Geophysical Habitat Mapping in Plymouth Sound

Introduction

The aim of the geophysics survey was to assess the sediment type and morphology of the seafloor in Plymouth Sound and to draw conclusions on the habitat type and to determine what benthic species inhabit the area. The survey was composed of 5 transects performed with the side scan sonar in combination with one video footage across the transect area.

Plymouth Sound sits at the mouth of the Tamar Estuary, offshore of Plymouth in the southwest of the UK. Heybrook Bay is located at the south-eastern reach of the estuary, and the Renney Rocks that extend offshore are composed of sandstones, slates and conglomerates of Devonian origin [1] Plymouth Sound has been a Special Area of Conservation since 2005 (Natural England). It is home to a range of fauna and flora which are susceptible to change, so to conserve the biodiversity of the area is key that stable environmental conditions are maintained. The sediment type greatly impacts the range and diversity of the species that inhabit the Sound, hence side scan sonar can be used to assess habitat change across spatial and temporal scales. A specific species of interest within the Plymouth Sound is *Zostera marina*, or more commonly known as seagrass, which is important due to the bed communities they form [2]. Video recording, coupled with side scan sonar, is an ideal method to identify these communities and monitor the changes in habitat type in order to conserve the unique wildlife that dwells in the Plymouth Sound.

Methodology

Date 04/07/2019

Time 12:48 UTC to 14:12 UTC

Start Coordinates 50°18.122'N | 004°07.529'W

End Coordinates 50°18.446'N | 004°06.656'W

Weather 8mph Easterly Wind | 22°C | 1 Okta Cloud Cover | Sea State 1

Tide times High Tide 19:01 UTC | Low Tide 13:03 UTC | Tidal Range of 4.7m

PSO Cameron Jackson-Rowe

Vessel Sonardyne

A real time kinematic (RTK) program was used to produce 4 parallel 1km track lines for Sonardyne to follow. In reality, two of the track lines were shorter due to deviation of the vessel from the guidelines. The swath range was 70m due to the angle of the side-scan SONAR and the shallow depth of the water. A towfish was towed behind the boat at a layback of 6m. The dual frequency 100kHz side scan SONAR was used to map the seafloor habitat as the intensity of the reflected acoustic beams can be used to determine substrata; more intense reflection corresponds with harder substrate and vice versa. The side scan imaging was overlaid onto a plot of the ship's track line produced using Surfer 8 to create a benthic habitat map. However, the transect lines weren't straight so the boundaries of the images overlap and the image is distorted, meaning that features observed are unlikely to be in the locations recorded.

An underwater camera relayed a live video feed to the vessel to film the seafloor for ground-truthing. The vessel drifted whilst the camera was deployed on the offshore side of the boat just above the substrate and video footage was analysed to reveal both substrate and epifauna and nekton present. Timestamps were taken at the beginning and end of the video recording. The video transect was shoot on the 4th of July, starting at 050˚ 18.635N 004˚ 07.638 W at 13:53 UTC and ending at 050 ˚ 18.758 N 004 ˚ 07.780W at 14:07 UTC. This allowed us to survey across the side scan sonar transect area, which was then left to drift towards the shore. The survey was interrupted as the glider was caught on a rope and it was necessary to retrieve it. To identify species, the Marine Life Information Network [3] and the guide Seaweeds of Britain and Ireland were used [4]. No grab samples could be taken for ground-truthing due to the rocky nature of the substrate revealed by side scan SONAR rendering the technique useless.

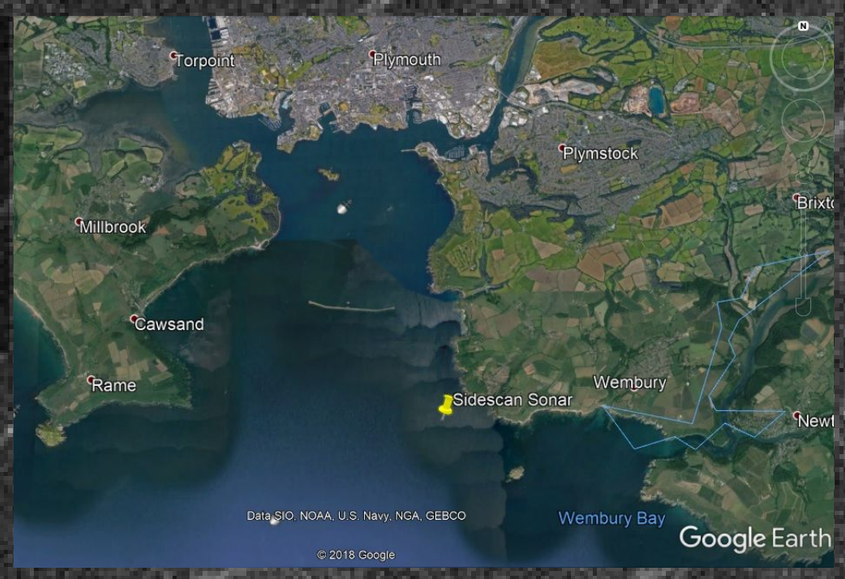

Figure 1
The sampling location of the side scan sonar and video transect in Heybrook Bay

Results

According to the side scan sonar track, the substrate is mainly composed of rocks with a few small sandy areas. On the habitat map (figure 2), the bed environment is divided into 3 zones, with zone 1 being the rocks, zone 2 representing large rocks and zone 3 indicating patches of sand. There are many overlaps and the sandy areas shown are sporadic, although we originally had 2 areas of sand on the side-scan sonar track. This might be due to the fact that the boat tracks are not straight, therefore causing distortion to the shapes. Points outside the limits are the data taken when the boat was turning, which is also where we deployed the underwater camera.

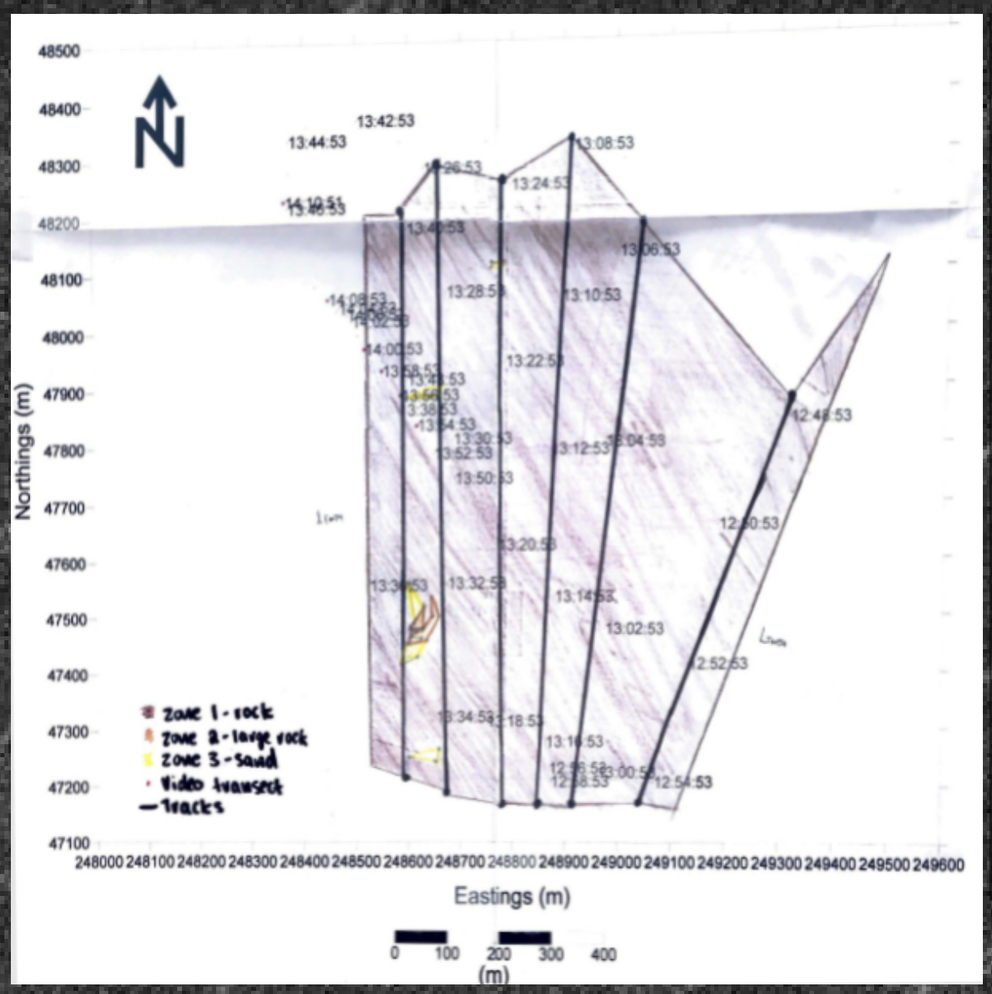

Figure 2
A habitat map produced using results from side-scan sonar survey of Heybrook Bay
Grey represents rocky substrate, yellow represents sand, brown represents large rocks
Dots show the video transect location and lines show the side scan tracklines

The results of the side scan survey suggested that the habitat was rocky. This was confirmed by the video survey, which showed a rocky substrate covered by seaweed with patches of large pebbles. The seaweed cover increased along the transect, covering an average of 70% of the seafloor and six different species of seaweed were identified. The Rhodophyta species *Callophyllis lacinata*, a common species around Britain that grows on rocks at up to 30m depth [4], was present throughout the survey and made up 60% of the seaweed turf. Other significant species present throughout the survey were the brown algae *Dyctyota dichotoma*, which represented around 10% of the seaweed and the sea lettuce species *Ulva linza* (5%). Finally, a few strands of *Fucus* spp. and *Laminaria digitata* were seen in the second half of the transect.

The fauna observed were mainly composed of individuals from the Asteroidea genus *Henricia*, of which 43 individuals were counted. The second most abundant species (23 individuals identified) was the sponge *Cliona celata* in its boring form. Three *Dysidea fragilis* sponges were observed, as well as one sea cucumber and one bony fish, both not identified.

Figure 3
A Henricia sp. (R) and an unidentified bony fish (L)

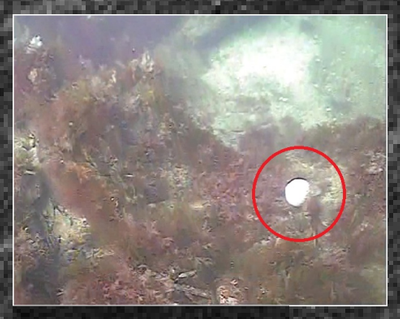

Figure 4
Dysidea fragilis

Figure 5
Two Clione celata (L) and an unidentified holothurian (R)

References

[1] Seago, R.D., 1991. Tectonics and sedimentation in the Devonian and carboniferous rocks of SW Devon, England.

[2] Curtis, L., 2012. Plymouth Sound and Estuaries SAC Seagrass Conditions Assessment 2012. Natural England, p. 6.

[3] Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [accessed 09-07-2019]

[4] Bunker, F. StP. D. Maggs, C. A. Bunker, A.R. (2017). Seaweeds of Britain and Ireland. Second Edition, Wild Nature Press, Plymouth, UK.

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