Geophysics Survey of Plymouth Sound

Aims:
The aim of the geophysics survey was to map the benthic habitat using sidescan sonar by performing a series of five transect lines. This would then allow us to categorise the sediment and draw possible conclusions about the habitats within Plymouth Sound.

Fine Sediment (Lighter Areas):
The majority of our sidescan trace was made up of homogenous finer muddy sediments characterised on our track plot as the broader light patches and confirmed by our video footage taken at multiple transect locations. This finer mud was widely bioturbated, covered in burrows and the shells of the mollusc *Turritella communis*.

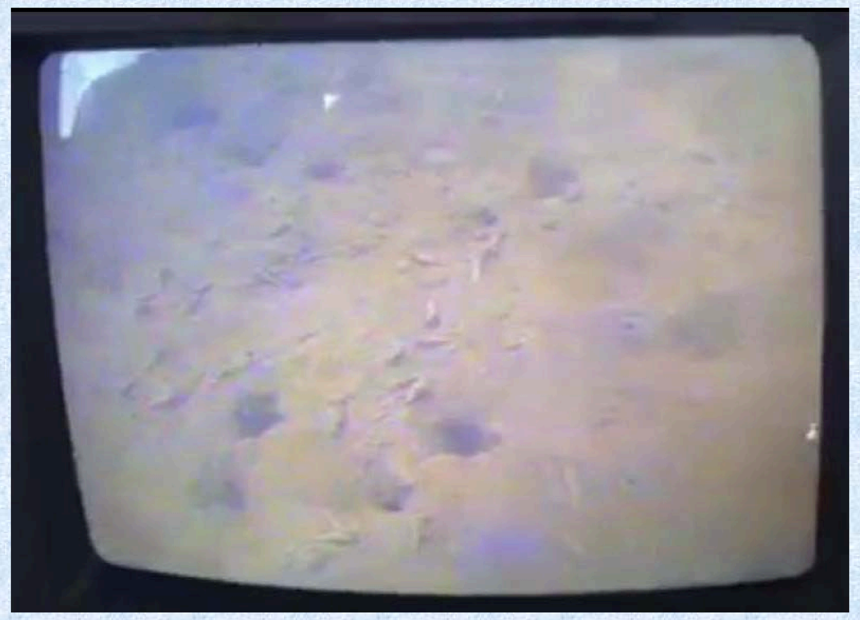

Figure 3.2: Still from video survey from transect 5 showing bioturbated sediment with the shells of the mollusc *Turritella communis*.

Duke Rock and Surrounding Area:
Transect 3 ended roughly above the structure known as Duke Rock this can be seen by the slight swerve for the Duke Rock cardinal buoy in transect 3 roughly where the blue triangle in figure 3.7 is. This gives us an insight into the sediment and habitat type of that area as studies such as the report produced by Vance, 2014 and Ware and Medows, 2012 survey this structure and the surrounding area. With this evidence and the small amount of video we collected we can identify this areas as most likely SS.SMp.KSwSS.LsacR.CbPb which is a biotope classification code which means the are has Red seaweeds and kelps on tide-swept mobile infralittoral cobbles and pebbles, however we can not be certain. Ware and Medows, 2012 also identified that the areas surrounding the rock as A5.43/SS.SMx.IMx, infralittoral mixed sediments this supports the sidescan sonar data we collected and the small section of video from that area. Although we cannot definitively say the sediment and biotope is this as a complete video survey was not performed.

Figure 3.4: Stills from the video survey along transect 2 showing SS.SMp.KSwSS.LsacR.CbPb and SS.SMx.IMx

Darker Areas:
On the sidescan data there were some darker patches meaning there was a change in reflectivity of the substrata. This could be caused by three main reasons; increase in species density, increase in the density of the sediment or that there are air pockets within a species. Air is a very good barrier for sound therefore species which contain air pockets such as some macroalgae return a darker sidescan trace. Unfortunately without video in these areas there is no way to tell which one of these reasons has caused this darkening of the sidescan print out.

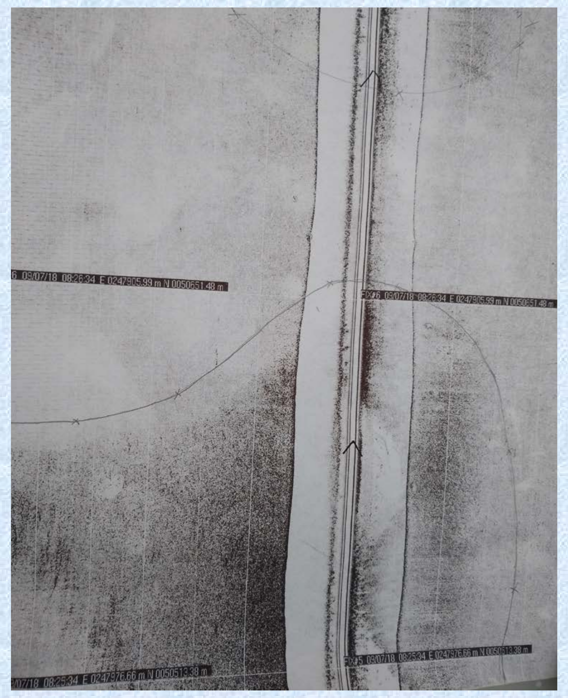

Figure 3.6: Sidescan sonar print out showing the areas of increased reflectivity.

Background and Introduction:
On 09/07/18 between hours 08:00 – 10:00 UTC we ran a sidescan sonar in Plymouth Sound roughly East of the breakwater. Conditions on the day of the survey were hot and sunny with highs of around 27°C and weak South Westerly winds. Low tide was at 09:00 UTC and high tide at 15:13 UTC with a 2.8m tidal variation.
The significance of Plymouth Sound as a Special Area of Conservation (SAC)(Vance 2014) means it's home to an extensive number of flora and fauna determined by a number of variables, an example of these include the rock and sediment type (Vance 2014). Rock and sediment types make up the substrate which can be closely monitored by performing a sidescan sonar, this can then be used to create a substrate/ habitat map.
A notable species of interest that grows in Plymouth sound is Seagrass specifically *Zostera marina* and the bed communities they form (Curtis 2012). By identifying the areas of substrate we know these species to grow on we can film the benthos to potentially locate and identify them. An example of this occurred recently when a new seagrass bed was located off Tomb Rock (Curtis 2012). These seagrasses ultimately form the habitats of multiple species that may not be able to exist without their presence. This highlights the importance of performing sidescan sonars in an attempt to monitor the health of the benthos, and the increase or decline in these significant substrates and the habitats they lead too.

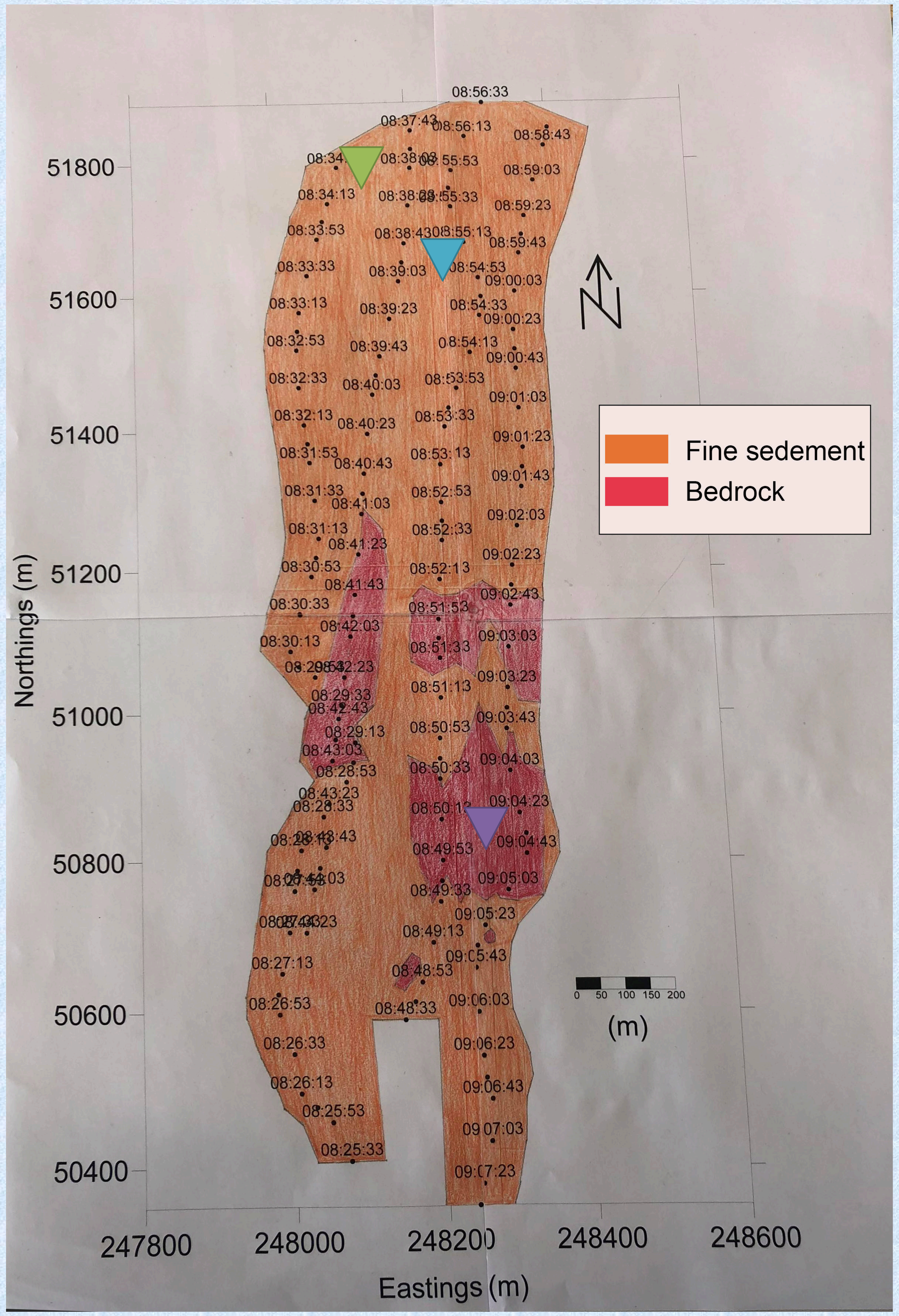

Figure 3.7: Track plot of transects with boundaries of the sediment type with the boundary of the sidescan shown as the outline of the plot with points of interest indicated with their colours corresponding to the colour of the information.

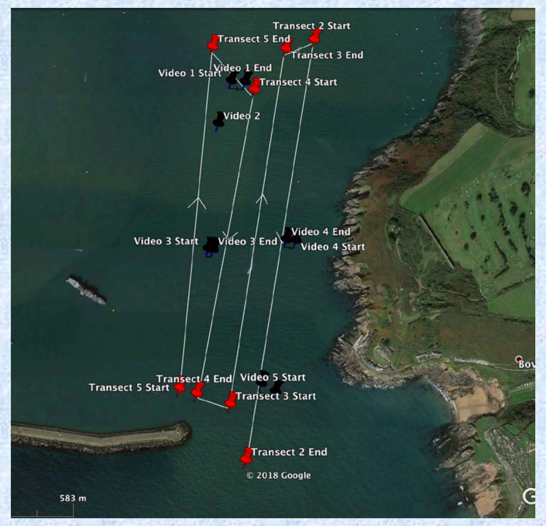

Figure 3.1: Google maps image of our transects with the location of the video surveys marked

Methodology:
We ran a 100 kHz sidescan sonar over five parallel transects, each 100m apart and 1.5km long, all derived from an original transect line starting at coordinates: 50°20.85N, 004°07.85W; finishing at 50°19.95N, 004°07.95W. The sidescan was ran at a 75m slant range off port and starboard while towed at 5-6 knots to give an optimum resolution. The resulting trace, coupled with some live video footage of the benthos along our transects, was used to produce a mosaic of the different benthic substrates in the area surveyed. When back in the lab the ship's track was plotted in surfer and printed out while the sidescan sonar print out was categorised into bedrock and fine sediment. The data from the sidescan was then normalised and used to plot the boundaries on the printed track plot. These boundaries were then coloured to create the final track plot figure 3.7.

Bedrock:
On our sidescan trace there were areas characterised by darker areas next to areas of lighter shadowing. These are sonar shadows caused by something blocking and reflecting the signal back to the boat, essentially meaning the areas of shadowing represent areas of missing data on our track plot. This pattern of darker areas and shadowing shows raised areas of the seabed which can be identified as bedrock formations.

Figure 3.3: Sidescan sonar print out showing bedrock formations

Anthropogenic Structures:
The sidescan sonar also picked up non-biological structures and even the swells of other boats. Between latitude and longitude 50° 20' 38.06", 4° 8' 6.72" and latitude and longitude 50° 20' 32.73", 4° 8' 7.60" we had a boat pass through the path of the survey vessel, the wake of which, was picked up on the sidescan as shown. There was also a structure between 50° 20' 39.14", 4° 8' 2.17" and 50° 20' 44.68", 4° 8' 2.41". Considering the length of the structure to be roughly 68.4m this it is like to be the chain from a buoy.

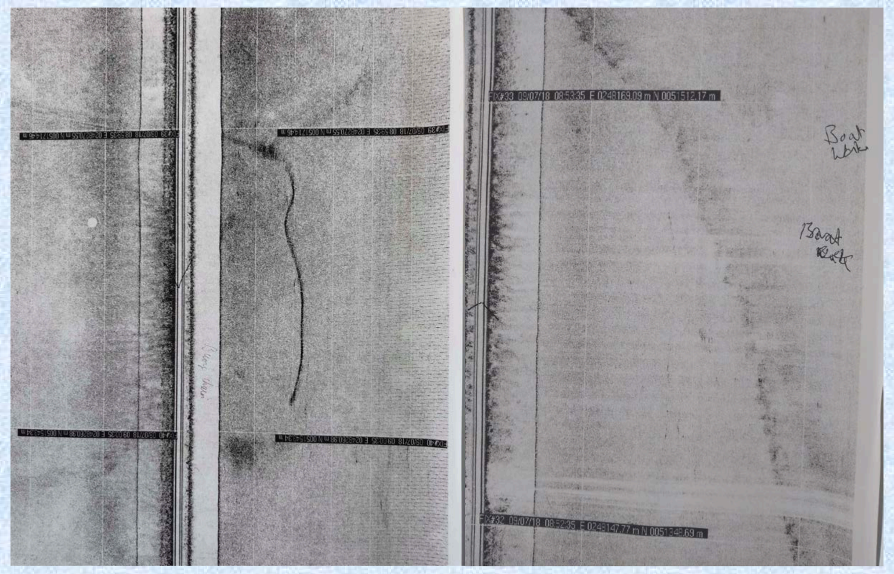

Figure 3.5: Sidescan sonar print out showing the chain from a buoy on the left and a boat swell on the right.

Conclusion:
The sediment of the area Plymouth Sound we sampled can be categorised into two types; bedrock and fine sediment. Although the sediment was much more diverse than just fine sediment in the small portions of video we recorded ourselves, we cannot classify the sediment further. As a result we were unable to classify the habitats but the literature around some areas such as Duke Rock provided us some insight into the possible habitats and biotopes in the survey area.

References:
- Vance, T. (2014). "Plymouth Sound and Estuaries SAC: Sub-tidal and Mixed Gravel Sub-feature and Sub-tidal Rocky Reefs Sub-feature Condition Assessment". Marine Monitoring Framework. *Natural England*, pp.37-38.
- Ware, S. and Medows, B. (2012). "Monitoring of Plymouth Sound and Estuaries SAC 2011". *Natural England*, pp.13-14, 19-20, 23-24.
- Curtis, L. (2012). "Plymouth Sound and Estuaries SAC Seagrass Conditions Assessment 2012". *Natural England*, p.6.