MASTS DPMS1 – small grant

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Introduction

Priority Marine Features (PMFs) are habitats and species which are considered to be marine nature conservation priorities in Scottish waters. In recent years SNH surveys have identified a number of PMFs in the North-East of Scotland, in particular expansive horse-mussel and maerl beds. However, at present, large areas of the Pentland Firth and Orkney waters (PFOW) are still yet to be habitat mapped. The PFOW is currently the focus of planned developments in the renewable energy sector and it is anticipated that an improved method for rapid high quality habitat mapping will be extremely valuable for both spatial planning and monitoring future change in this region.

At Wyre Sound colour sonar data is compared to side scan sonar, the current way of mapping the area. The aim is to assess whether a new type of colour sonar, currently being developed by Kongsberg in association with the Environmental Research Institute, can map benthic habitats better than the current available equipment in Scotland (e.g. side scan sonar).

Methods

A side-scan sonar survey was carried out in the Wyre sound to map Maerl extents within a study area. The survey was carried out in the Wyre sound, between the Islands of Wyre and Rousay in Orkney. The channel is approximately 4 km in length being 1.5 km in width at its widest point and 0.7 km in width at its narrowest. Previous diver surveys had been carried out at the test locations WYS12C WYS11A and WYS10B marked in Figure 1.

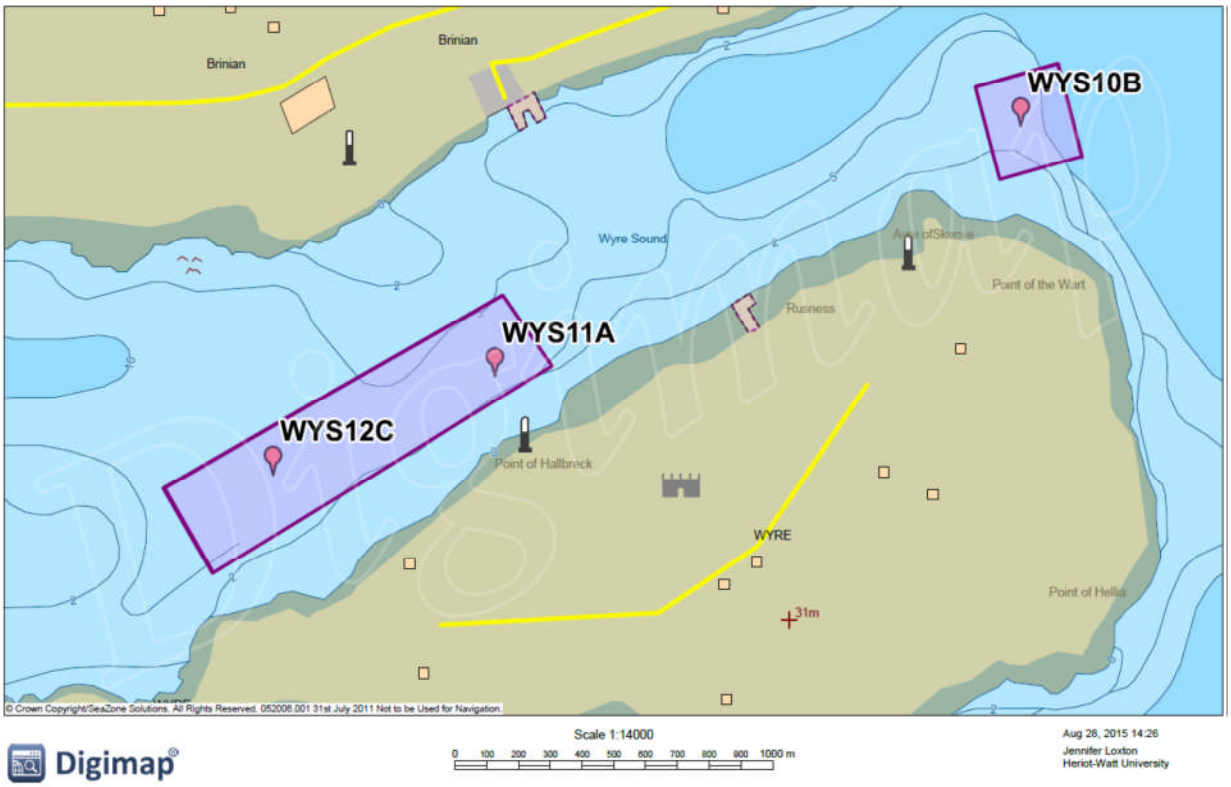

Figure 1: Diver survey sites WYS12C, WYS11A and WYS10B with side-scan survey extents.

Bathymetry

The Wyre sound is a shallow channel with depths <20 m. The central part of the channel is shallower with depths of <10 m.

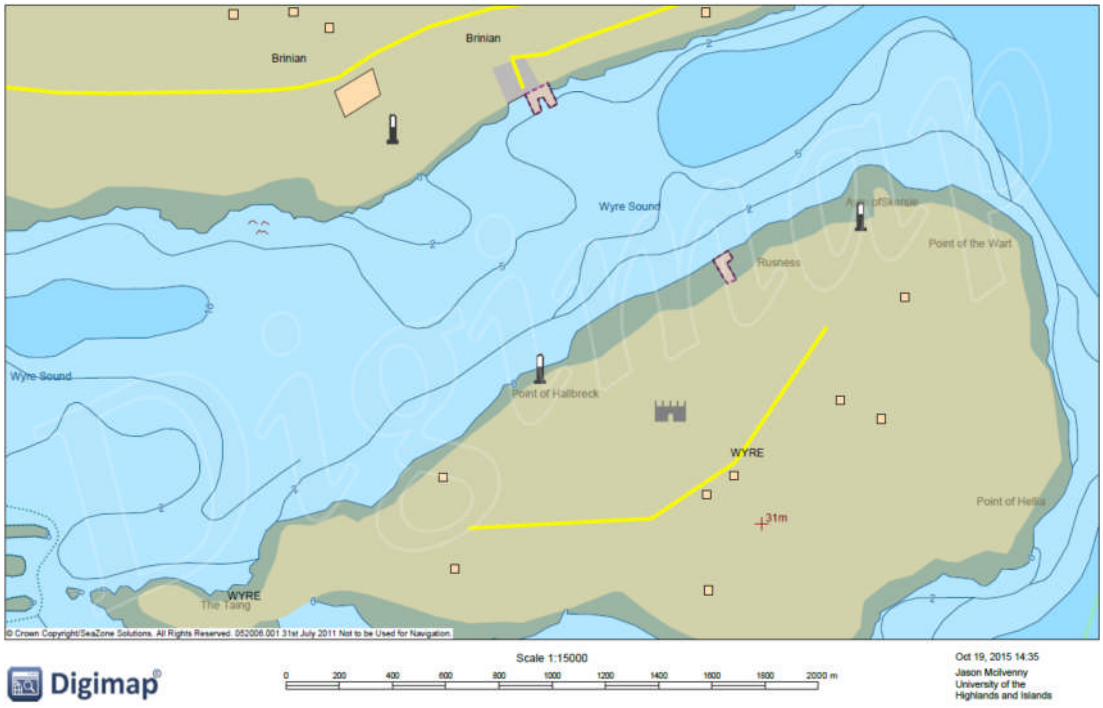

Figure 2: Wyre sound Bathymetry

Current speeds

Astronomical tidal current speeds within the sound are <1m/s (Table 1). Non astronomical generated currents or residual currents may occur in the channel generated by wind and waves and other sources.

Table 1: Tidal currents after Edwards (2012).

Time from HW Dover	Neap		Spring	
Hours	Speed $m.s^{-1}$	Direction	Speed $m.s^{-1}$	Direction
-6	0.2	eastward	0.4	eastward
-5	0.3	eastward	0.6	eastward
-4	0.4	eastward	0.8	eastward
-3	0.6	eastward	1.2	eastward
-2	0.4	eastward	0.9	eastward
-1	0.1	eastward	0.3	eastward
0	0.3	westward	0.1	westward
1	0.3	north-westward	1.2	north-westward
2	0.7	north-westward	1.2	north-westward
3	0.6	north-westward	1.2	north-westward
4	0.6	North-westward	1.0	north-westward
5	0.3	north-westward	0.6	north-westward
6	0.1	eastward	0.2	eastward
Mean	0.4	east-west	0.7	east to northwest

Vessel

The survey was carried out using the MV Challenger vessel based in Orkney (Figure 3). The vessel is an offshore 105 with length of 11m and breadth of 3.4m. The shallow draft of 1 m made it ideal for side-scan operations.

Figure 3: MV Challenger

Side Scan Sonar

A prototype multi-frequency side-scan sonar system developed by Kongsberg GeoAcoustics Ltd. The sonar pings at three frequencies 114, 256 and 410 kHz. The sonar is a basic range only system and provides no bathymetric data along trace. The Kongsberg GeoAcoustics Ltd. propriety software, GeoTexture was used to process the sonar data. GPS navigation and heading data were provided by a Hemisphere Vector V110 unit mounted directly above the side scan pole mount.

The sonar acoustic data acquired at three ping frequencies constitutes acoustic colour data. These were mapped onto the optical primary colours in the electromagnetic spectrum for human visualisation. The side scan sonar was pole mounted on the side of the vessel (Figure 4).

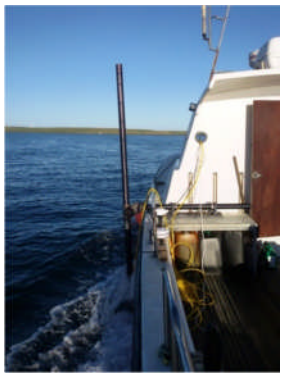

Figure 4: Side scan sonar pole mounted with Hemisphere GPS system position nearby (top) and fish (bottom).

Survey

The survey was undertaken on the 8th of October 2015. Weather was fine with no wind and calm seas. Survey lines were drawn in hydrographic survey software called Hyrdopro which the boat captain could follow. Survey lines were planned at 20 m spacing. Due to the very shallow nature of the bathymetry in places the boats echo sounder was left on for safety. This introduced some noise in the sonar data.

Results

The sonar survey successfully covered the areas surrounding dive sampling sites WYS12C, WYS11A and WYS10B. In some survey lines noise from the vessels echo-sounder is visible however it does not detract from the sonar images on the whole.

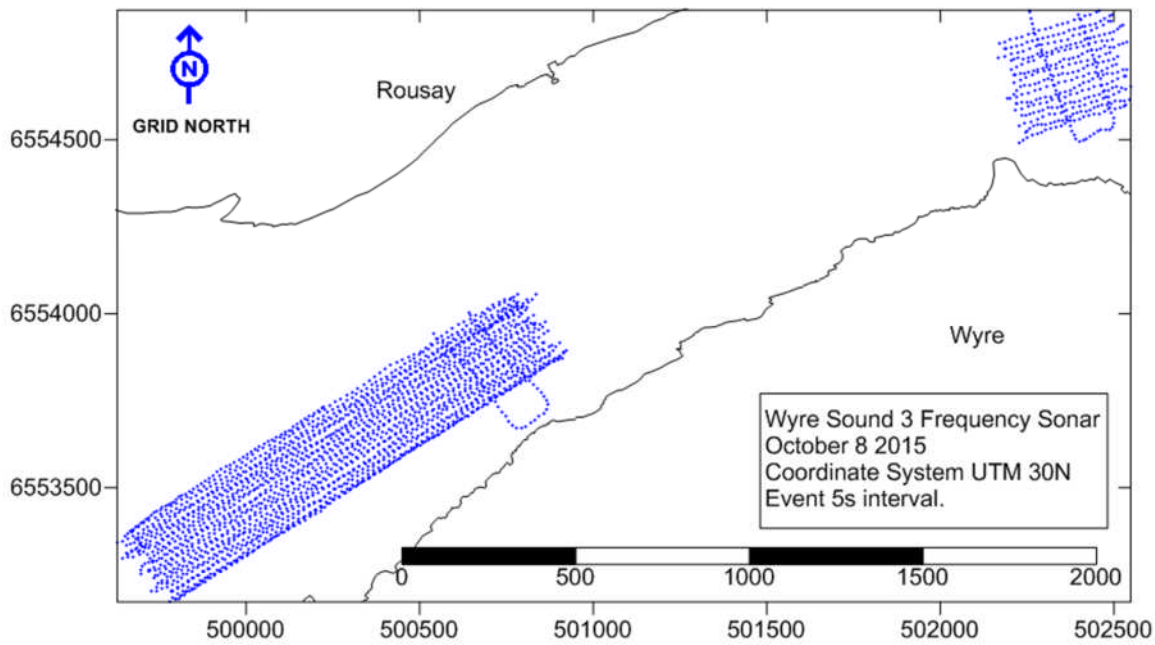

Figure 5: Survey coverage.

The area covering the sampling site WYS12C & WYS11A was found to be primarily Maerl coverage, with the Maerl consisting of a carpet like formation and in places showing tough and ridge morphology (Figure 6: Side scan raw sample image in vicinity of sites WYS12C & WYS11A.. The area surrounding the survey site WYS10B was found to have a steep slope with bare rock in deeper areas and Maerl coverage in shallow waters.

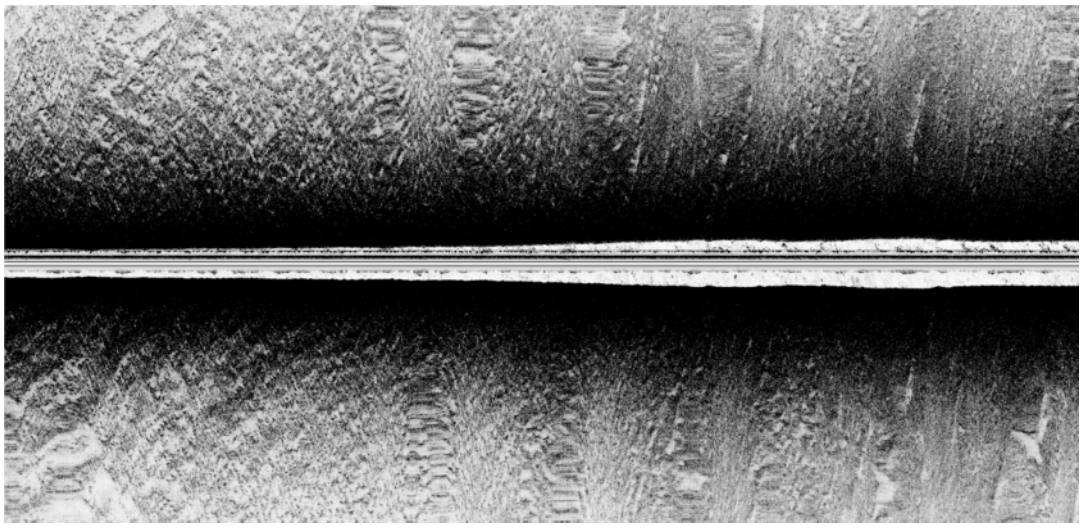

Figure 6: Side scan raw sample image in vicinity of sites WYS12C & WYS11A.

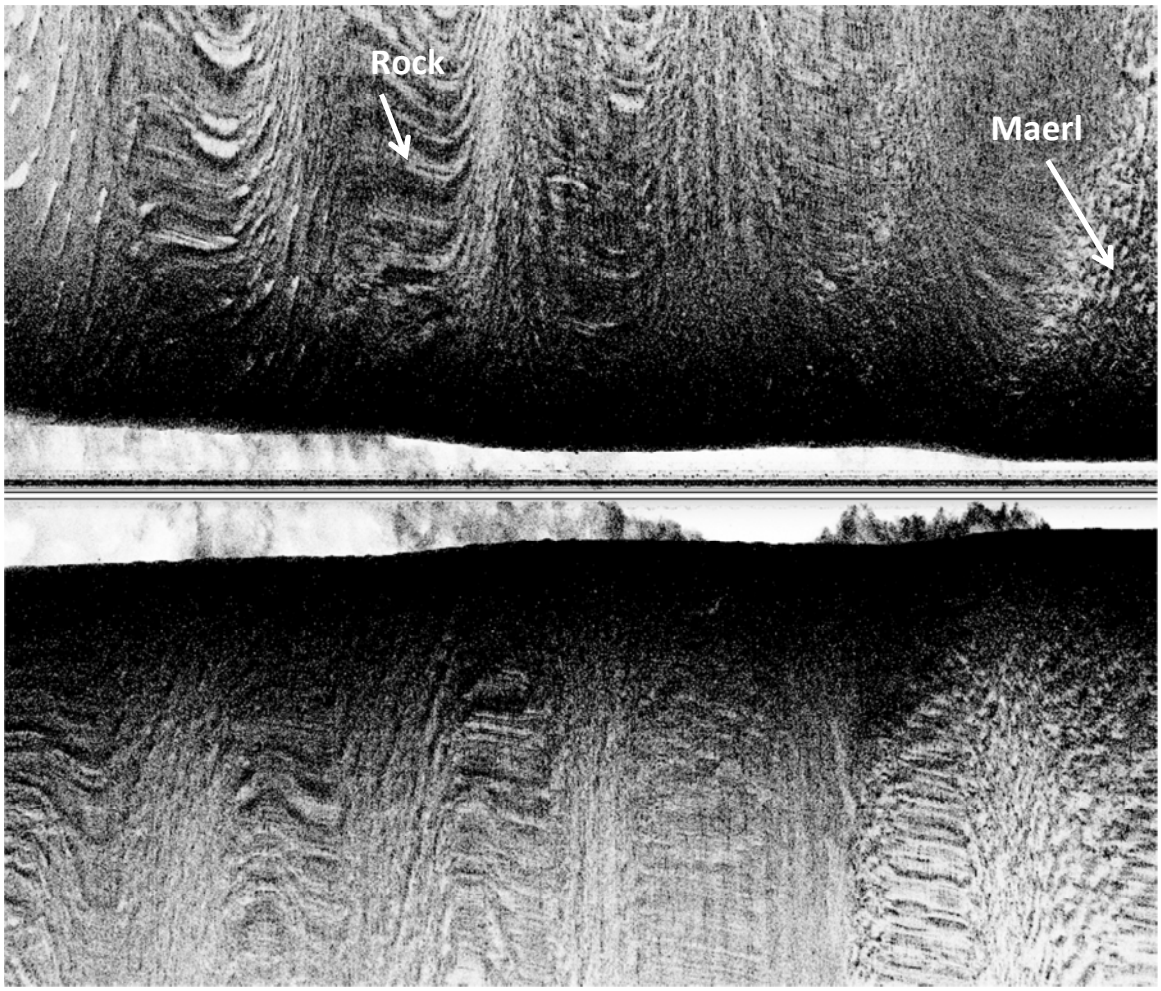

Figure 7: Sample raw sonar image showing port and starboard images.

Further processing is required to generate composite colour images of the three frequency bands however preliminary low resolution results are promising with the maerl bed showing different colour intensities within itself. The edge of the bed can be recognised easily with the naked eye (Figure 8), which was not the case with other methods such as the side scan sonar (Figure 6 & 7) The ground truthing by divers is forthcoming and will allow ascertaining whether the differences in colour represent bioloically meaningful data.

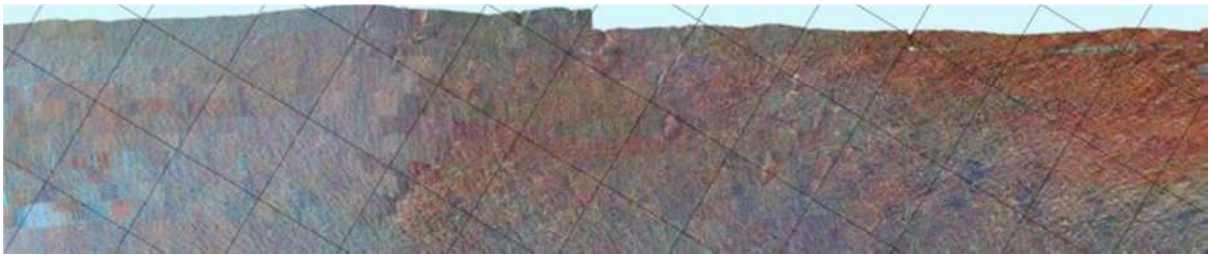

Figure 8: Colour mosaic covering sampling sites WYS12C & WYS11A

Conclusion

The colour mosaic obtained through the new multi-frequency sonar gives enhanced information about the maerl bed in the Wyre sound. For the purpose of quick visualisation of the maerl bed and the positon where it starts and ends, the multi-frequency sonar gives a representation that is easier to interpret than the side-scan sonar. Since there are clear colour differences in the maerl bed, it is expected that the ground truthing will show different properties of the bed in the differently coloured patches (maerl density, rodolith size etc.).

In short, the MAST-DPSM1 small grant has allowed a proof a concept to be made for the multi-frequency sonar and to gain preliminary results about areas of significance to SNH. The next steps are to analyse the ground truthing data and to map the areas fully.