Geophysical Surveying and Habitat Mapping in the Fal Estuary

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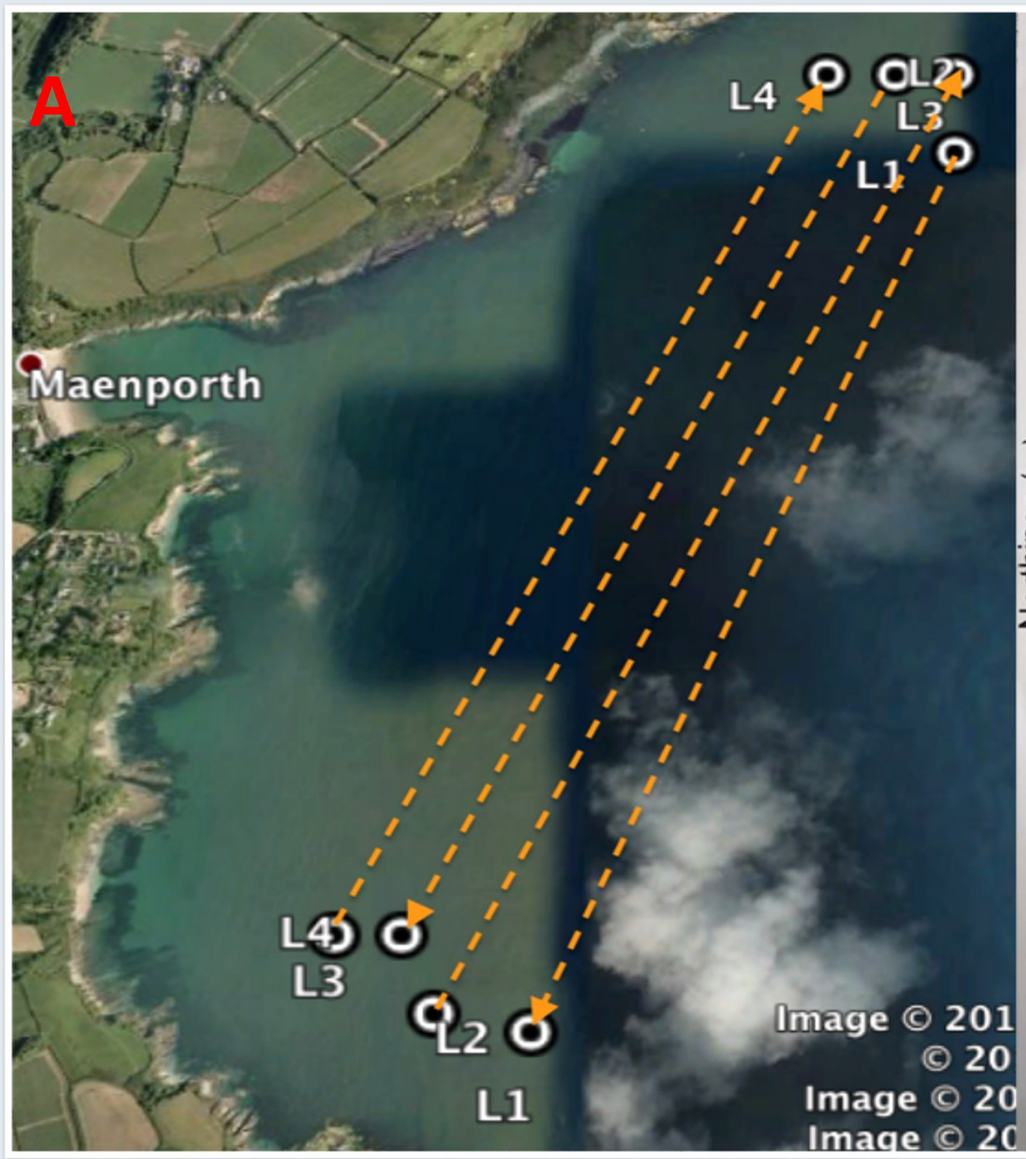
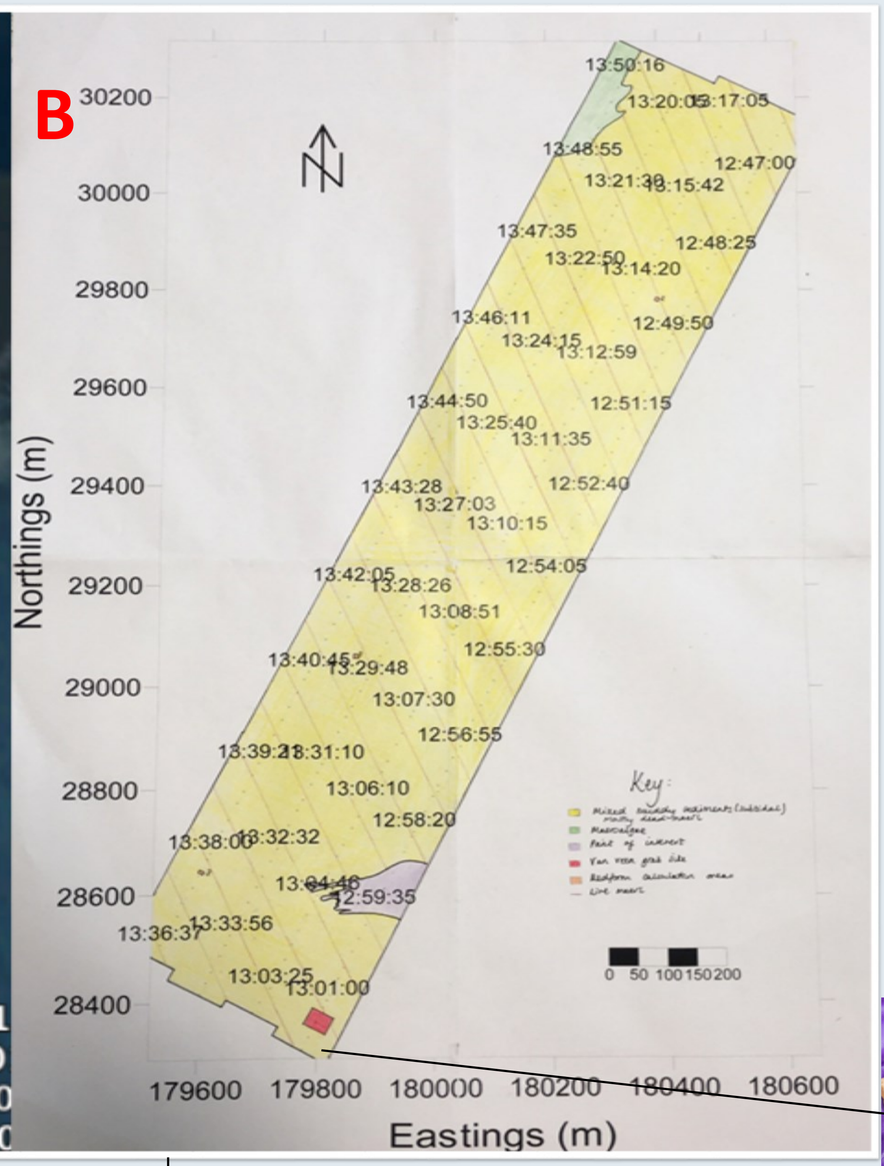
Introduction:

The rise and fall of sea levels during the Holocene period led to the deposition of large quantities of sediment in the upper part of the fal estuary. The flooded system formed (composed of two rias—Bird, 2000) gave rise to a wide range of habitats. Amongst some of the habitats with the highest scientific interest are the sea grass and the maerl beds (the latest one found in the area mapped). The Wheal Jane mining incident in 1992 has had a large impact on the habitats in the region, making the estuary the most polluted in the U.K. even today, 25 years after the incident. The combination of these factors has made the Fal and Helford areas a Special Area of Conservation (SAC) and therefore a license or 'pass' was needed to allow the extraction of grab samples for the analysis.

The aims of this experiment was to differentiate between different habitat types in the Fal estuary, and the biota that inhabits these areas.

***Number figures**: 1– undulations and seafloor pattern, 2– seastar, 3– dead sea scallop 4-maerl bed, 5 – maerl, 6- grab sample, 7– Leptocardii **Letter figures:** A– google earth map with the transect lines fitted on it, B– seafloor habitat map derived from sidescan data*



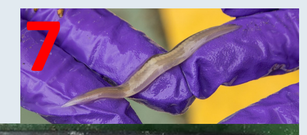


Methods:

- A Side Scan Sonar Tow Fish was used off the stern of the boat to remotely map the seafloor along 4 transect lines (figure A) in site 7 off Maenporth. The sonar images were then used to produce a habitat map by hand.

- Two areas of interest were revisited and video footage was captured to closely analyse the fauna and habitat composition in situ. The video was lost so the pictures used for this poster (figures 1-4) are from the same species found in the footage of another group.

- A Van Veen grab sample was taken at coordinates 50° 06.9 N 005° 04.8 W (red square in figure B) to inspect fauna not seen from the video footage. The sediment was then sieved through 1mm sieves to isolate the fauna and wash the specimens which were identified using a number of I.D guides and dichotomous keys (Fish and Fish, 2011; Hayward, 2012; Naylor, 2011)



Results:

The sidescan revealed a habitat dominated by soft sediment (figure A and B). A small area of macroalgae of the genus *Laminaria* was found on the north west corner of the site whilst an unidentified section was found on the south side. This section (labelled in purple) was lighter than the adjacent sand and had no ripples. The bedform pattern was mainly sinuous transverse and the sediment ripple frequency ranged between 1.45 m and 1.58 m.

The video footage showed the physical structures of the sediment and as seen with the side scan sonar, large rippling bedforms could be identified (figure 1). Numerous examples of marine flora and fauna were able to be identified in situ on the live feed. In the first video several different examples of chlorophyta macroalgae could be seen, the only recognisable example was *Ulva lactuca*. Sand eels were seen shoaling just above the substrate, one sea star was seen (figure 2), as well as numerous dead and alive bivalve species, including a cockle species and three dead scallops (figure 3)

The second video revealed sea stars on 9 occasions, it was believed that at least two different species were captured in the footage, however this cannot be confirmed. Sand eels were observed in a greater abundance in the second video. A greater variety of macroalgal species could be seen in the second video, at least one Laminaria species, *Ulva lactuca*, and numerous other examples of Chlorophyta, Rhodophyta and phaeophyceae could be spotted but not identified. In both videos what was believed to be a holothurian species was seen, but due to video quality constraints and again this cannot be confirmed. Both areas sampled with the camera showed a vast abundance of both live and dead maerl (figure 4). Due to footage recording errors the exact locations of the video trawls cannot be stated as they were saved in the footage.

In the Van Veen grab at 50° 06.9 N 005° 04.8 W recovered a sample composed mostly of dead maerl, live maerl, course sand and mud, containing several examples of benthic fauna (figure 5 and 6). Several polychaete worms were sieved from the sample (figure 8), including a terrebellid worm. Two cephalochordates were found in the muddy portion of the grab sample; this was later identified to be a member of the class *Leptocardii (figure 7)*. One isopod crustacean was later identified to be a member of the family *idotidae.* Numerous empty bivalve shells were found, as well as 2 live samples of *Abra alba* and throughout the sample many broken shell fragments from bivalves and gastropods were found. The empty unbroken shells were brought back to the lab and were identified to be those of Venerupis saxatilis (2 specimens) Abra alba (3 specimens) and Dosinia spp. (2 specimens). The shells of several smaller bivalve species were recovered but not identified.

Discussion:

The abundance of chlorophyta and maerl and the presence of mud not far below the surface suggest that this is not a very dynamic area. The only area that would be unidentified is the section labelled in purple (figure B). This section was described as a paleo-river bed by another group last year, but this year it was not further inspected under the false in situ assumption that it was an anomaly. Its composition is not known exactly but the smoother appearance on the side-scan suggests a finer sediment as less backscatter and subsequently a "smoother" appearance was produced. Without ground truthing of that area it is impossible to have an accurate answer for the habitat type in that area.

The live specimens retrieved from the grab such as the polychaetes, bivalves and cephalochordates inhabit a muddy/sandy sediment. The sediment was layered with maerl at the sediment-water interface and finer fragments of maerl, coarse sand and mud beneath. Assuming the conditions were consistent over the whole area marked as live maerl and subtidal mixed muddy sediment on figure B, the existence of a large infaunal bivalve community is possible either in recent times or in the past. The empty valves found in the grab sample may have been washed into the sample area over time, this may be why very few live bivalve specimens were found in the grab. Another possibility is that surrounding the sample area there are zones with a finer sediment, offering a habitat for the burrowing infauna which in time will have led to shells being washed into our sample area. When the shelled organisms die their shells are subject to spatial migration with ocean currents, this may explain why the concentrated zones of organic matter, shell fragments and other bioclastics are found in the troughs of the sediment ripples in the video footage. The video showed a dead scallop with the valves still connected meaning the scallop died recently.; despite not seeing any live scallops in the footage or the grab this does support the idea of a nearby community, potentially in the maerl covered zone, as they only occasionally are found in muddy areas (Marshall & Wilson 2008).

The habitat type depicted by the side-scan sonar, video footage and the Van Veen grab are all consistent, this supports the accuracy of our habitat map as the side-scan sonar was used to plot the expanse of the habitat type.

From broader research and visual inspection of our sample it is clear that the maerl bed explored during our habitat survey was not a pristine, healthy habitat. The majority of the maerl recovered was dead or fragmented; live maerl has a vibrant pink/purple colour (Perry and Jackson 2017), whereas the maerl seen in our explorations was dull and brown. This may be a contributing factor as to why the biodiversity of the grab sample and video footage was low, only healthy maerl beds are host to a wide range of species and generally have a high biodiversity (Scottish national heritage, 2017).

References

Fish, J. and Fish, S. (2011). *A student's guide to the seashore*. Cambridge: Cambridge University Press.

Hayward, P. (2012). *Handbook of the marine fauna of north-west Europe*. Oxford [u.a.]: Oxford Univ. Press.

Heritage, S. (2017). *Maerl - Scottish Natural Heritage*. [online] Snh.gov.uk. Available at: http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/maerl/ [Accessed 12 Jul. 2017].

Marshall, C.E. & Wilson, E. 2008. *Pecten maximus* Great scallop. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/species/detail/1398

Naylor, P. (2011). *Great British marine animals*. Cornwall: Published by Sound Diving Publications.

Perry, F. & Jackson, A. 2017. *Phymatolithon calcareum* Maerl. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: http://www.marlin.ac.uk/species/detail/1210