 will also incorporate altimetry, laser scaling and the attachment of additional GoPro cameras to the ROV to capture more video data during each dive.

It should be noted that both towing and free-diving the ROV near potting gear carries a high risk of the ROV umbilical cable becoming entangled with ropes and gear, particularly as the videos have shown the ground ropes are usually floating about 1m above the seabed where they are easy to entangle if the ROV passes beneath them without spotting them. During the 87 ROV dives conducted in 2021, the ROV did become entangled with potting gear on several occasions but was able to be freed without damage to either the ROV or fishing gear. Because untangling gear generally requires lifting the gear to the surface along with the ROV, 20m of buoyant rope has been taped to the ROV end of the umbilical so weight can be lifted on that rather than on the umbilical.

- Subject to weather conditions and water clarity, Eastern-IFCA hope to conduct a small number of ROV surveys over the winter. These would be conducted in the same locations as some of the dives conducted in summer to determine whether there were natural seasonal changes to the biota.
- In addition to filming deployed gear with the BlueROV2, trials are also planned to deploy GoPro type video cameras within a pot to film any damage that might be caused by the pot when it is deployed. This approach has been used successfully in other fisheries. One trial using this approach was conducted in 2021, but on that occasion no usable data was gathered. Along a similar theme, Natural England have also been discussing “lobster cam” set ups with Cefas, with the potential to use these in 2022.

3.4 Trialling Alternative Gear Technologies and Fishing Practices

Imagery from local divers and the Phase 1 study had shown that both the pots and ropes used by the potting fishery cause damage to soft-chalk structures. There was insufficient evidence from these or the literature review, however, to determine whether these impacts were sufficient to prevent the site achieving its Conservation Objective targets. Through the ARM approach, mitigation measures will be trialled, the effects of that mitigation monitored and then potentially adapted depending on the results. During 2021, the R&D TF group considered ways in which gear and/or fishing practices could be modified to reduce potential impacts. These included ideas such as spatial closures around the sensitive features, seasonal closures, the elimination of ropes by utilising rope-less technologies, to ways of modifying existing gear to reduce impacts. Important considerations taken into account during these discussions were

the importance of the rugged chalk area to the fishery and that any gear modifications needed to be both financially viable to implement and not inadvertently lead to more damage being caused.

Although the ROV video footage from the 2021 surveys has not been closely examined at this stage to determine the overall impacts of the fishery, this process should not cause any required mitigation to be delayed. Evidence from the Phase 1 study and initial viewing of the ROV videos have highlighted that pot strikes and ground ropes sawing into soft chalk features are potentially among the most damaging impacts to the site's Conservation Objectives that need addressing. The R&D TF group, therefore, determined that two gear modifications should be trialled during 2022. These would be to incorporate soft-armouring on the pots to determine whether these reduced the strike and abrasive types of impacts caused by the pots, and adding light floats to the drop lines that connect the pot to the ground rope. While these will not interfere with hauling the gear, it is hoped they will increase the overall buoyancy of the ground ropes, enabling them to float above the raised chalk features that they can currently impact.

The precise method for studying the effects of these modifications is yet to be developed but it is felt that the approach used in the Phase 1 study of examining the gear in situ has definite merit. Once officers had familiarised themselves with operating the BlueROV2 in 2021, it proved capable of following shanks of pots with sufficient control to study any impacts caused by the gear.

3.5 Determining the Economic Importance of the Rugged Chalk Areas to the Fishery

In many instances where no-take zones are implemented, the improved habitat often provides long-term benefit to the fishery when "spill over" occurs around the edges, providing good fishing opportunities (Lenihan, 2021; Davies, 2015). The rugged chalk areas are important to the local fishermen, however, who report that catches are much better in the rugged areas than off them. Further, as the rugged features are close to shore, they are easier and safer for the small open boats to access. For these fishermen, there might not be alternative fishing grounds if they are displaced from the rugged chalk. The economic importance of the rugged chalk features to the local fishermen, therefore, needs to be better understood and tested. There are plans to conduct a bespoke study in 2022 to examine the value of the crabs and lobsters caught on and off the rugged chalk to the overall fishery. The use of onboard camera systems aboard fishing vessels to record catch rates have been developed elsewhere, so are being considered for this particular study, alongside physical sampling of the catch.

4.0 Timelines

At its conception in February 2021, there was a general consensus among the members of the R&D TF group that the research work required to properly inform the ARM approach would take a minimum of 2 years, but that some elements of the work might need ongoing monitoring beyond that period. The general timeline the project will follow is:

2021

- Conduct a reassessment of the MCZ, using existing scientific literature to assess the impacts of the fishery within the site.
- Develop the Aims and Objectives required of the R&D TF group to inform the ARM approach, and to then determine and agree what research work would be required to provide the necessary information
- Acquire and distribute 10 vehicle trackers among volunteer fishermen to record detailed seasonal fishing patterns
- Commission the reanalysis of the current multibeam survey data to improve the resolution of the output and to include analyses of rugosity. This will provide clearer detail of rugged chalk extent and identify where the more rugose features are located.
- Acquire a BlueROV2 ROV and test its capabilities and functionality within the site
- Conduct ROV surveys within the MCZ to:
    - Map the extent of the rugged chalk features, using the existing acoustic data as a baseline to inform survey transect lines and to provide new footage in areas not covered by the multibeam data.
    - Film potting gear on the seabed to study the interaction of pots, anchors and ropes on the various seabed features.
    - Weather and visibility permitting, conduct some winter surveys to identify any ecological changes that may occur during winter

2022

- Examine video data from 2021 surveys to assess what components of the potting gear may be posing a risk to the site's Conservation Objectives.
- Where specific risks are identified, work with the Project Board and Management T&F group to develop appropriate mitigation measures.
- Develop a survey method to be employed during 2022 to study the effectiveness of selected gear modifications.
- Continue conducting ROV surveys and subsequent video analysis to:
    - Improve further our understanding of the extent of the rugged chalk features by providing footage in areas outside of the multibeam survey coverage and areas without previous ground truth data.
    - Improve our understanding of what impacts various components of the gear have on chalk features
- Using methods developed by the R&D TF group, study the impacts of mitigation where technical measures have been introduced to reduce risk of gear impacts on chalk features.
- Continue gathering tracker data from fishermen and to potentially increase its coverage to include more fishermen. Explore the use of algorithms to efficiently analyse the tracker data.
- Commission reanalysis of the remaining multibeam data from two further existing surveys using methods used in 2021, to provide similar high-resolution outputs and rugosity information.
- Use information gained from the ROV video footage to inform further analysis of the MB rugosity data, to identify where the most sensitive areas are situated.

- Commission chalk ecology study, looking at correlation between chalk features and associated ecology
- Conduct an economic assessment of the importance of the rugged chalk to the local fishery

5.0 Glossary

AI	Artificial intelligence
ARM	Adaptive Risk Management
BACI	Before-after-control-impact
CO	Conservation Objective
EIFCA	Eastern Inshore Fisheries and Conservation Authority
ICES	International Council for the Exploration of the Sea
IFCO	Inshore Fisheries and Conservation Officer
JNCC	Joint Nature Conservation Committee
MB	Multibeam
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSAR	Monthly Shellfish Activity Returns
R&D TF	Research and Development Task and Finish group
ROV	Remotely Operated Vehicle

6.0 References

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