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Fishermen's Environmental Monitoring Pilot

Exploring the role of fishermen in MPA and environmental monitoring

The evidence and data requirements for the designation and subsequent monitoring of MPAs place significant logistical and economic burden for official bodies. This report demonstrates how the fishing industry can play an integral role in marine monitoring and evidence collection using underwater video surveys as a model. Collaborative surveys are shown to have mutual benefits in terms of cost and efficiency savings, knowledge transfer and relationship building.

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1. Introduction

1.1. Need for monitoring and evidence collection to designate and manage MPAs

Marine Protected Areas (MPAs) in England are primarily for the conservation of marine biodiversity and to protect species and habitats of international or national importance. Currently there are two main types of MPA in the UK; Special Areas of Conservation (SACs) designated under the EC Habitats Directive and Special Protection Areas (SPAs) for birds designated under the EC Wild Birds Directive. These are commonly referred to as European Marine Sites (EMS) or Natura 2000 (N2K) sites and are underpinned along the foreshore by a series of Sites of Special Scientific Interest (SSSI). A series of Marine Conservation Zones (MCZs) are likely to be designated under the Marine and Coastal Access Act (2009) beginning in 2013. These sites will contribute to an ecologically coherent network of marine protected areas.

Designation of MPAs requires good quality evidence and information to ensure that they are located and scaled appropriately to achieve their primary aims. This requirement has recently been highlighted in the English MCZ process; in September 2011 the Regional MCZ Projects made their recommendations for 127 possible sites for MCZs; these recommendations were reviewed by the independent Marine Protected Areas Science Advisory Panel[1] which concluded that, although the Projects had broadly met the requirements of the guidance provided by the Statutory Nature Conservation Bodies (SNCBs), there were a number of shortcomings including in the evidence base supporting site recommendations. As a result of this advice MCZ, designation will now be carried out in a series of tranches with the 31 best evidenced sites being consulted upon first.

A subsequent independent review of the evidence underpinning the 127 recommended MCZ highlighted key information shortfalls that reduced confidence in the evidence base[2]. Amongst the key evidence gaps required to be addressed before designation were confirmation that features are present, the extent of features, their boundaries and the need more detailed habitat maps. This has resulted in the commissioning of further seabed and habitat monitoring to support MCZ designation process. This work will directly support the MCZ designation process but will also support the implementation of the Marine Strategy Framework Directive.

[1] MPASAP Assessment of Regional Project Recommendations

[2] In-depth review of evidence supporting the recommended Marine Conservation Zones

Monitoring, surveillance and surveys, as well as other less formal methods such as wildlife observations can be used to gather information about the condition of habitats and species in MPAs. These different information collecting activities are commonly referred to as "monitoring".

- A **survey** is a usually undertaken to produce baseline information e.g. to describe the distribution of a habitat or community type.
- The aim of **surveillance** is the detection of change and the description of trends. This usually involves the regular or repeated collection of information over time.
- **Monitoring** is a more focused approach that aims to collect quantified data that enable managers to assess the condition of site features and to inform adaptations to its management.

There are a series of statutory drivers for MPA monitoring in England, these are legal obligations under:

- the Habitats Directive, the Birds Directive and the Ramsar Convention,
- the Marine and Coastal Access Act (MCZs)
- the UK Biodiversity Action Plan,
- the Water Framework Directive (e.g. reporting on 'protected areas'),
- the Marine Strategy Framework Directive
- the Common Standards Monitoring Agreement between UK agencies and JNCC,
- and UK commitments for reporting against State of the Environment reporting such as the 2010 'Charting Progress 2' document under the UK Marine Monitoring & Assessment Strategy.

Member states are required to report to Europe every 6 years on the conservation status of features on all SACs and SPAs; the most recent reporting round was in 2007. Information about the conservation status of English sites is submitted to JNCC who report to Europe on behalf of the UK.

The implementation stage of the MCZ process requires the establishment of an ecological baseline and then subsequent monitoring to inform the 6-yearly reporting and assessment of site features and network condition cycle to meet Ministerial reporting obligations.

Many SSSIs overlap with the footprint of SACs and the same marine habitats and species are addressed under both designations. Condition information about these features is usually collected through a single programme of monitoring. There are a number of SSSI that contain marine features outside of SACs and monitoring the condition and conservation status of these is an additional burden for Statutory Nature Conservation Bodies.

Additional monitoring requirements arise from the Water Framework Directive which aims to ensure "Good Ecological Status" of inland and coastal waters, and the Marine Strategy Framework Directive (MSFD) which aims to ensure "Good Environmental Status" of the European marine environment by 2020. The MSFD describes eleven high level descriptors of "Good Environmental Standard" these include:

- Populations of fish and shellfish are within safe biological limits.
- Maintaining the biological diversity of marine habitats and species.
- Limiting contaminants to the marine environment to levels which do not cause pollution.

Evidence-based management is the cornerstone of the Inshore Fisheries and Conservation Authorities approach to MPA management. This approach is outlined in the Defra guidance[3] to IFCAs which describes an adaptive evidence-based cycle (Figure 1).

The fishing related management of all English marine inshore MPAs including MCZs is the responsibility of the 10 English IFCAs.

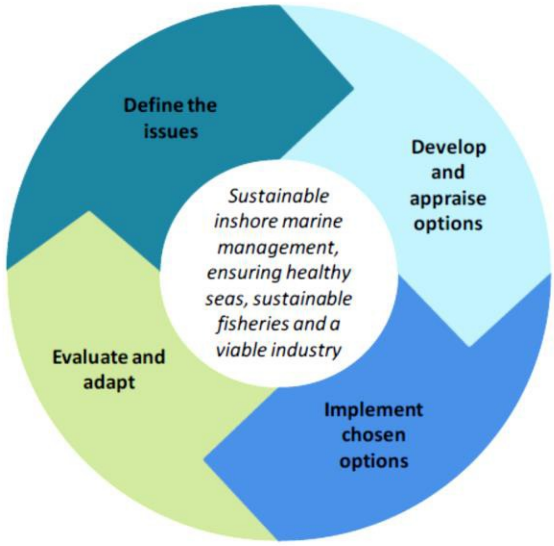

FIGURE 1. THE IFCA EVIDENCE-BASED MARINE MANAGEMENT CYCLE.

Evidence as defined by Defra's Evidence Investment Strategy[4] is:

"Reliable and accurate information that Defra can use to support sound decisions in developing, implementing and evaluating policy."

Defra's new approach to the management of commercial fisheries within (EMSs) SACs and SPAs in England has highlighted the urgent requirement for science and survey based evidence to inform effective site management. Government and fishery regulators in England (primarily the Marine Management Organisation (MMO) and Inshore Fisheries and Conservation Authorities (IFCAs)) have legal obligations to ensure that fishing activities, which could adversely affect EMSs, are managed in a manner that secures compliance with the requirements of Article 6 of the EU Habitats Directive. To achieve this, a series of Habitat Regulation Assessments (HRA) of fishing activity's impact on the conservation objectives for site features are currently being carried out by the MMO and IFCAs. Even though this is a phased and risk based process there is an urgent requirement for accurate feature extent and boundary information if accurate assessments are to be achieved.

Subsequent to the completion of HRAs, fishing activities shown to have a significant negative effect on the site features will be subject to management measures. It is likely that amongst the available management tools, spatial restrictions will place a key role in implementing prohibitions around sensitive site features. A prerequisite for the development of spatial activity management in EMSs and future MCZs is detailed information on the location and extent of site features. The burden of this evidence gathering for inshore (<6 miles)has fallen to IFCAs and Natural England and the MMO and JNCC for offshore sites.

Previous Seafish studies have demonstrated that information shortfalls can prevent HRAs from progressing with the result that permitting of shellfish aquaculture and wild capture fisheries have been delayed or prevented and can have serious economic impacts[5,6]. It is likely that similar information shortfalls may either prevent HRAs being carried out resulting in the adoption of precautionary management measures, or that these shortfalls will restrict the ability of fishery regulators to develop proportionate spatial management, both resulting in similar economic impacts.

[3] IFCA Guidance: Evidence-based marine management
[4] De fra's Eviden ce In ves tmen t Stra te gy: 201 0 -2013 and beyond – 2011 update
[5] http://www.seafish.org/media/Publications/StrategicEnvironmentalAssessmentProject.pdf
[6] Information Shortfalls Affecting Assessment of Shellfish Farm Projects Report

1.2. Benefits of using fishermen

Fishermen have an in-depth knowledge of their fishing grounds built up over many years experience fishing and from traditional knowledge passed down from the older generation. This knowledge has become more accepted as a potential source of valuable information in fishery and conservation management over the last decade and a half[7]. There are a number of terms commonly used to describe this knowledge and perhaps the most commonly used are "Traditional Environmental Knowledge" (TEK), "Local Environmental Knowledge" (LEK), and "Fishermen's Environmental Knowledge" (FEK) and very often "environmental" is replaced by "ecological" [8]. Fishermen's Ecological Knowledge may incorporate a variety of information types acquired through their own experience, from their peers and based upon more traditional cultural knowledge. This may include ecological information such as inter-annual, seasonal, lunar, diet and food-related variations in the behaviour and movements of marine fauna and physical information such as tidal streams, seabed types, local operating constraints and effects of prevailing weather conditions.

In the context of MPA monitoring or evidence gathering, and specifically gathering seabed information and mapping of features, the use of local fishermen offers a number of benefits including their local knowledge of ground types and their understanding of local conditions under differing weather and tidal conditions. McKenna et al (2007)[9] demonstrated that fishermen's own mental maps of broad seabed habitat types were very accurate when compared to science based survey data in Loch Neagh, Northern Ireland. This type of information can help to inform the planning stage and make survey work more efficient by targeting areas of conservation interest.

Practical operational considerations make the use of fishermen and fishing vessels a logical choice; all commercial fishing vessels are subject to the Maritime and Coastguard Agency Fishing Vessels Code of Practice for the Safety of Small Fishing Vessels[10] which ensures a good level of vessel safety and equipment, fishing vessels are by nature well suited to survey work having sufficient deck space and lifting equipment should it be necessary, and fishing vessel crews are experienced in dealing with the various technical and operational challenges that occur working at sea and especially deploying and recovery of gear to the seabed.

There are potential cost savings to statutory bodies engaged in marine monitoring activities as fishing vessels are most likely to cost less to hire than a bespoke survey vessel and crew.

Beyond the practical considerations in favour of using fishers in this role, and especially relevant to MPA designation and management, the involvement of stakeholders is well acknowledged as being vital to the success of MPA network planning[11]. Marine Protected Areas by their basic definition have the potential to affect the activities of fishermen; probably the most numerous marine stakeholders. Inadequate stakeholder processes and transparency in MPA designation and management have been

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[7] e.g. Berkes, Fikret, Johan Colding, and Carl Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10, 1251–1262

[8] Murray, C., K. Wieckowski, D. Hurlburt, C. Soto and K. Johnnie. 2011. Incorporation of Traditional and Local Ecological Knowledge and Values in Fisheries Management. Final Report. Prepared for the Pacific Fisheries Resource Conservation Council, Vancouver, BC, by ESSA Technologies Ltd., Vancouver, BC. 92 pp.

[9] McKenna, J., R. J. Quinn, D. J. Donnelly and J. A. G. Cooper. 2008. Accurate mental maps as an aspect of local ecological knowledge (LEK): a case study from Lough Neagh, Northern Ireland. Ecology and Society 13 1:13

[10] www.dft.gov.uk/**mca**/msn_1813_amended_5.pdf

[11] Gleason, M., S. McCreary, M. Miller-Henson, J. Ugoretz, E. Fox, M. Merrifield, W. McClintock, P. Serpa and K. Hoffman. Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California. Ocean & Coastal Management 53 2:52-68.

cited as sources of conflict and feelings of disenfranchisement within the fishing industry. Involvement of fishers in the evidence gathering and monitoring process may help address these issues.

Fishermen are playing a growing role in collaborative fisheries research (CFR) and monitoring programmes by providing key information to inform MPA management in other areas, e.g. the California Collaborative Fisheries Research Programme has been conducting collaborative fisheries research since the late 1990s and plays a key role in monitoring the Central Coast MPAs[12]. This approach is well established where MPA networks have been implemented giving rise to integrated citizen science programmes that play a role in monitoring and evidence gathering e.g. the Oceanspaces[13] project in California. Collaborations such at these offer opportunities to build strong relationships between regulators, fishers, conservation interests and scientists and in doing so engender a common level of understanding across all groups. Partnership working in evidence gathering can build trust, create transparency and stakeholder confidence in the MPA designation process and subsequent management development.

1.3. Aims of study.

The aim of the pilot was to demonstrate how fishermen can collaborate with fishery regulators, SNCBs, and scientists to carry out evidence gathering and monitoring in MPAs in a cost effective way using drop-down video surveys as a model activity.

Key activities carried out in this project were:

- Develop and test robust and straightforward underwater video equipment for use from fishing vessels.
- Carry out a series of case studies trialing collaborative underwater surveys with fishermen, SNCBs, fishery regulators and scientists.
- Establish the quality, metadata and procedural requirements for stakeholder generated video data and footage.

FIGURE 2. FISHERMAN NIGEL MARSH DEPLOYING THE SEAFISH CAMERA SLEDGE IN LYME BAY

[12] http://ca-sgep.ucsd.edu/focus-areas/healthy-coastal-marine-ecosystems/california-collaborative-fisheries
[13] http://oceanspaces.org/

2. Underwater video equipment for use on-board fishing vessels

2.1. Requirements for a fisher deployed system

A customised video system was developed for this project specifically designed to enable ease of deployment from inshore fishing vessels and to generate good quality video footage of seabed habitats. The development process was informed from previous experience working with shellfish farmers, through discussions with fishermen and IFCA officers engaged in video survey duties. A series of key considerations were developed:

- **Size and Weight:** The vessels to be used in the current project were inshore fishing vessels ranging in size from 7-12 m. The video gear and especially the video sledge had to be small enough to be easily handled on the smallest vessel. As some vessels would be engaged in static gear fisheries (potting and netting) there was no guarantee that a winch or gantry would be available for hauling and therefore the sledge should be light enough for hand hauling. The higher cost of armoured umbilical cable suitable for winch hauling was another factor in the decision to adopt a hand hauled sledge approach.

- **Portability and Robustness:** As the video system was required to be transported and transferred between vessels it had to be easily portable and self-contained. Video recording equipment and monitor screens are sensitive electronic equipment and therefore they should be protected from the rigours or working at sea on small vessels. The video cameras and light units mounted on board the sledge are vulnerable to rough handling and physical damage by coming into contact with the seabed. The sledge design should account for this and offer sufficient protection.

- **GPS Overlay:** A key requirement for video analysis and mapping is the provision of GPS derived position information. Unlike stills photographs which can be linked to the vessel GPS track (geo-referenced) the capacity does not exist for digital video files. The solution is to overlay GPS derived coordinates on the video footage.

- **Adjustable Lighting:** Underwater video footage is greatly affected by lighting which although required to illuminate the seabed can cause backscatter, over illumination and 'hotspots' on the recorded picture. These factors can be addressed by being able to make adjustments to the angle and position of the underwater lights and by varying the lighting intensity.

- **Video Quality:** Video footage quality is probably the most important factor influencing the amount of useful information that can be derived during subsequent analysis. High resolution colour images were considered to be the minimum although since the development of the system High Definition (HD) should now considered to be standard

- **Simplicity of Operation:** There are a variety of potential approaches for recording video footage including using Laptop Computers, Digital Tape Recorders, Digital Video Recorders (DVRs), and DVD/BlueRay recorders. Simplicity of operation was a priority as the intention was to make the system and the capacity to gather seabed habitat footage as accessible as possible.

2.2. Description of the Seafish system

Underwater video system: Although professional video equipment produced for the offshore industry can be prohibitively expensive we were able to source a cost-effective system from RovTech

Ltd.[14] This system originally designed for the commercial diving industry offered a cost-effective solution that included an easy to use topside control unit, cameras and lighting unit.

Video system specification:

Micro Hi-Res Digital Colour Camera:

Stainless Steel Housing, 200m rated
1/3" Sony Super HAD CCD
480 TV lines resolution
1 lux at F2.0
4.3mm wide angle lens (6mm, 8mm, 12mm optional)
12-24v DC operation
4pin subcon connector

Mini Seabeam Light:

Stainless Steel Housing, 200m rated
Toughened glass front port
12v Ultra LED lamp
2pin subcon connector

Topside Unit:

Control Console housed in lightweight Explorer Case
Camera Control Console
Variable Intensity Lighting
Sony DVD Recorder with Compact memory Stick Input / USB Output to printer / 2" LCD Display to playback images
12" LCD TFT monitor
240v AC

Ancillaries:

Lightweight 100m Umbilical with mating tails for camera and light

Additional HD video capacity: At the time of development cost-effective High Definition cameras such as the GoPro range[15] became available and although these did not allow for real time monitoring from the vessel they did offer an additional HD recording capacity. A GoPro Hero 2 HD camera and case was included for trial in the project.

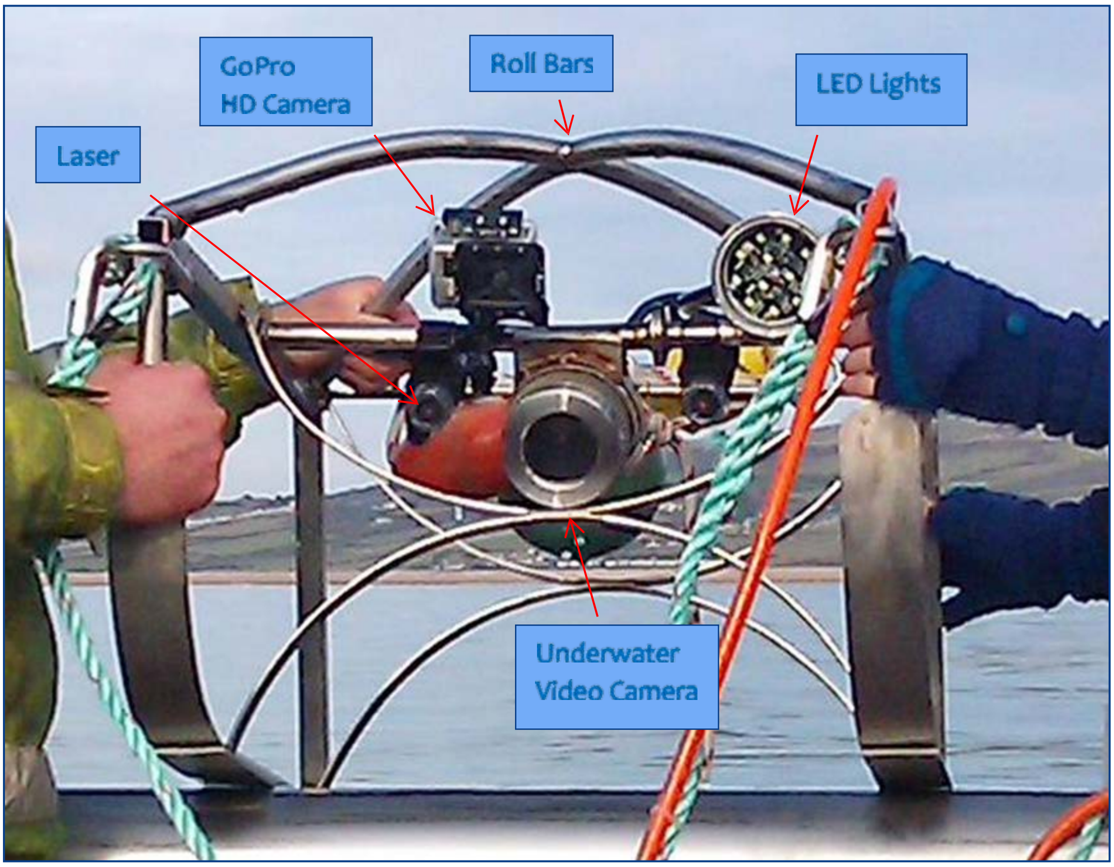
Scaling lasers: Analysis of video footage, especially biotope classification, is greatly assisted by the addition of a scale bar or a means of being able to measure the size of fauna or to determine the size of physical features such as pebbles, cobbles and rocks on the seabed. To this end, a pair of waterproof laser pointers were fitted in parallel to the sledge to provide two equidistant reference points on the footage.

Video sledge: A video sledge was designed around the dimensions of the RovTech video camera and light units. Their mounting location was designed to be within a protective framework including roll bars across the top of the sledge and the cross bracing on its underside.

Constructed of 2 mm wall stainless steel the sledge is light enough to be hand hauled but strong enough to withstand contact with the seabed and with vessel hulls when deploying and recovering.

[14] http://www.rovtechsystems.co.uk/underwatercameras/portablecamerasystem.php
[15] http://gopro.com/

FIGURE 3. THE SEAFISH VIDEO SLEDGE PRIOR TO DEPLOYMENT. NOTE THE PLACEMENT OF ALL CAMERAS AND LIGHTING WITH THE PROTECTIVE FRAMEWORK



2.3. Latest developments and adoption by other organisations

2.3.1. *Updated HD camera technology*

Since the development of this system developments in HD camera technology have reduced the cost of real-time HD recording with a return to surface capability. The latest versions of the RovTech system now have full HD (1080p) cameras recording directly to a removable hard drive on the vessel.

Latest Seacam HD Camera specification:

316 Stainless Steel housing
Fused Silica Front Port
3Mp/Full HK 1920 x1080/25FPS
Wide angle fixed focus lens
Internal video fuse
12-24v DC Operation

2.3.2. *Adoption of Seafish design by other organisations*

Following the successful trials as part of this project the design has been adopted by a number of organisations for evidence gathering that will inform fisheries management within MPAs:

- Sussex IFCA,
- Southern IFCA,
- Kent and Essex IFCA,
- Eastern IFCA, and,
- the Hampshire and Isle of Wight Wildlife Trust.

An adapted sledge design is currently being trialled by Bangor University for fishermen self-surveys of scallop grounds. This more basic approach uses GoPro cameras mounted on the sledge to obtain seabed imagery for ground truthing acoustic data and to provide baseline information on seabed habitat types.

3. Case studies (Field reports can be found in Annex I)

Four separate video surveys were carried out as part of this project (Table 1). Their aim was to demonstrate and evaluate the efficacy of collaborative survey, monitoring and research between fishermen and researchers, fishery regulators and SNCBs. In order to fully explore and demonstrate the utility of fishers involvement in monitoring and research a variety of case study sites were identified that included European Marine Sites (3x SACs), a recommended MCZ (rMCZ) and a community-based project site. Each of these case study sites had its own particular information gaps that required video survey effort to address them to inform site management.

TABLE 1. DETAILS OF THE 4 CASE STUDY SURVEYS CARRIED OUT DURING THIS PROJECT.

Site	Partner organisations	Key features and objective	Date
Wreck to Reef lobster restocking reef Weymouth **Studland and Portland SAC**	• Wreck to Reef Project[16] • Luke Copperthwaite Skipper of *FV Freya May*	• Provision of monitoring information on the colonisation of the reefs by newly settled epifauna. • Baseline seabed information around the site and within the SAC to inform management	16th September 2012
Selsey Bill and the Hounds rMCZ	• Sussex IFCA • Natural England (Emma Kelman) • Skipper and Crew of *FV Robert Louise* (Tony Delahunty, Peter Delahunty and Wayne Jones)	• Provision of information on the condition of seabed habitats at risk of shingle inundation • Baseline habitat information within the Selsey Bill and the Hounds rMCZ	17th-18th September 2012
Lyme Bay cSAC	• Dorset IFCA • Devon and Severn IFCA • Natural England • Plymouth University (Adam Rees, Sara Gall) • Skipper and Crew of *FV Silver Spirit* (Alex Jones, Nigel Marsh)	• Provision of information from an area of low confidence data in the east of the cSAC to complement existing surveys and contribute to a robust evidence base to inform management	1st – 2nd December 2012
The Wash and North Norfolk Coast SAC	• Eastern IFCA • Natural England • Spindrift Marine • Garnett Shellfish Ltd. (Martin, Paul and Bob Garnett)	• Provision of information on the location and persistence of *Sabellaria spinulosa* reefs to inform management.	24th-25th January 2013

[16] http://www.wrecktoreef.co.uk/

3.1. General approach

1. Each case study began with a discussion with IFCA officers, Natural England conservation advisors, fishermen and, in the case of the Wreck to Reef study, other relevant local stakeholders in order to identify where there was a particular information shortfall preventing effective management within a site or where there was a regular information need to inform monitoring programmes.

2. Once the aims of each case study survey had been established a survey plan was developed with participating fishermen. The fishermen's local knowledge was invaluable at this stage as they could provide insight into local conditions under which it would be best to work. By involving fishermen, fishery regulators and SNCB staff in discussions in the planning stage potential pitfalls were avoided.

3. As each case study site had a particular suite of information gathering requirements a tailored field log sheet was produced. This was to be filled out with a record for each camera sledge deployment and recorded essential information including:
   - Survey station number
   - Time tow start/Time tow stop
   - Coordinates start/Coordinates stop
   - Seabed habitat type
   - Site specific information e.g. % cover *Saballaria spinulsoa*
   - Conspicuous species
   - Notes

4. Case study surveys were coordinated and arranged around best available tides and weather conditions. The skipper had the final word on this as in all other vessel operation and safety matters.

5. The surveys closely following the Seafish Standard Operating Procedure - Basic Video Mapping Seabed Habitats[17]. Survey work was carried out on board local fishing vessels with staff from participating organisation attending and working alongside crew. This worked particularly well and it was clear that collaborations enhanced the survey results.

6. Video footage was stored onto a hard drive and copies made for all participants either available as a direct download from an online storage site or as a DVD formatted to play in a domestic DVD player. The objective of this was the "close the loop" and ensure that all participants had the opportunity to review the video footage.

7. Analysis of the video footage was outside the scope of this project but footage generated during all case study surveys has undergone analysis by IFCA or University experts to inform site management or scientific research projects.

[17] http://www.seafish.org/media/Publications/SR639_BasicSeabedHabitatVideoMappingSOP_Final.pdf

3.2. Wreck to Reef lobster restocking reef Weymouth (Studland and Portland SAC)

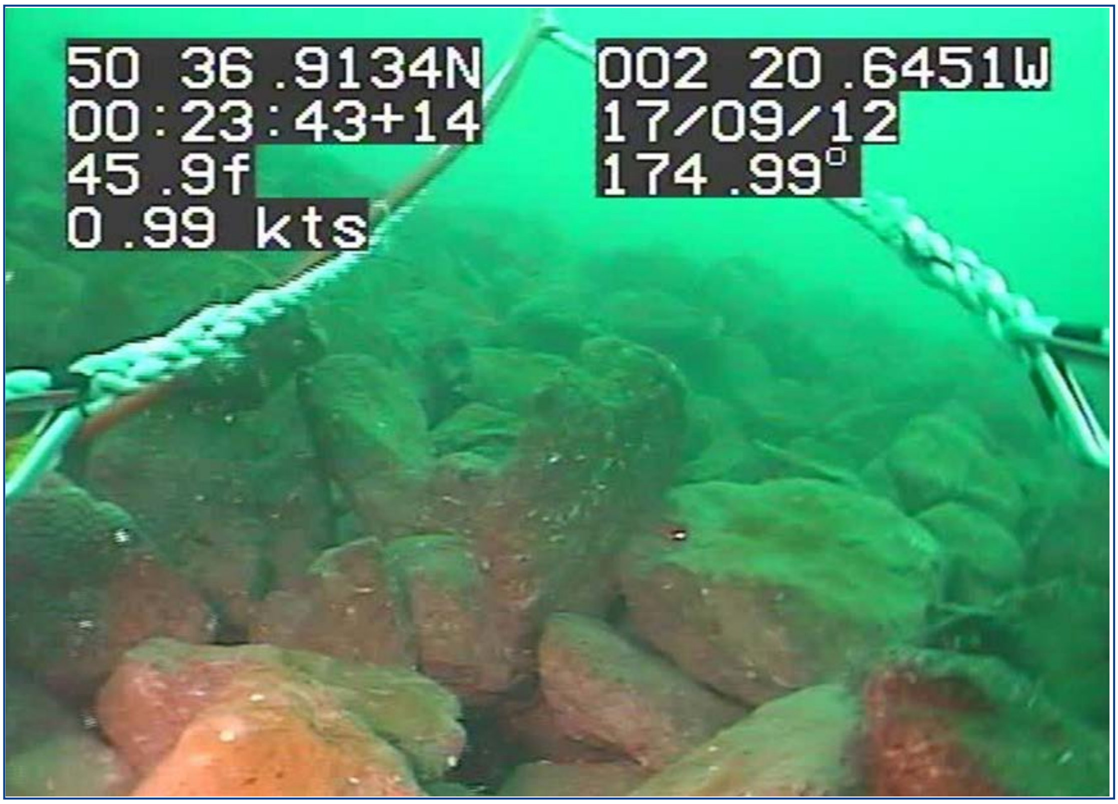
Wreck to Reef is a non-profit community group developing a project to create a series of artificial reefs off Ringsted Bay east of Weymouth and Portland. In March 2012 1700 tonnes of Portland stone were placed on the seabed to form 6 lobster restocking reefs. The aim of these reefs is to provide habitat and refuge for juvenile and pre-recruit lobsters that will then enter the local fishery. The Studland and Portland SAC bisects the Wreck to Reef site

The aim of this survey was to provide monitoring information on the colonisation of the reefs by epifauna since their formation. The survey also aimed at gathering seabed information around the site and within the SAC to inform future management.

The planning and survey were carried out with Wreck to Reef staff and local fisherman Luke Copperthwaite from his fishing vessel *FV Freya May*. After initial trial tows a series of good quality videos were recorded of the reefs and of the surrounding seabed. The footage revealed the presence of maerl on the sediment surface, a large number of small queen scallops and invasive non-native slipper limpet (*Crepidula fornicata*). The reefs were observed to be at the early stage of colonisation with algae and invertebrates starting to colonise what was initially white Portland stone.

The footage from the survey will form part of the monitoring work of the Wreck to Reef project. Some of the footage has already been used in presentations to the public and Dorset Wildlife Trust. The footage will be offered to Universities for future research projects and to Southern IFCA and SNCBs to inform management of the SAC.

FIGURE 4. LOBSTER RESTOCKING REEF DEMONSTRATING THE FIRST STAGES OF EPIFAUNAL COLONISATION



3.3. Survey of a recommended Marine Conservation Zone at Selsey, East Sussex.

The 1290 ha Selsey Bill and the Hounds rMCZ is situated to the south and west of Selsey Bill in East Sussex. The Selsey fishermen had been actively involved in the MCZ process and have participated in the Balanced Seas project providing input and local knowledge. Fishermen had raised concerns with Natural England and Sussex IFCA that coastal defence and beach replenishment works adjacent to the site were affecting infralittoral rock habitats. There was a concern that shingle from the works was washing off the shore and being deposited over the reefs and rocky ground.

This survey aimed to gather more information on the condition of seabed habitats thought to be affected by shingle inundation and to increase the baseline habitat information about other areas within and adjacent to the Selsey Bill and the Hounds rMCZ

The planning and survey were carried out with Natural England and Sussex IFCA staff attending both survey days working alongside the skipper and crew of *FV Robert Louise*. Despite strong winds affecting their ability to work to the west of Selsey Bill, 18 survey stations were worked much to the credit of skipper Pete Delahunty's boat handling skills.

A great deal of information on habitat and biotope distributions was generated during the survey. The location of a range of habitats including rocky reef with kelp stands, gravel and soft sediments were mapped. This information will inform the MCZ designation process and enable effective site management.

Subsequent to the survey Natural England have secured further funding to enable *FV Robert Louise's* crew to train other Selsey fishermen in video survey techniques and undertake further survey work in the western part of the rMCZ. The possibility of regular monitoring surveys using local vessels is also being discussed.

FIGURE 5. A HARD GROUND STATION AT SELSEY SHOWING KELP AND RED SEAWEED ON ROCK BOULDERS.

3.4. Survey of a candidate Special Area of Conservation, Lyme Bay

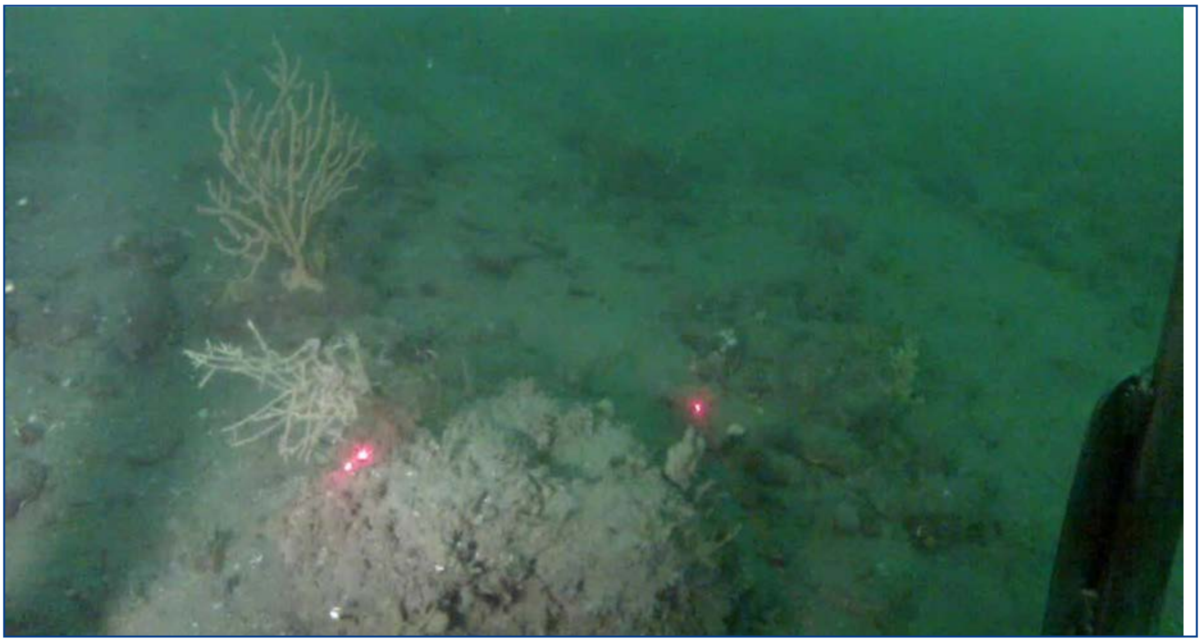
Lyme Bay, situated in the southwest of England encompasses 2460 km^2 from Portland Bill in the east to Start Point in the west. The area of Lyme Bay between Beer and West Bay is a candidate Special Area of Conservation (cSAC), part of the Lyme Bay and Torbay cSAC, proposed due to the presence of Annex I reef habitat. Recent inshore Vessel Monitoring System (iVMS) trials which were permitted to fish in areas between sensitive reef habitats have been successful. This survey aimed at gathering information on seabed habitats where information gaps existed in two areas, one within and one outside of the iVMS trial area.

Survey planning involved fishermen working with Plymouth University researchers and staff from Southern IFCA, Devon & Severn IFCA and Natural England to plan suitable dates and methodologies. Survey sites were determined following discussions with Southern IFCA and Natural England who identified areas in the east of the cSAC where information gaps existed. The survey work took place from the *FV Silver Spirit,* based in Lyme Regis with Alex Jones and another local skipper Nigel Marsh (*FV Little Shrub*) working alongside Adam Rees and Sarah Gall from Plymouth University.

A total of 12 video stations were worked recorded in over 2 hours of seabed footage in the 2 days of survey. Preliminary analysis by Plymouth University has reported that the predominant habitat in the iVMS trial is cobble and pebble whereas bedrock dominates the currently closed area. A great deal of information was contained within the video footage on habitats and species including pink seafans and ross corals.

Both participating fishermen were very enthusiastic about the survey and are confident that they could carry out similar work unsupervised or in partnership with management bodies in the future. The data gathered during this survey will be analysed by Plymouth University, IFCA and NE staff and will add to the baseline data to inform the development of a site management plan being developed by the Blue Marine Foundation Lyme Bay Fisheries & Conservation Reserve project

FIGURE 6. PINK SEAFANS RECORDED IN LYME BAY DURING FISHERMEN'S SURVEY



3.5. Survey for Sabellaria spinulosa, Wash and North Norfolk Coast SAC.

The Wash and North Norfolk Coast SAC is an extensive 1078 km^2 site straddling the border of Lincolnshire and Norfolk. The site is designated for a number of Annex I habitats including "reefs". The latter for the tube-dwelling polychaete worm *Sabellaria spinulosa* that forms areas of biogenic reef in the SAC. An important shrimp fishery occurs in the Wash and there is a well-established spatial management approach implemented by Eastern IFCA and Natural England.

Eastern IFCA carries out its own extensive survey program to inform the management process. Increasing survey coverage of the surveys would increase confidence, spatial resolution of the data and prevent the information shortfalls from constraining activities. The aim of this case study survey was to help develop video survey capacity within the local fishing industry and enable them to participate in data gathering.

Survey planning involved extensive communication between local fishermen and Eastern IFCA and Natural England via email. Eastern IFCA and Natural England staff were unable to participate in the survey work due to staff availability but provided support via email and telephone on the day. The fishing vessel used for this survey was a typical local multi-role shrimp/shellfish vessel operated by Martin Garnett. Also participating were Paul and Bob Garnett who also operate fishing vessels in a variety of fisheries in the SAC, and Jess Woo of Spindrift Marine who is currently assisting the shrimp industry to achieve MSC accreditation.

The survey successfully worked 11 video tows producing 2 hours of footage despite high tidal currents and poor weather conditions curtailing the second days survey. Poor visibility restricted the quality of imagery but local knowledge of tides and target areas Sabellaria was observed and areas of previously unsurveyed ground was surveyed. The video footage, GIS layers and field records from the survey will be included in the evidence base to inform their monitoring and management. There was interest from participants to trial alternative approaches such as sidescan sonar for future *Sabellaria* surveys.

FIGURE 7. *SABELLARIA SPINULOSA* REEF RECORDED ON FISHERMEN'S SURVEY

3.6. Outcomes from Case Studies

There were a range of positive outcomes from each of the case study surveys. Each of the case study surveys was successful in collecting useful seabed habitat information that can be used in fishery and conservation management of the site in question.

The footage was assessed by participating IFCAs and SNCBs as being of sufficient quality to determine seabed habitat types and to classify biotopes to inform MPA management. Positive outcomes were not limited to the production of seabed habitat information as the process of partnership working during survey planning and implementation acted to strengthen relationships between partners which can be built upon.

TABLE 2. OUTCOMES AND FUTURE ACTIONS ENABLED BY CASE STUDY SURVEYS.

Survey	Outcomes	Future actions
Wreck to Reef lobster restocking reef Weymouth Studland and Portland SAC	• 8 video tows worked • 1 fisherman and 1 stakeholder trained in basic video survey techniques • Baseline information established for monitoring programme	• Continuation of monitoring programme using similar techniques • Footage to be offered to University researchers and students • Footage to be submitted to Southern IFCA and NE to inform site management
Selsey Bill and the Hounds rMCZ	• 17 video tows worked • 3 fisherman and 2 IFCA and NE officer trained in basic video survey techniques • Information gaps addressed in an rMCZ • Establishment of good working relationships	• Survey footage undergoing analysis by Sussex IFCA • Follow up survey work and collaborative project underway • Possible fishermen collaborations on future rMCZ monitoring
Lyme Bay cSAC	• 12 video tows worked • 2 fisherman trained in basic video survey techniques • Information gaps addressed • SAC baseline information gathered	• Analysis underway by Southern IFCA • Data will inform co-management of mobile gear vessels in SAC via the Lyme Bay Fishery and Conservation Reserve Project • Participating fishermen are seeking funding to carry out further survey work
The Wash and North Norfolk Coast SAC	• 12 video tows worked • 3 fisherman trained in basic video survey techniques • Surveillance and monitoring information generated on location and persistence of *Sabellaria spinosa* reefs	• Survey footage submitted to Eastern IFCA and Natural England for interpretation and analysis • Data will inform site and fishery management • Future collaborative surveys may help industry to achieve MSC accreditation • Participants are exploring the possibility of methods such as sidescan surveys

3.7. Feedback from Fishermen

There was a great deal of enthusiasm expressed by the fishermen who participated in the case studies. Without exception the participating fishermen were keen to be involved in future monitoring and survey work. The participants highlighted a number of common perceptions about collaborative evidence gathering and monitoring in MPAs:

- **Fishers interest in seabed habitats:** All participating fishermen showed a great interest in the live video footage during the survey work. They expressed a desire to learn more about their fishing grounds and were curious to test their own predictions on seabed type. Very often this manifested in suggestions of additional stations to address their own curiosity about seabed features and fishing "hotspots".

- **Willingness to work with fishery regulators and SNCBs:** All participants expressed a willingness to work with fishery regulators and SNCBs, and other stakeholder groups. Fishermen collaborating with University researchers valued their interactions and have committed to further joint working.

- **Perceived benefits of collaborative working:** A common theme was that the fishermen would welcome the opportunity to demonstrate or prove their own understanding to official bodies and other organisations (eNGOs). This was often either related to local fishery management issues or, especially in matters concerning nature conservation, a perception that decision makers do not share the fishermen's understanding of the marine environment or fishing methods. There was a general feeling that a better understanding would reduce unnecessary conflict.

  Fishermen collaborating with the University researchers had the opinion that better understanding of the marine environment and how fishing interacts with it would enable more proportionate management measures and that by collaborating with researchers they had more confidence in the results. They also enjoyed the opportunity to share and discuss knowledge with researchers.

- **Interest in research and future studies:** Without exception all participants expressed an interest in participating in future studies and in the concept of becoming involved in regular MPA monitoring programmes.

  The extra income generated was considered a useful addition to offset reduced fish quotas at certain times of the year.

- **Training requirements:** A number of participating fishermen highlighted that in order to undertake survey and monitoring work on their own that they would require further training. It was clear that although many of the participants were technically proficient at operating without support, it would still be a challenge.

3.8. Feedback from SNCBs, IFCAs and Universities

The participating SNCBs, IFCAs and Universities were all keen to be involved and to assist in the case study surveys. There was a general acknowledgement of the urgent requirement for information and data concerning MPA site features to evidence designations and management. Discussions with the participants have highlighted a number of common points about the concept of collaborative evidence gathering and monitoring in MPAs by fishermen.

- **Use of video surveys in data collection:** Underwater video surveys were considered to be probably the most appropriate and cost-effective way of gathering seabed habitat information for mapping and biotope classification in collaboration with fishermen.

  The quality of the footage was judged to be sufficient for basic classification and for mapping requirements. If fishermen were to undertake surveys alone then there should be a standardised approach and the importance of metadata collection (times, depth etc.) emphasized.

  The potential for the use of other technologies and approaches was suggested, e.g. sidescan sonar may be a cost-effective approach to achieve a wider spatial coverage and would complement the video survey work.

- **Benefits of collaborative working:** Participating official bodies (SNCBs and IFCAs) were enthusiastic about the wider benefits of collaborating with fishermen in data collection. Their shared view was that collaborations such as this increased the level of shared understanding of the habitats and management issues in MPAs.

  Collaborative working was considered to offer the opportunity to learn more about aspects of the MPAs from the fishermen's local knowledge; information about wildlife, activities and seasonal patterns was often discussed during the survey days.

  A number of participants voiced the opinion that collaborative working could be a useful tool in establishing dialog and trust between organisations where the MPA designation process has been difficult.

  Potential cost savings, particularly in vessel charter costs, were highlighted by some organisations. For example, the Eastern IFCA survey vessel costs £2700 per day to run and takes 3 IFCA Officers away from other duties (Judith Stout, pers. comm.). Commercial survey vessels may be charged at a similar rate.

  An unexpected potential benefit suggested was that a reducted enforcement burden within the MPA could occur as a consequence of collaborative working as fishermen would have more confidence that management regulations were meaningful and well evidenced.

- **Quality of the footage:** Feedback on the quality of the video footage gathered during the case study surveys was positive. The video footage was considered to be sufficient to achieve the aims of the survey with all participants proceeding to carry out analysis. For example, Southern IFCA are currently analysing the footage to augment existing biotope maps of Lyme Bay in order to inform their spatial management of mobile gears in the SAC, feedback from the analyst involved confirms that the video footage from both camera systems was of good quality (Lowri Evans, Southern IFCA).

- **Interest in research and future studies:** Without exception all participants expressed an interest in participating in future studies and were interested in the concept of integrating collaborative monitoring in regular MPA monitoring programmes.

FIGURE 8. SELSEY FISHERMEN WORKING ALONGSIDE SUSSEX IFCA OFFICER MAPPING RMCZ FEATURES

4. Video data standardisation workshop

During the course of the current project, collaborations and links were made with other organisations and stakeholders interested in the collection of video survey data and its analysis. Discussions with these groups resulted in the identification of a number of common issues that could constrain the usefulness of video survey data for wider scientific and MPA management use.

In order to explore areas in which standardisation would be beneficial an informal workshop was arranged in March 2013. Delegates attended from organisations including SNCBs, IFCAs, Universities, private sector technical experts, and Seafish.

Example where standardization would increase the value of survey data:

Post survey video analysis often records species abundances using the SCARFOR scale. Unfortunately this scale prevents statistical analysis by scientists who would have to re-analyse the footage. Adapting the analysis stage to actual counts would enable the data to be used for statistical analysis to address a variety of uses.

TABLE 3. VIDEO DATA STANDARDISATION WORKSHOP DELEGATES MARCH 2013

Attendees	Organisation	Roles and expertise
Kirsten Ramsey Charlie Lindenbaum Lucy Kay Monica Jones	Countryside Council for Wales	Conservation advice, habitat mapping and monitoring, benthic ecology and data management
Simon Pengelly	Southern IFCA	Fisheries and conservation management, habitat mapping, fishery and stakeholder liaison
Hilmar Hinz Gwladys Lambert	School of Ocean Sciences, Bangor University	Benthic ecology, scientific research, seabed habitat surveys, video analysis
Holly Whiteley	Seafish	Fishery and stakeholder liaison, fisheries partnership working, capacity building
Andy Woolmer	Salacia-Marine	Fisheries and conservation management advice, habitat mapping, research, fishery and stakeholder liaison
Harry Goudg Liz Morris	Ecoserv Ltd	Commercial seabed habitat surveys, research, benthic ecology, video analysis

4.1. Scope of Workshop

Data collection: aim to establish minimum and best practice in survey work, including,

- Cameras and auxiliary equipment specification
- Positional data and standards
- Deployment protocols
- Data quality

Data analysis: aim to establish the requirements for scientific studies and MPA monitoring, including,

- Data types and associated problems: e.g. Abundance, Biomass, Coverage, Colonial species, Encrusting species, Alive or dead, Sediment classification, Siphons, tubes, burrows, Biotopes
- Data analysis tools (Andy and Hilmar)
- Data entry Marine Recorder (Liz and Harry)
- Potential for new data standards that satisfy most data requirements (Group discussion)

4.2. Outcomes

The workshop resulted in an agreement to establish a Working Group aimed at addressing the issues discussed and to ensure that best practice and information on new development in technology and analytical approaches are shared. Seafish (Holly Whitely) has agreed to coordinate the Working Group in the first instance.

4.2.1. Short-term aims and outcomes for the Working Group

- **Agreement to share best practice:** The working group have agreed to share best practice and work together to develop ways to ensure that best practice can be achieved by all stakeholders
- **Standard Operating Procedures/minimum Standards:** Although a series of Standard Operating Procedures exist for SNCBs and government bodies these are not appropriate for all stakeholder groups (e.g. MESH[18]). A series of revised Standard Operating Procedures will be developed with input from the group aimed at a wider group of stakeholders. This will be led by the author under further Seafish coordinated EFF projects already underway. The SOPS will be based upon a set of minimum Standards that describe video, operational and data collection best practice.
- **Metadata standards:** The Working Group agreed that they would endeavour to record metadata following the MEDIN metadata guidelines[19].
- **Video standards:** The Working Group have agreed that HD video should be a minimum standard for video survey equipment where possible and that cost-effective GoPro type cameras can fulfil this to augment SD systems. By promoting these minimum standards video footage future surveys will be likely to achieve high quality footage for analysis.
- **Further studies:** The Working Group have agreed to collaborate on a study to develop a standard calibration technique that will enable quantitative comparative video analysis between footage generated by different systems. This is considered very important from a long-term monitoring perspective. Bangor University will lead this element in collaboration with the other members.

[18] http://www.searchmesh.net/PDF/GMHM3_Video_ROG.pdf
[19] MEDIN metadata guidelines for video surveys

- **Video footage and data archiving:** Although a data archive exists through the Archive for Marine Species and Habitats Data (DASSH)[20] there is a cost for this service. Although SNCBs often support DASSH by incurring this cost in budget for their survey work this is unlikely to be an option for the voluntary sector. The Working Group will communicate likely funding routes to support data archive services to the relevant parties and where possible include that service in survey budgets.

4.2.2. Notes on best practice and draft minimum standards

4.2.2.1. Minimum requirement for camera system/equipment

- High Definition video should be considered a minimum quality standard for new systems. Older systems can be augmented by the use of cost-effective sport cameras such as the GoPro range.
- The use of GPS overlays where possible greatly aid the analysis of video footage.
- Lighting should be adequate to illuminate the field of view. The use of diffusers is encouraged to address hot spots on video footage.
- The ability to determine sizes of fauna and seabed features from video footage is greatly enhanced by the provision of a scale. It is recommended that an appropriate scale is visible in the video camera's field of view. Laser pointers or line lasers are common solutions.

In development:

- *Calibration guidelines to ensure that all footage from sled systems for video and stills camera can be standardised. The purpose of this is to enable the determination of the exact area in the field of view; this is very useful for accurate estimates of density*
- *Standard for field of view.*

4.2.2.2. Minimum standards for camera deployment

- Tow Speed should be circa 0.5 knots. This is the key factor in poor quality footage. Consensus is that the slower the towing speed the better.
- The angle of the camera relative to the sledge should normally be between 30-45 degrees. The angle should also be recorded in the metadata. The calibration study will address aspects of camera angles.
- In order to ensure that sufficient areas of seabed are surveyed to enable quantitative analysis a minimum time of 10 minutes or 100 metres is recommended.
- It is recommended that video sleds should be towed against the prevailing current where possible as to reduce the effects of sediment clouds created by its passage over the seabed.
- Time and position should be synchronised on all equipment including GPS, cameras, laptops used in the survey. Time should be in UTC only. Note: Handheld GPS have an option to display daylight saving hours, but may log track records in UTC.
- The use of a "clapper board" at the start of each video tow is recommended. The board should clearly show: date, station number, and vessel name. For systems that do not have a GPS overlay this should be augmented with start coordinates, time tow start, stop coordinates, time tow stop, this may be achieved by placing a handheld GPS in front of the camera.
- Where possible vessel track data should be downloaded from the vessel's track plotter. If unavailable GPS loggers should be employed and placed towards the stern of the vessel.

[20] http://www.dassh.ac.uk/

5. Training course development – Swansea University

Following feedback received during the early case study surveys it became clear that if fishermen are to have a growing involvement in MPA survey and monitoring that they will require sufficient training in both the practical process and also some theoretical and contextual aspects.

An opportunity arose from discussions with the Advanced Professional Training (Bioscience) team at Swansea University to develop a training course in Marine Ecological Surveys that would address the requirements of fishermen wishing to become involved in MPA monitoring.

The APT Bioscience project is part of the Work Based Learning programme, funded by the EU's Convergence European Social Fund. Their courses aim to equip professional learners with practical skills and specialist knowledge to enhance and supplement their existing laboratory or field skills. The courses are accredited by the University and are CQFW[21] Level 4. Level 4 CQFW courses are aimed at professional learners who require introductory level training, are new to a particular topic of study or would benefit from refresher training.

TABLE 4. OVERVIEW OF SEAFISH/APT BIOSCIENCES MARINE ECOLOGICAL SURVEYS COURSE

Marine Ecological Surveys Course

Module overview
This course will provide learners with the necessary skills, knowledge and confidence to design and conduct basic marine ecological surveys or monitor conservation areas. The syllabus emphasise practical skills and covers:

- The reasons for surveys
- Regulatory requirements
- Protected areas (European Marine Sites, MCZ)
- Survey design
- Survey techniques

Level: CQFW Level 4 - Entry

Time requirements: 20 hours formal contact

Credits: 10

Pre-requisites: Minimum 1 Science A-level or equivalent vocational experience.

Module assessment: Submitted portfolio (practical assessment and related questions) and web- based tasks.

By the end of this module, learners should:

- Be able to keep accurate records (including use of a GPS).
- Demonstrate an understanding of the use and importance of marine surveys.
- Be able to specify and design a survey appropriately.
- Be able to perform simple survey techniques (transects, grabs, trawls, video).
- Be able to identify common marine species (fish, crustaceans, molluscs, etc.) and be able to use keys.
- Be able to present the results of a survey appropriately.

[21] Credit and Qualifications Framework for Wales

The course was based on the Seafish Standard Operation Procedures[22] developed to enable shellfish farm developers and fishermen to gather basic ecological information to inform the consenting process and management.

A course has been run in Wales with members of the Welsh Fishermen's Association. Participants undertook the classroom training in evening group sessions run on the Llyn Peninsular with practical field training being carried out on subsequent afternoons. This arrangement was ideal for the fishermen as it allowed them to continue their fishing duties during the early part of the day.

The participants will apply the lessons and skills gained in the course by participating in a collaborative Seafish monitoring project using video equipment to map unsurveyed areas of the Pen Llŷn a'r Sarnau SAC.

Comments from Marine Ecological Survey course participants:

"A comprehensive and informal introduction to marine surveying.

Very informative practicals which hopefully will give a good basis for surveying in a commercial capacity; giving insight into equipment needed and deployment techniques."

Colin Evans

"Some very useful information on the technologies used for studying under water. The information put forward will prove very useful in the future".

Brett Gardener

FIGURE 9. FISHERMEN ENGAGED IN VIDEO SURVEY TRAINING WITH SWANSEA UNIVERSITY KTC BIOSCIENCE

[22] http://www.seafish.org/retailers/responsible-sourcing/environmental-toolkit-/seabed-and-foreshore-mapping-by-industry-

6. Financial consideration of collaborative survey and monitoring

5.1. Potential benefits for the fishing industry

Many of the current and proposed MPAs in English waters are sited close inshore where that majority of under 10 m vessels operate. MPAs and subsequent management measures may reduce the fishing opportunities and therefore income for fishermen who currently use the sites. Under 10 m vessels are restricted to working within a safe range of their port, and may not be able to travel to areas outside the MPAs to fish.

It is possible that employing inshore fishermen to participate in monitoring seabed habitats and species inside MPAs where fishing has been restricted could help compensate for loss of earnings. Safeguarding fishermen's jobs would also help protect coastal communities and businesses associated with fishing; preserve maritime skills and knowledge developed over generations of fishing and contribute to the achievement of food security, all key aims of the Government's UK Marine Policy Statement.

Tables 4 and 5 present model calculations that indicate that welcome additional income could result from participation in MPA monitoring programmes.

5.2. Potential benefits for SNCBs and Fishery Regulators

The monitoring and evidence gathering costs are borne by the UK Government through the SNCBs and IFCAs. Direct cost savings could be realised by utilising fishermen and fishing vessels in some survey and monitoring roles and by avoiding high vessel chartering costs. Tables 4 and 5 below present model calculations that indicate significant cost savings of based upon vessel charter costs alone.

FIGURE 10. ***FV FRYJA MAY*****, AN EXAMPLE OF A COST-EFFECTIVE SURVEY PLATFORM**

Table 5. Conceptual economic case outlining the potential benefits for the fishing industry if participating in MPA monitoring work using European Marine Sites as an example.

Potential revenue generated from monitoring European marine sites (EMS)	
Proportion of English inshore waters currently designated as EMS:	9% (4328 sq km)
Proportion of English inshore waters currently considered for designation as EMS	18% (9917 sq km)
Approximate number of active English inshore fishing vessels operating at any one time	1200
Approximate number of English inshore fishing vessels operating within a EMS (18% of fleet)	216
Approximate number of English inshore fishing vessels that could be employed to collect data from EMS annually (based on a six yearly reporting cycle)	36
The estimated cost of chartering a fishing vessel and crew to participate in survey and environmental monitoring work is in the region of £800 per day.	£800 per day
Total annual revenue for 36 fishing vessels spending 4 days monitoring EMS	**£115,200**

Table 6. Conceptual economic case outlining the potential benefits for the fishing industry if participating in MCZ monitoring work.

Potential revenue generated from monitoring Marine Conservation Zones (MCZ)	
These calculation are based upon an assumption that the proportion of English inshore waters designated as MCZs is likely to be at least 10%	
Approximate number of active English inshore fishing vessels operating at any one time	1200
Approx. no. of English inshore fishing vessels operating within a EMS (10% of fleet)	120
Approx. no. of English inshore fishing vessels that could be employed to collect data from MCZs annually (based on a six yearly reporting cycle)	20
The estimated cost of chartering a fishing vessel and crew to participate in survey and environmental monitoring work is in the region of £800 per day.	£800 per day
Total annual revenue for 20 fishing vessels spending 4 days monitoring MCZs	**£64,000**
Comparing this figure when compared with chartering a bespoke survey vessel and crew at around £2,000 per day will result in a cost saving of £96,000	

7. Discussion

The multiple statutory drivers are placing increased burdens on SNCBs, IFCAs and other statutory bodies for the provision of MPA related marine survey and monitoring data. The fishing industry is also experiencing increasing situations where it is obliged to submit its own data and evidence to inform fishery and conservation decision making.

There is little doubt that good quality evidence is a prerequisite to ensure that MPA designation is successful in achieving their conservation objectives by accurately siting boundaries with a minimum impact on the activities of coastal stakeholders. Once designated the effectiveness and performance of management measures need to be assessed through monitoring which requires regular production of information through survey work.

These requirements bring with them burdens both in terms of financial costs and in staff resources. Based on figures supplied by the Eastern IFCA, the use of a dedicated IFCA survey vessel with a crew of 3 may cost £2700 per day and take the 3 officers away from other duties. Natural England expects to pay up to £2000 per day for a dedicated survey vessel with crew. Section 5.2 above highlighted how collaboration with the fishing industry may deliver significant cost savings on vessel charter alone.

Collaborative working on evidence gathering and monitoring surveys was considered to deliver significant "intangible" benefits by the IFCAs and SNCBs. Foremost of these intangibles cited was the use of collaborative working to establish dialog between the IFCA/SNCB and the fishermen working in and around MPAs. Collaborative working was considered to be an ideal opportunity to establish discussions around MPA management and to enable the IFCA/SNCBs to learn more about the sites and to inform fishermen about site specific issues. This approach has been adopted by Southern IFCA who actively involve fishermen in survey work to inform Habitat Regulation Assessments. They have found that this approach increases understanding of site specific management issues and can stimulate industry-led solutions (Simon Pengelly, Southern IFCA pers comm). The Selsey rMCZ case study has resulted in NE funding further training and survey work that will address information gaps on seabed habitats within the rMCZ; a key factor in securing this funding was the acknowledgment that the work would enable NE to communicate the importance of the site for conservation.

Clearly dialog is a two-way process and this is recognised by the Selsey fishermen who are enthusiastic about the project as it will enable them to reinforce and demonstrate the validity of their views and understanding of the site features and therefore ensure that they are considered in designation and future management measures.

Beyond the relationship and knowledge building aspects of collaborative working there were some quite important practical considerations that arose from the case study survey work. Local fishermen often have many years of experience in working in and around their coastline. Access to this experience and knowledge can lead to efficiencies in survey effort and increased success in gathering high quality footage. For example, a prerequisite for producing good quality underwater video footage is a slow boat speed (<0.5 kt) which can be difficult to achieve when working in tidalswept areas and in channels, the use of fishermen's local knowledge can help target survey effort to areas of the MPA at different state of tide. The Wash case study was a good example of this and is a key consideration for Southern IFCA working around Portland where they preferentially work with fishermen on SAC survey work (Simon Pengelly, pers. comm.).

Further cost savings and logistical efficiencies can be gained by collaborative working in the survey planning stage especially in MPAs where there are significant information gaps. Fishermen's local knowledge of the different ground types in their fishing grounds often surpasses the charted features and can be used to produce a conceptual habitat map from which a stratified survey plan can be developed (e.g. McKenna et. al., 2007[23]). The Selsey case study survey employed this approach and drew upon on collective local fishermen's knowledge to target effort in areas that they considered to be different ground types; many of these habitats would have been missed due to their small spatial footprint using alternative survey strategies.

If the fishing industry is to be considered as partners in MPA evidence gathering and monitoring work the quality of information and data produced has to be of sufficient standard to meet the objectives of the survey. The seabed habitat footage produced during the case studies, despite being produced by fishermen and IFCA/NE officers with little or no previous experience, was of high enough quality to enable biotope analysis and, in the case of the Lyme Bay survey, for further scientific research. In fact all of the footage produced has gone on to be analysed either by IFCAs or by Universities.

Feedback from fishermen suggested that they would require training before proceeding with unsupported survey work. The Swansea University KTC training courses based on the Seafish guidance SOPs offers an example of how training can be provided in a structured but accessible manner to ensure that the skills are developed to ensure high quality work. A combination of support materials and training would build the capacity within the fishing industry to undertake monitoring work and to ensure that the quality of the outputs is of the required standard for the task at hand.

The Seafish Standard Operating Procedures and guidance are currently already being revised with input from the Video Data Standardisation Working Group. The revised SOPs will aim to promote the best practice developed in the current project and recommendations of the Working Group to ensure that key metadata is recorded and that high quality video footage is recorded.

The continuation of the Working Group will be central in ensuring that future video survey work carried out by all stakeholders is of the best possible quality and that its outputs can be used in multiple applications. The Workshop highlighted that the adoption of quite simple procedures can increase the utility and quality of the video footage, and enables more detailed analysis to take place. The Seafish video system will be one of those included in calibration trials during the summer of 2013 to ensure that footage from future work can be used by scientists engaged in comparative studies and in long-term monitoring work.

The case studies carried out in this project have demonstrated that the fishing industry can realistically play a key role in helping to deliver information on seabed habitats and species in a cost effective manner. There are other aspects of marine data and information collection that could be undertaken by, or in collaboration with, fishermen to inform both fisheries and conservation management. These may include:

- Wildlife observations (seabirds, marine mammals, fish species),
- Climate change indicator species monitoring,
- Alien invasive species surveillance,
- Platforms for data loggers (e.g. depth/salinity/temperature on gears)
- Deployment of instrumentation (e.g. water quality and plankton sondes)
- Fisheries data recording (e.g. length/frequency measurements)

Marine monitoring is carried out at a variety of spatial scales and focusing on a variety of areas of the environment. Whilst the current study has focused upon MPA evidence gathering and monitoring to inform MPA management, UK Government has wider marine monitoring commitments. These commitments are coordinated under the UK Marine Monitoring and Assessment Strategy (UKMMAS)

[23] McKenna, J., R. J. Quinn, D. J. Donnelly and J. A. G. Cooper. 2008. Accurate mental maps as an aspect of local ecological knowledge (LEK): a case study from Lough Neagh, Northern Ireland. Ecology and Society 13 1:13

and its evidence groups which in turn coordinate monitoring programmes. It is likely that some aspects of monitoring carried out under the direction of these groups and their programmes could derive cost and efficiency savings by collaboration with the fishing industry. Table 7 below presents a series of examples of where collaborations would be possible.

At present, involvement and collaboration of the fishing industry in data collection is uncoordinated and mainly carried out on a local level and in response to the demands of casework or local issues. Integration of fishermen into monitoring programmes at local (MPA specific) and national scales could deliver cost and efficiency savings to UK Government bodies and increase opportunities for dialog and with this, increased shared understanding of environmental and management issues.

TABLE 7. UK MARINE MONITORING AND ASSESSMENT STRATEGY EVIDENCE GROUPS AND POTENTIAL AREAS FOR COLLABORATION

Monitoring Coordination Group	Aim and Focus of Group	Potential Collaborations with Fishing Industry
Ocean Processes Evidence Group (OPEG)	The OPEG focuses on the physical marine environment including monitoring changes to weather and climate, sea temperature and salinity, CO_2 and pH (for acidity), circulation, sea level, waves, suspended particulate matter and morphology.	Provision of offshore vessels for research platforms Deployment of data loggers from gear and on vessels Deployment of instrumentation from offshore and inshore vessels and gear.
Healthy and Biologically Diverse Seas Evidence Group (HBDSEG)	The HBDSEG focuses on the biodiversity and ecological aspects of the marine environment monitoring changes to cetaceans, marine and estuarine fish, marine habitats, microbes, plankton, seabirds and waterbirds, seals and turtles	Provision of offshore vessels for survey work and sample collection Provision of offshore vessels for research and observation platforms Wildlife and non-native species surveillance
Clean Seas Environmental Monitoring Programme (CSEMP)[24] Formally the National Monitoring Plan (NMP) and the National Marine Monitoring Programme (NMMP)	The CSEMP aims to detect long-term trends in the quality of the marine environment focusing on the distribution of contaminants.	Provision of offshore vessels for survey work and sample collection Deployment and maintenance of fixed monitoring buoys Provision of samples from offshore stations e.g. fish flesh
Global Ocean Observing Systems Action Group (GOOSAG)	The main focus of GOOSAG is the physical nature of the marine environment and indicators (including biological) of short and long term variations in weather and climate.	Deployment of instrumentation from offshore and inshore vessels and gear. Deployment of data loggers from gear and on vessels Indicator species surveillance

[24] http://www.cefas.defra.gov.uk/our-science/observing-and-modelling/monitoring-programmes/clean-seas-environment-monitoring-programme.aspx

Annex I

Case Study: Survey of an artificial lobster restocking reef and seabed adjacent to Studland and Portland Special Area of Conservation

Background

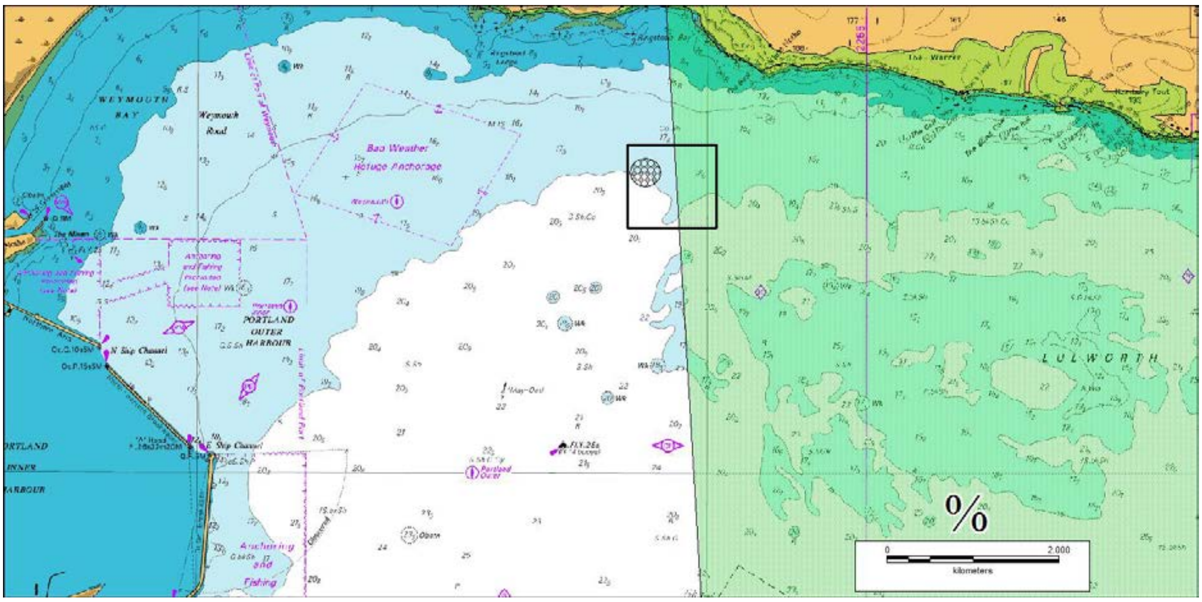
Weymouth and Portland Wreck to Reef is a non-profit community group developing a project to create a series of artificial reefs, including sinking a warship, off Ringsted Bay east of Weymouth and Portland (Figure 11). This project aims at creating a multiuse site to benefit the local economy by attracting diving tourists and in doing so the project has been designed to provide ancillary benefits such as enhancing biodiversity and local fisheries.

In March 2012 1700 tonnes of Portland stone were placed on the seabed to form 6 lobster restocking reefs. It is envisaged that these reefs will provide settlement habitat and refuge for juvenile and pre- recruit lobsters. The stones were sized to provide small interstitial spaces ideal for small lobsters but likely to exclude larger sizes. Although no restocking has taken place to date the Wreck to Reef project is currently applying for funding to purchase hatchery produced juvenile lobsters to release on the reefs. Their aim is to provide enhancement for local fisheries located inshore of the site through migration of larger lobsters out of the reefs.

The 330 sq km Studland to Portland Special Area of Conservation (SAC) recently became 37th in English territorial waters. The SAC boundary bisects the Wreck to Reef project site as defined in their MMO licence.

The aim of this survey was to provide monitoring information on the colonisation of the reefs by newly settled epifauna. Since the reef was deposited in March 2012 it was hoped that some colonisation had occurred over the summer period. The survey also aimed at gathering seabed information around the site and within the SAC to inform future activities and to provide information about the dynamics of the site.

FIGURE 11. THE WRECK TO REEF PROJECT AREA WITH APPROXIMATE AREA OF LOBSTER RESTOCKING REEFS. THE STUDLAND TO PORTLAND SAC IS SHOWN IN GREEN BISECTING THE SITE.



Approach

Where relevant the survey work followed the Step-by-Step approach described in the Seafish Standard Operating Procedure[25].

Step 1: Consultation and Planning

This survey was carried out at short notice in response to an invitation from the participants after their learning of the Selsey survey work being carried out the following day.

The fishing vessel used was a small 21ft aft wheelhouse potter, the *FV Freya May*, operated by Luke Copperthwaite who fishes static gear around Portland. The survey was to be undertaken by Luke and his father Neville, an ex-fisherman and shellfish farmer who has been championing the concept of lobster restocking reefs.

FIGURE 12. SKIPPER, LUKE COPPERTHWAITE, AT THE WHEEL OF *FV FREYA MAY* STEAMING TO SURVEY SITE

Survey planning was undertaken referring to Admiralty charts of the area and coordinates of the lobster restocking reefs. Once plotted to the chart a survey strategy was discussed considering the local tidal streams over the site and the predicted effects of the wind forecast. Local knowledge of the site was vital at this stage as the orientation of the reefs in relation to tidal currents and wind dictated the approach that we developed.

A basic log-sheet had already been produced to record tow start and end along with basic seabed characteristics. It was decided that this would suffice for this survey with a focus on note taking to record features of interest and conspicuous species.

[25] Seafish Standard Sampling Operating Procedure -Basic Video Mapping Seabed Habitats

Step 2 Setup and training

The video equipment was set up and tested on board the fishing vessel before we untied. This enabled us to locate the topside unit in a protected area off the deck and away from risk of getting swamped; this is an important consideration on a small vessel. As power is a constraint on small vessels a small generator was hired for the survey and was located in a secure location behind the wheelhouse.

Testing the equipment when tied up alongside gave the participants the opportunity to familiarise themselves with the equipment and for the author to provide an overview of the process.

Before casting off the coordinates of the lobster restocking reefs were entered into the vessels plotter to assist positioning when on site.

Step 3 Video Survey

For this survey a colour video camera was employed which relayed the video signal to a recorder and monitor housed in a briefcase on board the fishing boat. The recording equipment and electronics housed in the briefcase were protected from the weather by a large waterproof tarpaulin.

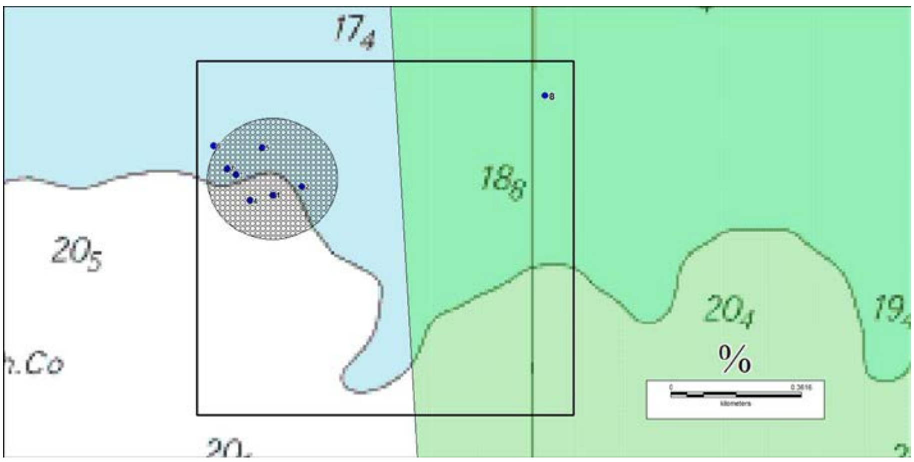
We initially had difficulty locating the lobster restocking reefs even with the aid of GPS. The reefs were deposited aligned to the tidal currents parallel to the shoreline and form 100 m long fingers of cobble. Even when in the vicinity of the reef the tide would tend to move the vessel parallel to and not over the reef. This was resolved by first searching for the reef position using the vessel sounder, quickly deploying the video sledge and going ahead at such and angle to stem and move across the tide.

The procedure at each survey station closely followed the Seafish SOP guidance instructions and the video log form was filled out. A trawl float was attached to the rear of the video sledge which helped it maintain a horizontal aspect during deployment.

We elected to deploy the video gear for longer tows for the purposes of this survey in order to maximise likelihood of crossing reef areas. Despite timing the survey over the slack water period there was still a significant current across the site but experimentation with vessel positioning and use of vectored thrust enabled the speed of travel to be sufficiently low enough (<0.5 kts) to obtain good quality footage.

The weather on the day of the survey was a fresh F4 which was about the limit for working on a small vessel due to the rising sea state. In a sheltered inshore area this may not be such a constraint. The survey was halted when the tide turned and reduced the visibility.

FIGURE 13. VIDEO STATIONS WORKED DURING THE SURVEY. GREEN AREA IS THE STUDLAND AND PORTLAND SAC



Results

A total of 8 video stations were surveyed during the day producing 90 minutes of footage (Figure 13)

TABLE 8. TABLE OF VIDEO STATIONS WORKED DURING SURVEY

Station	Lat	Lat min	Long	Long min	Habitat	Conspicuous Species
1	50	36.8486	2	20.6128	Aborted sledge inverted.	
2	50	36.862	2	20.5445	Gravel, Sand	Maerl, Scallops, Crepidula
3	50	36.8791	2	20.6987	Gravel, Sand	Maerl, Scallops, Crepidula
4	50	36.8408	2	20.6659	Gravel, Sand	Maerl, Scallops, Crepidula
5	50	36.9191	2	20.6375	Gravel, Sand, boulders (reef)	Maerl, Scallops, Crepidula, Bib
6	50	36.9218	2	20.7505	Gravel, Sand, boulders (reef)	Maerl, Scallops, Crepidula, Tunicates, Bib
7	50	36.888	2	20.7194	Boulders (reef)	Calcareous tube worms, Bib
8	50	36.9768	2	19.8812	Gravel, Sand, Shell material	Maerl?

The video footage was good quality as the skipper was able to balance the vessels drift with the tide to ensure that the sledge was moving slowly. The footage revealed a mixed seabed of sand and gravel with varying amounts of shell material. At stations around the reefs queen scallops (*Aequipecten opercularis*) were common and were recorded swimming in response to the approach of the sledge (Figure 14). The invasive non-native slipper limpet (*Crepidula fornicata*) was common at the stations around the reefs (Figure 15).

FIGURE 14. QUEEN SCALLOP SWIMMING UP FROM MAERL BED AT STATION 1

Figure 15. Slipper limpets at Station 1.

The lobster restocking reefs appeared to be intact and not affected by weather or wave action and showed signs of colonisation by sessile epifauna. When first deposited the stone was pure white and dusty having be sourced straight from a local quarry whereas the footage showed it to have been covered with encrusting red algae. Other fauna that had colonised the reef since its formation included calcareous tube worms and colonial ascidians (Figure 16). Shoals of *Trisopterus luscus* (bib, pouting, pout whiting, pout) were present over all the reefs as were larger unidentified fish (Figure 17).

Figure 16. Lobster restocking reef demonstrating the first stages of epifaunal colonisation

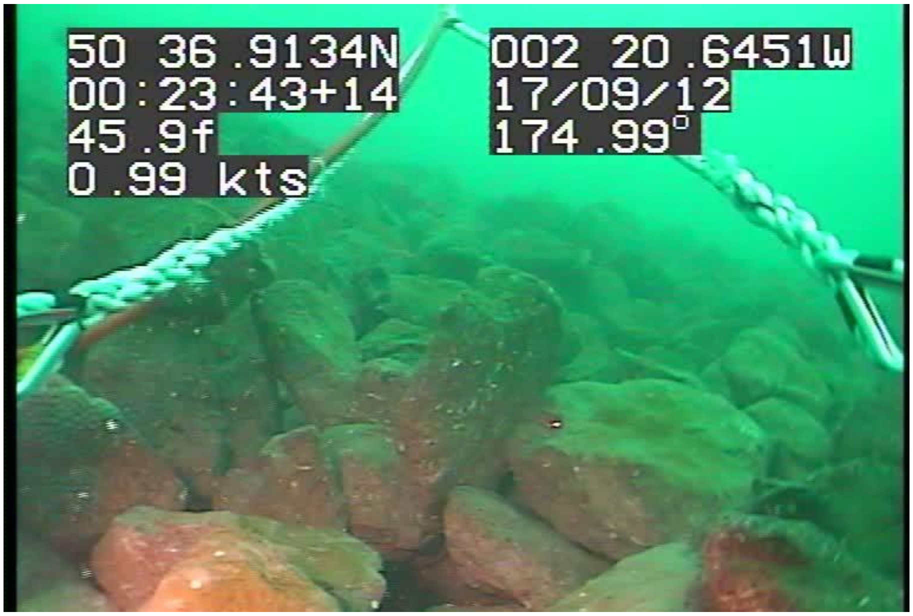


FIGURE 17. SHOAL OF BIB OVER LOBSTER RESTOCKING REEF

Outcomes from survey

The footage from the survey will form part of the monitoring work of the Wreck to Reef project. Some of the footage has already been used in presentations to the public and Dorset Wildlife Trust.

The participants have indicated that they would be happy to carryout future work now that they have gained experience and hope to carry out repeat surveys in 2013 to assess the level of recruitment on the reefs.

The footage will be offered to Universities for future research projects on colonisation and the role of artificial reefs in marine fisheries and conservation management.

Case Study: Survey of a recommended Marine Conservation Zone at Selsey, East Sussex.

Background

The 1290 ha Selsey Bill and the Hounds rMCZ is situated to the south and west of Selsey Bill in East Sussex (Figure 18). The site has been proposed as an MCZ for a series of broad-scale habitats including high energy infralittoral rock (tide and wave swept shallow rocky ground) and sandy and mixed sediment habitats. The rMCZ also includes the Mixon Hole Reference Area, a steep 20 m depression in the seabed that forms a submerged cliff of clay and limestone colonised by a diverse range of species.

The Selsey fishermen have been actively involved in the MCZ process and have participated in the Balanced Seas project providing input and local knowledge. Fishermen have recently raised concerns with Natural England and Sussex IFCA that coastal defence and beach replenishment works along the west facing coast of the site may be causing impacts to the infralittoral rock habitats. There was a suspicion, arrived at through observations while fishing, that shingle from the works was washing off the shore and being deposited over the reefs and rocky ground.

This survey aimed to gather more information on the condition of seabed habitats thought to be affected by shingle inundation and to increase the baseline habitat information about other areas within and adjacent to the Selsey Bill and the Hounds rMCZ.

FIGURE 18. THE SELSEY AND HOUNDS rMCZ

Approach

Where relevant the survey work followed the Step-by-Step approach described in the Seafish Standard Operating Procedure[26].

Step 1: Consultation and Planning

Survey planning involved fishermen working with staff from Sussex IFCA and Natural England via email. Key areas of interest were originally identified focusing on habitats thought to be at risk of shingle inundation. Weather forecasts indicated that these areas could be untenable on the survey dates due to strong winds and exposure so a series of alternatives were identified in the east of the site where there would be more shelter.

A survey specific log-sheet was produced to record tow start and end along with basic seabed characteristics, the presence of shingle cover (%) and abundance of conspicuous species.

The fishing vessel used for this survey was a Kingfisher 32, the *Robert Louise,* operated by Tony Delahunty, Peter Delahunty and Wayne Jones who usually fish a range of static gear for fin- and shell-fish. Also in attendance was Emma Kellman from Natural England and Kat Nelson from Sussex IFCA.

Step 2 Setup and training

The video equipment was set up and tested on board the fishing vessel while at the mooring. A small generator was hired for the survey and was located secured in a sheltered position behind the wheelhouse. The topside unit was positioned on the stern rack which was a perfect area off the deck and away from risk of getting swamped. The rack provided a platform at a comfortable working height; it is common for operators to succumb to seasickness whilst viewing video screens at sea for long periods, especially whilst kneeling or bent over, so being able to either sit or stand is beneficial (Figure 19).

FIGURE 19 WORKING THE VIDEO SURVEY GEAR FROM THE STERN OF *FV ROBERT LOUISE*

[26] Seafish Standard Sampling Operating Procedure -Basic Video Mapping Seabed Habitats

Testing the equipment when tied up alongside gave the participants the opportunity to familiarise themselves with the equipment and for the author to provide training on the survey methodology. This testing highlighted some aspects of deployment that had not previously been considered; the sledge has usually been deployed with some buoyance in the form of a trawl float attached to its rear tubing to maintain horizontal orientation, it was suggested that a tripping line should be attached to the rear of the sledge as a means of recovery should it become stuck fast on an obstruction. This is a commonly used technique to recover anchors in areas with a foul bottom. This proved to serve a dual purpose and was used to maintain horizontal orientation during deployment when stationary.

Due to rising wind conditions on both days the original objectives of surveying the west of the rMCZ were abandoned and the decision to focus on the alternative sites was made. The crew's local knowledge was invaluable in identifying fine scale features as they knew of specific sites where different grounds occurred or where particular species were more common.

Step 3 Video Survey

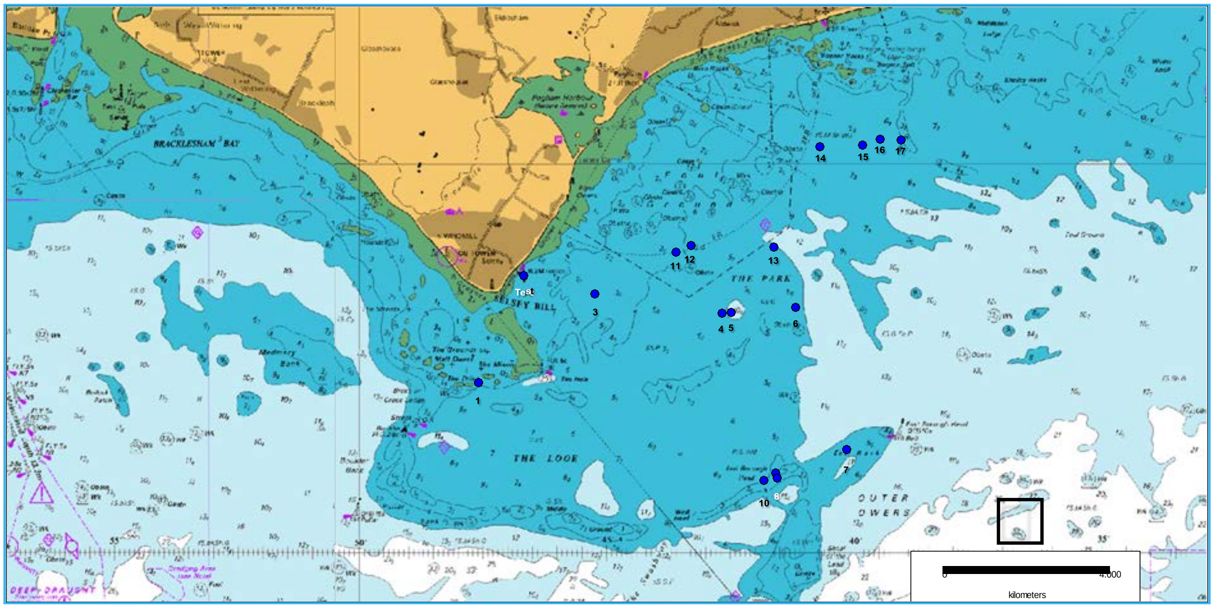
The procedure at each survey station closely followed the Seafish SOP guidance instructions and the video log form was filled out. As there were sufficient crew members and IFCA/NE staff present, key tasks were delegated with vessel crew in charge of deployment and recovery of the sledge and the adjustment of lights, cameras and scaling lasers, topside control unit was operated by IFCA/NE staff.

Recording sheets were completed by IFCA and NE staff with all present observing footage and participating in identification and interpretation.

FIGURE 20. CREW OF *FV ROBERT LOUISE* AND IFCA STAFF WORKING TOGETHER DEPLOYING SLEDGE AND MONITORING VIDEO SURVEY

On the first day the sledge was deployed out of the stern shooting chute. This worked well and the skipper was able to maintain position and a slow speed although as wind and tide increased we found that this became more difficult at the offshore sites. On day two the wind had increased to F5-6 but luckily it was off the land and therefore the sea state was not too rough. The deployment of the sledge off the starboard side enabled the skipper to better control the drift of the vessel in relation to wind and tide.

FIGURE 21. VIDEO STATIONS WORKED DURING THE SURVEY.



Results

A total of 18 video stations were worked recording 2 hours of seabed footage over the 2 days of survey despite being subject to strong winds which normally preclude this type of work.

TABLE 9. TABLE OF VIDEO STATIONS WORKED DURING SURVEY

Station	Lat	Lat min	Long	Long min	Habitat	Conspicuous Species
Test	50	43.5463	0	46.6853	Sand, Cobble & Pebbles	Crepidula, Red seaweed
1	50	42.1597	0	47.6058	Sand, Cobble & Pebbles	Red seaweed
3	50	43.3029	0	45.2355	Gravel	Red seaweed
4	50	43.0516	0	42.659	Gravel	Slipper limpet, Red seaweed
5	50	43.0652	0	42.4559	Gravel	Starfish, Slipper limpet, Red seaweed
6	50	43.126	0	41.1461	Cobble & Pebbles, Gravel	Slipper limpet, Oyster shells, Whelks, Starfish
7	50	41.2934	0	40.1232	Sand	
8	50	40.9942	0	41.5606	Gravel, Sand	Kelp, Red seaweed, Starfish
9	50	40.9229	0	41.5249	Cobble & Pebbles, Gravel	Kelp, Red seaweed, Starfish
10	50	40.8908	0	41.799	Boulders, Gravel	Kelp, Red seaweed, Starfish
11	50	43.8462	0	43.5941	Gravel	
12	50	43.9253	0	43.2881	Gravel	Slipper limpet, Red seaweed
13	50	43.9079	0	41.5954	Gravel, Sand	Red seaweed, Clams, Crabs
14	50	45.2021	0	40.6582	Gravel, Sand	Red seaweed
15	50	45.2301	0	39.7932	Gravel, Sand	Red seaweed, anemone
16	50	45.2967	0	39.4415	Gravel, Sand	Slipper limpet, Red seaweed
17	50	45.2873	0	39.0102	Cobble & Pebbles, Gravel, Sand	Red seaweed

The gravel and shingle areas were commonly observed across the whole area. They typically had a high level of red seaweed cover in the shallow water area (Figure 22).

FIGURE 22. SHINGLE SEABED HABITAT WITH EXTENSIVE RED SEAWEED COVER AT STATION 3.

Slipper limpets (*Crepidula fornicata*) were common across the site but footage from Station 5 showed an area carpeted by this invasive species. Interestingly they were observed to be predated upon by the starfish *Asterias rubens* which may account for the amount of dead shell present. The area is known to attract black bream (*Spondyliosoma cantharus*) in some seasons suggesting that it is foraging area or possibly utilise the shell material as a breeding habitat as at nearby Kingsmere off Littlehampton.

FIGURE 23. CARPET OF SIPPER LIMPETS AND SHELLS AT STATION 5

The hard ground areas around the drying reefs were characterised by kelps and seaweeds (Figure 24). A variety of fauna was observed and a more detailed analysis will be undertaken by the IFCA and NE staff.

FIGURE 24. HARD GROUND AROUND STATION 9

Outcomes from survey

The *Robert Louise* crew were confident that they could carry out similar work unsupervised or in partnership with management bodies. The data gathered during this survey was going to be analysed by IFCA staff and NE and add to the baseline data to inform the management of this site.

Natural England staff were pursuing further funding to enable *Robert Louise*'s crew to train other Selsey fishermen in video survey techniques. It is envisaged that training sessions will take place followed by targeted surveys of the western part of the rMCZ where concerns over shingle inundation remain. The possibility of regular monitoring surveys using local vessels was also being discussed.

Case Study: Survey of a candidate Special Area of Conservation, Lyme Bay (Author Sarah Gall, Plymouth University)

Background

Lyme Bay, situated in the southwest of England encompasses 2460 km^2 from Portland Bill in the east to Start Point in the west (Figure 25). The bay contains a variety of substates, including reefs which have been defined under the Habitats Directive Annex I as 'habitats where animal and plant communities develop on stable boulders and cobbles' (Jackson & McLeod, 2000, 2002). The bay has been designated a marine biodiversity hotspot. These are defined as areas of 'high species richness that include rare and threatened species' (Hiscosk & Breckels, 2007), with rare sunset cup coral *Leptopsammia pruvoti*, and ecologically important ross coral *Pentapora fascialis* both found within the bay. The bay is of great importance to local people and the local economy, supporting both mobile and static gear commercial fisheries and recreational activities including SCUBA diving and sea angling.

In July 2008, following advice from its statutory nature conservation advisors Natural England, who raised concerns that use of bottom towed fishing gear within the bay was causing physical damage to the seabed, the UK Government (Defra) implemented a Statutory Instrument (SI) (The Lyme Bay Designated Area (Fishing Restrictions) Order 2008) which closed a 206 km^2 area to bottom towed fishing gear (Figure 25). The area did, however; remain open to fishing using static gear and to recreational use. The primary conservation objective of the SI was to promote marine biodiversity, namely to allow recovery of biodiversity and ensure the reef structure was maintained. The area has been monitored by Plymouth University and project partners who have conducted annual surveys in the area since 2008 to determine whether recovery is occurring (see Attrill et al., 2011). In August 2010, the SI was encompassed by a candidate Special Area of Conservation (cSAC), part of the Lyme Bay and Torbay cSAC, which was put forward due to the presence of Annex I reef habitat which extended beyond the boundaries of the SI (Figure 25). Use of bottom towed fishing gear was also excluded from the cSAC, with the exception of vessels taking part in an inshore Vessel Monitoring System (iVMS) trial which were permitted to fish in areas between those identified as sensitive reef habitat.

Reef habitat was surveyed by Cefas in the area of the cSAC in 2011, but confidence in some of the data was low. Consequently, this survey aimed to gather more information from an area of low confidence in the east of the cSAC to complement existing surveys and contribute to a robust evidence base from which future management decisions can be made.

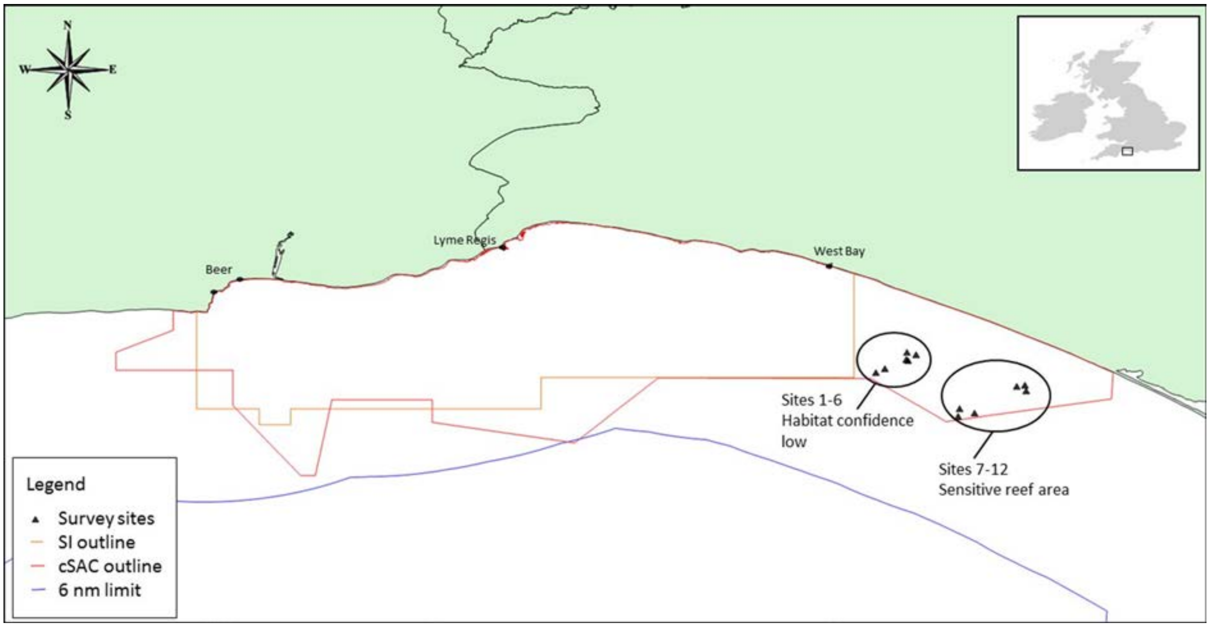


FIGURE 25: LYME BAY CANDIDATE SPECIAL AREA OF CONSERVATION AND STATUTORY INSTRUMENT SHOWING SURVEY SITES

Approach

Where relevant the survey work followed the Step-by-Step approach described in the Seafish Standard Operating Procedure[27].

Step 1: Consultation and Planning

Planning the survey involved fishermen working with PhD students at Plymouth University and staff from Southern IFCA, Devon & Severn IFCA and Natural England to plan suitable dates and methodologies. Survey sites were determined following discussions with Southern IFCA and Natural England who identified areas in the east of the cSAC where confidence in reef data was low. Twelve sites were planned, six within an area open to fishers using bottom towed gear who were participating in the iVMS trial, and six in an adjacent sensitive reef area (Figure 25).

A survey specific log-sheet was produced to record tow start and end along with basic seabed characteristics, the dominant habitat type, conspicuous species observed, and whether these where characteristic of the tow (i.e. of great enough abundance to be present along its length).

The fishing vessel used for this survey was the *Silver Spirit*, based in Lyme Regis operated by Alex Jones and Nigel Marsh who usually fish using static nets, targeting a range of species throughout the year including Dover sole, cod and turbot. Sarah Gall and Adam Rees from Plymouth University also joined the survey, but unfortunately, due to delays caused by the weather, staff from Southern IFCA, Devon & Severn IFCA and NE were unable to come.

[27] Seafish Standard Sampling Operating Procedure -Basic Video Mapping Seabed Habitats

Step 2: Setup and training

The video equipment was set up and tested on board the fishing vessel while at the mooring, providing a chance for some training on the survey methodology and familiarisation with the kit. A small generator was used to power the camera and topside unit and was secured in a sheltered position on deck. The topside unit was positioned on a raised section in the centre of the deck, and the camera equipment was operated from the stern (Figure 26).

FIGURE 26. CREW OF *SILVER SPIRIT* WORKING THE VIDEO SURVEY GEAR FROM THE STERN OF THE VESSEL

Step 3: Video Survey

The procedure at each survey station closely followed the Seafish SOP guidance instructions and the video log form was filled out. Key tasks were delegated, with the vessel crew in charge of deployment and recovery of the sledge and the adjustment of lights, cameras and scaling lasers (Figure 27). Plymouth University students operated the topside control unit and completed the video log at each site (Figure 227). Whilst the tow was in progress, all present observed the footage and participated in identification of species and interpretation of habitat type.

FIGURE 27. CREW OF *SILVER SPIRIT* AND PLYMOUTH UNIVERSITY STUDENTS WORKING TOGETHER DEPLOYING THE SLEDGE AND MONITORING THE VIDEO SURVEY

Initially the sledge was deployed from the starboard side of the vessel, but it became apparent that it was easier for the skipper to control the speed if it was flying from the stern. Once this was altered, deployment was easy and worked well, allowing the skipper to maintain position and a slow speed. Conditions deteriorated throughout the day, with the wind increasing, causing sea state to worsen. Despite this, it was possible to complete sufficient transects. Conditions were very calm on day two, allowing the remainder of the survey to be completed and some exploratory tows to be conducted at sites of interest to the crew.

Results

A total of 12 video stations were worked recording in excess of 2 hours of seabed footage over the 2 days of survey. Basic analysis was conducted, with more detailed analysis to be completed at a later date by Plymouth University students, NE staff and Southern IFCA staff. Video analysis conducted to date has identified the habitat types present and produced species lists for each site for conspicuous species. Table 10 shows a summary of the habitat type and list the most abundant species at each site. Sites 1-6 were in the area where confidence in the reef habitat data was low, and fishing permitted for all static gear vessels, and those mobile gear vessels fitted with iVMS, and sites 7-12 those in the sensitive reef area closed to fishing with mobile gear.

TABLE 10. TABLE OF VIDEO STATIONS WORKED DURING SURVEY

Site	Lat		Long		Dominant habitat type	Characteristic species
1	50	39.5114	-2	43.2730	Cobbles/pebbles	Queen scallop
2	50	39.1251	-2	44.3020	Cobbles/pebbles	Hermit crab, slipper limpet, queen scallop
3	50	39.2531	-2	44.0150	Cobbles/pebbles	Hermit crab
4	50	39.7710	-2	43.3090	Cobbles/pebbles	Queen scallop, hermit crab
5	50	39.5450	-2	43.3320	Cobbles/pebbles	Queen scallop, hermit crab
6	50	39.6970	-2	43.0170	Cobbles/pebbles	Queen scallop
7	50	37.9740	-2	41.6270	Cobbles/pebbles, bedrock & boulders	Hydroids, hydroid & bryozoan turf
8	50	37.7300	-2	41.6730	Cobbles/pebbles some bedrock & boulders	Queen scallop, hermit crab, hydroids
9	50	37.8310	-2	41.1500	Cobbles/pebbles, bedrock & boulders	Hydroids, hydroid & bryozoan turf, common brittlestar
10	50	38.6870	-2	39.8000	Cobbles/pebbles	Queen scallop, common brittlestar
11	50	38.5430	-2	39.5000	Cobbles/pebbles	Queen scallop, common brittlestar, hydroids
12	50	38.7250	-2	39.5410	Gravel	Common brittlestar, queen scallop

The dominant habitat type for sites 1-6 was consistently cobbles/pebbles (Figure 28), although some areas of bedrock and boulders were present at site 2. These areas were characterised by species such as the queen scallop *Aequipecten opercularis*, and common hermit crab *Pagurus bernhardus*, with other species present including the common starfish *Asterias rubens*, common whelk *Buccinum undatum,* and spider crabs *Inachus* spp. and *Macropodia* spp..

A common brittlestar *Ophiothrix fragilis* was present at site 9 (Figure 29), and covered approximately half of the length of the tow.

Sites 7-12 were more characteristic of reef areas, with a total of 34 species identified. Bedrock supporting reef associated species such as ross coral *Pentapora fascialis*, encrusting and branching sponges, hydroids and bryozoans were present at sites 7, 9 and 11 (Figure 30).

FIGURE 28. COBBLE AND PEBBLE HABITAT AT SITE 1

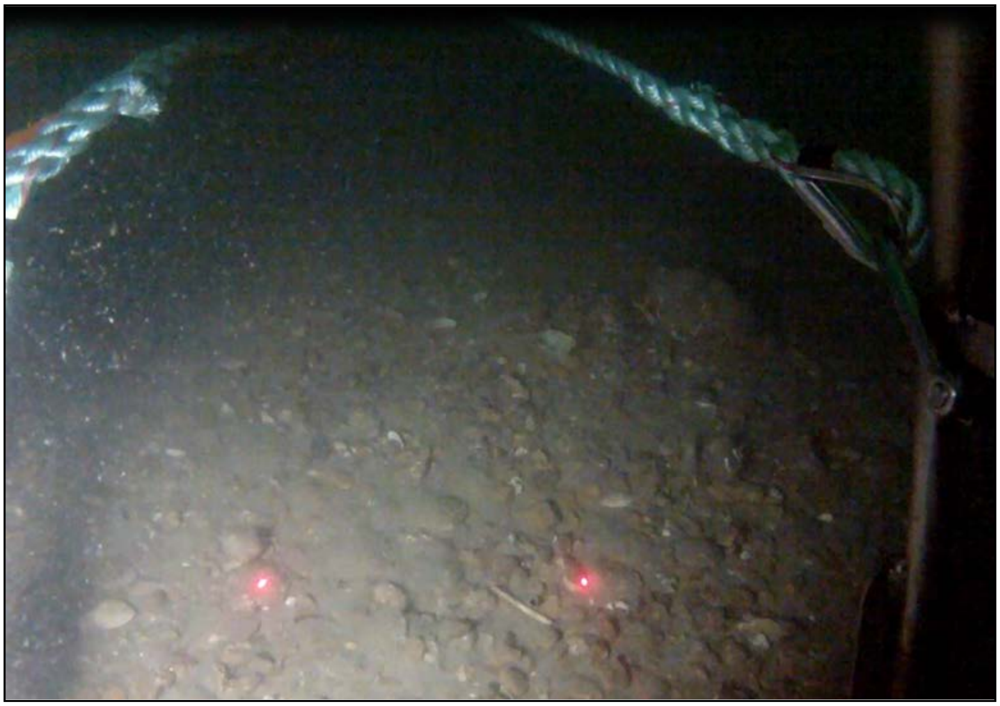


FIGURE 29. BED OF COMMON BRITTLESTAR *OPHIOTHRIX FRAGILIS* PRESENT AT SITE 9

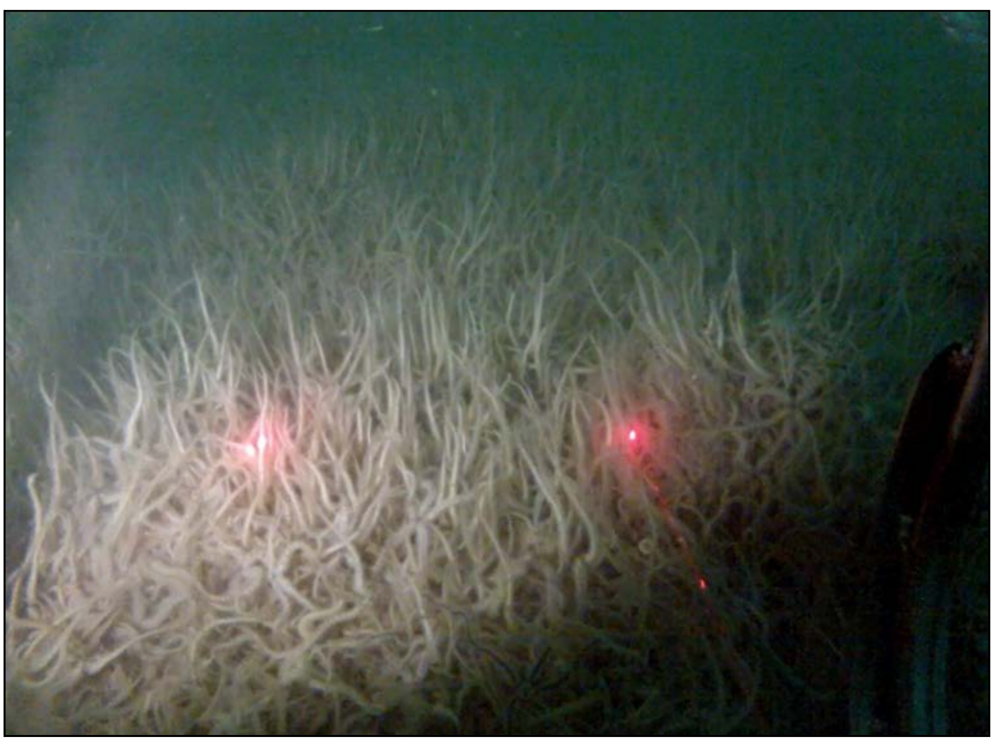


FIGURE 30. BEDROCK AT SITE 9 WITH SPECIES PRESENT INCLUDING ROSS CORAL PENTAPORA FASCIALIS, HYDROIDS AND BRYOZOANS AND A PINK SEA FAN EUNICELLA VERRUCOSA IN THE TOP RIGHT HAND CORNER

A full species list from the basic analysis completed to date is presented in Table 11 over.

Table 11. Species list from video stations worked during survey

Species	Common name	Species	Common name
Actinothoe sphyrodeta	Sandalled anemone	Hydroid & bryozoan turf	Hydroid and bryozoan turf
Aequipecten opercularis	Queen scallop	Hydroids	Unid. Hydroids
Alcyonidium diaphanum	Sea chervil	*Inachus* spp.	Spider crab
Alcyonium digitatum	Dead man's fingers	*Labrus mixtus*	Cuckoo wrasse
Asterias rubens	Common starfish	*Luidia ciliaris*	Seven armed starfish
Branching sponges	Branching sponges (grouped)	*Macropodia* spp.	Spider crab
Bryozoan	Unid. Bryozoan	*Maja squinado*	Spiny spider crab
Buccinum undatum	Common whelk	*Nemertesia antennina*	Sea beard
Calliactis parasitica	Parasitic anemone	*Nemertesia ramosa*	A hydroid
Callionymus lyra	Common Dragonet	*Ophiothrix fragilis*	Common brittlestar
Calliostoma zizyphinum	Painted topshell	*Ophiura ophiura*	A brittlestar
Cellaria fistulosa	A bryozoan	*Pagurus bernhardus*	Common hermit crab
Ciona intestinalis	A sea squirt	*Pecten maximus*	Great scallop
Cliona celata	A boring sponge	*Pentapora fascialis*	Ross coral
Colonial ascidian	Unid. colonial ascidian	*Phallusia mammillata*	A sea squirt
Crepidula fornicata	Slipper limpet	*Psammechinus miliaris*	Green sea urchin
Encrusting sponges	Unid. Encrusting sponges	*Sabella pavonina*	Peacock worm
Erect branching sponges	Unid. Branching sponges	*Sycon ciliatum*	A sponge
Eunicella verrucosa	Pink sea fan	*Trisopterus minutus*	Poor-cod
Gobies	Unid. Gobies		

Outcomes from the survey

The crew of *Silver Spirit* were very enthusiastic about the survey and were confident that they could carry out similar work unsupervised or in partnership with management bodies.

The data gathered during this survey was analysed by Plymouth University, IFCA and NE staff and will add to the baseline data to inform the development of a site management plan being developed by the Blue Marine Foundation Lyme Bay Fisheries & Conservation Reserve project.

References

Attrill, M.J., Austen, M.C., Bayley, D.T.I., Carr, H.L., Downey, K., Fowell, S.C., Gall, S.C., Hattam, C., Holland, L., Jackson, E.L., Langmead, O., Mangi, S.C., Marshall, C., Munro, C., Rees, S., Rodwell, L.D., Sheehan, E.V., Stevens, J. Stevens, T.F. & Strong, S. (2011). Lyme Bay – a case-study: measuring recovery of benthic species; assessing potential "spillover" effects and socio-economic changes, 2 years after the closure. Report 1: Response of the benthos to the zoned exclusion of bottom towed fishing gear in Lyme Bay, June 2011. Report to the Department of Environment, Food and Rural Affairs from the University of Plymouth-led consortium. Plymouth: University of Plymouth Enterprise Ltd. 108 pages.

Hiscock, K. & Breckels, M. (2007). Marine Biodiversity Hotspots: identification and protection. Godalming: WWF UK. Available from: ww.wwf.org.uk/marineact.

Jackson, D.L. & McLeod, C.R. (Eds), (2000,2002) Handbook on the UK status of EC Habitats Directive interest features: provisional data on the UK distribution and extent of Annex I habitats and the UK distribution and population size of Annex II species, Revised 2002, JNCC Report 312, 180 pages, ISSN 0963 8091

Case Study: Survey for Sabellaria spinulosa, Wash and North Norfolk Coast SAC.

Background

The Wash and North Norfolk Coast SAC is an extensive 1078 km^2 site straddling the border of Lincolnshire and Norfolk. The site is designated for a number of Annex I habitats including "sandbanks which are slightly covered by sea water all the time", "mudflats and sandflats not covered by seawater at low tide", "large shallow inlets and bays", and "reefs". The latter for the tube-dwelling polychaete worm *Sabellaria spinulosa* that forms areas of biogenic reef.

Sabellaria spinulosa forms a variety of biogenic structures ranging from isolated patches, more extensive crusts, concretions, and reefs standing proud of the seabed. *Sabellaria spinulosa* is vulnerable to damage and disturbance from mobile fishing gears and other activities that contact the seabed. *Sabellaria spinulosa* can be highly ephemeral, colonising and growing only to be lost a season or two later due to natural processes. In the SAC it is the well-established and persistent "core" reefs that are protected rather than the ephemeral crusts or isolated patches.

Reef and quality of reef is defined as:

- Low reef is between 2 and 5 cm high, covers between 25 and 10,000 square metres, with a percentage cover between 10 and 20 per cent.
- Medium reef is between 5 and 10 cm high, covers between 10,000 and 1,000,000 square metres, with a percentage cover between 20 and 30 per cent.
- High reef is over 10 cm high, covers more than 1,000,000 square metres, with over 30 per cent coverage.

Management and evidence gathering to inform a spatial management approach is an on-going process carried out in partnership with the Eastern IFCA, Natural England and the local fishing industry where shrimp trawling is an economically important activity. Although the IFCA carries out extensive survey work to determine the persistence of the "core" reefs increasing the coverage of the surveys would increase confidence and spatial resolution of the data. The development of video survey capacity within the local fishing industry offers the opportunity for vessel operators to participate in data gathering and to have more confidence in outputs.

Approach

Where relevant the survey work followed the Step-by-Step approach described in the Seafish Standard Operating Procedure[28].

Step 1: Consultation and Planning

Survey planning involved extensive communication between local fishermen and Eastern IFCA and Natural England via email. The nature of the Wash with its shallow water and strong tides made local knowledge vital to time the surveys to best periods of slack water and lower tidal streams.

Areas of interest where core *S. spinulosa* reefs were known to occur were identified and alternatives proposed in other areas of the SAC where there would be more shelter in the event of strong winds.

A survey specific log-sheet was produced to record tow start and end along with basic seabed characteristics, the presence of shingle cover (%) and abundance of conspicuous species.

The fishing vessel used for this survey was a typical local multirole shrimp/shellfish vessel operated by Martin Garnett. Also participating were Paul and Bob Garnett who also operate fishing vessels in a variety of fisheries in the SAC. Jess Woo from Spindrift Marine who is currently working with the shrimp fishery on their management plan to achieve MSC accreditation attended the survey to assist with recording and training.

Due to constraints in staff availability compounded by short lead times necessitated by weather conditions IFCA and NE staff were unable to participate but did provide real- time advice over email and mobile phone during the fieldwork.

Step 2 Setup and training

Testing the equipment when tied up alongside gave the participants the opportunity to familiarise themselves with the equipment and for the author to provide training on the survey methodology. The video equipment was set up and tested on board the fishing vessel while at the mooring. A small generator now purchased as an addition to the Seafish video survey gear was located secured in a sheltered position in the open hold (on these vessels this is a large open space).

[28] Seafish Standard Sampling Operating Procedure -Basic Video Mapping Seabed Habitats

The topside unit was positioned on a jury-rigged platform on top of the trawl winch. This allowed the skipper and operators to view the real-time footage from the wheelhouse which is a benefit when controlling tow speeds (Figure 31). This position also gave a degree of weather protection.

FIGURE 31. POSITIONING OF THE TOPSIDE UNIT ENABLED THE SKIPPER TO OBSERVE FOOTAGE GREATLY HELPING VESSEL CONTROL.

FIGURE 32 PAUL GARNETT DEPLOYING THE VIDEO SURVEY GEAR FROM THE STERN

Step 3 Video Survey

The procedure at each survey station closely followed the Seafish SOP guidance instructions. The video sledge was deployed from the stern quarters where a safe working area existed. As in previous surveys we had sufficient participants to delegate specific tasks. In this case 2 crew members were in charge of deployment and recovery of the sledge and shown to operate and adjust the lights, cameras and scaling lasers. The topside control unit was operated by the skipper Garnett and Jess Woo.

Recording sheet was filled out by staff with all present observing footage and participating in identification and interpretation. This was very much a team effort with the participants showing a great deal of interest.

The tide was running moderately fast (>1.0 knots) over the ground during the first tows which caused the fine material to be re-suspended resulting in very poor visibility on the footage. Controlling speed of the vessel over the ground is typically the main challenge when undertaking video survey work with every vessel behaving differently to wind and tide. The skipper and crew on this survey experimented with a variety of approaches before we were able to achieve an optimum balance. It was clear that video work in the Wash is likely to be limited to times around slack water due to the large amount of suspended material in the water column.

The integrated GPS that supplies position data for the video overlay was unable to fix its position until late in the day of the survey. This was thought to be due to the steel vessel and superstructure obstructing its view of the sky and interfering with satellite signals. A handheld GPS was held in front of the camera but this proved unsatisfactorily due to its reflective screen. The start and stop positions were logged on the recording sheet in order that estimated positions could be derived from the length of the short 5-10 minute (~150 m) tows.

Due to weather constraints, raising wind from the southwest, the sites identified for video survey on the second day were untenable and we were forced to return to port.

Results

A total of 11 video stations were worked recording 2 hours of seabed footage on the survey day.

TABLE 12. FIELD RECORDS OF VIDEO STATIONS WORKED DURING SURVEY. IFCA TARGETS WERE THE CENTRE POINTS OF THE AREAS OF INTEREST

	Tow Start			Tow Stop					
Station	**Time**	**Long**	**Lat**	**Time**	**Long**	**Lat**	**Seabed Habitat**	**Sabellaria Crust Tow (%)**	**Sabellari a Reef Tow (%)**
IFCA Target 1		52.9481333	0.37926666						
IFCA Target 2		52.9523	0.3788						
1	08:13	52.9472	0.37815		52.9505483	0.37994333	Pebbles, Sand	10-25%	10-25%
2	08:34	52.9514033	0.38021166		52.9527983	0.38061833	Pebbles, Gravel, Sand, Mud		
3	08:45	52.9514133	0.380675		52.9541666	0.38032333	Pebbles, Sand	10-25%	10-25%
4	09:16	52.9486666	0.37601666	09:16	52.9490666	0.37633333	Gravel, Sand		
5	09:27	52.9487833	0.37615	09:40	52.9502833	0.37745	Gravel, Sand		
6	09:42	52.9481166	0.38111666	10:00	52.9495866	0.38138333	Sand, Gravel		<10%
7	10:20	52.9750433	0.39951666	10:40	52.9648333	0.4032	Sand	10-25%	25-50%
8	10:47	52.9736833	0.39408333	10:57	52.9748166	0.39458333	Sand	<10%	<10%
9	11:21	52.9881833	0.35361666	11:41	52.9906166	0.35188333	Sand, Gravel		
10	11:55	52.972816	0.35746666	12:08	52.971	0.35818333	Sand, Gravel	<10%	
11	12:47	52.91805	0.40253333	12:52	52.91743	0.40306667	Mud		

FIGURE 33. VIDEO STATIONS WORKED DURING THE SURVEY.

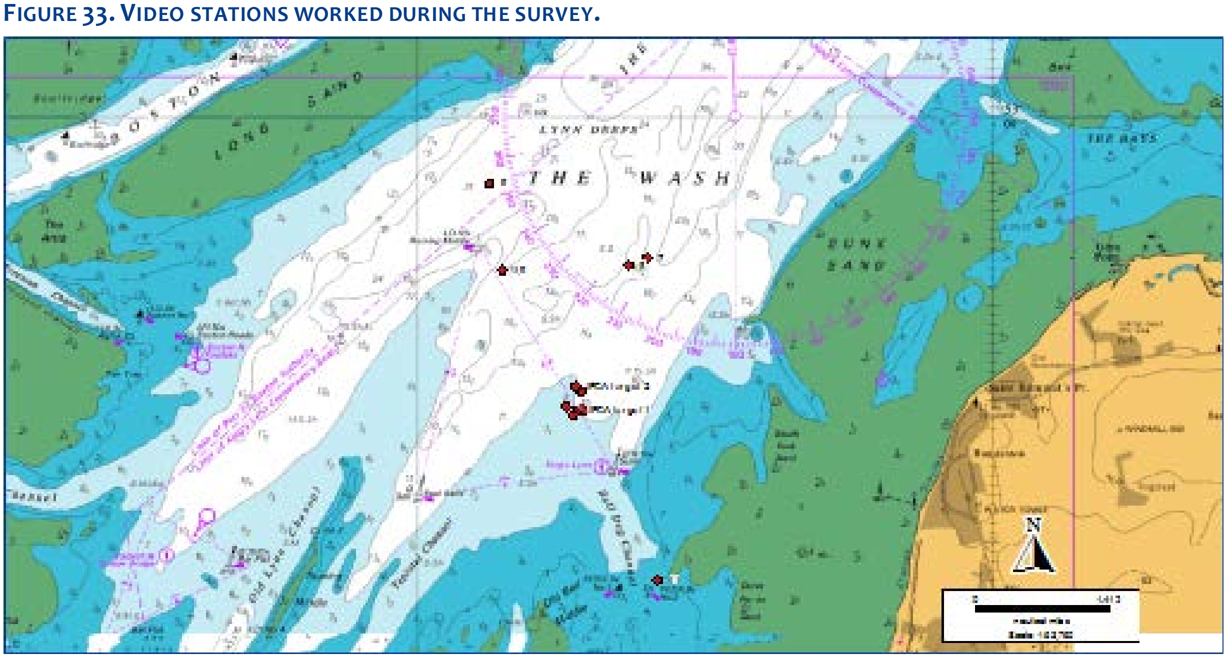


FIGURE 34. *SABALLARIA SPINULOSA* REEF AT STATION 6.

FIGURE 35. *LIOCARCINUS* SPP. SWIMMING CRAB ON SAND AND SHELL GRAVEL AT STATION 7.

Outcomes from survey

The video footage, GIS layers and field records from the survey were submitted to Eastern IFCA and Natural England to be included in their evidence base to inform their monitoring and management.

Participants were confident that they could carry out similar work in partnership with management bodies or scientists in future. Feedback during the survey suggested that although the process is straightforward some of the technicalities do require clear guidance and training. It is recommended that when survey or monitoring programmes are developed that a provision for some training is included at the beginning with telephone support made available throughout.

Adaptations to the topside unit will be investigated in order to improve GPS reception; it is likely that an external aerial will address this issue.