Bathymetric Terrain and Substrate Characterization in Killary Harbour, Ireland

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ABSTRACT

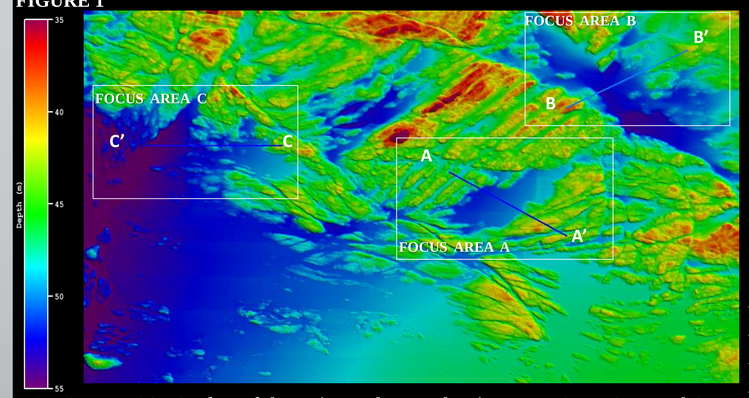
Killary Harbour in western Ireland is one of three fjards found in the country. A fjard is formed by glacial carving, but differs from fjords in being shallower, shorter, and broader in profile. The Harbour is located near the border of County Mayo and County Galway. The Marine Institute of Ireland, The Geological Survey of Ireland, and the INFOMAR project, led by chief scientist Kevin Sheehan, conducted bathymetric surveys in Killary Harbour during July and August of 2014 aboard the R/V *Celtic Voyager*. The area of study is a shallow harbor with seafloor depths ranging from 15 to 60 m. An abundance of rocky outcrops and narrow channels are present in the study area. Backscatter data collected during acquisition were used to determine the relative hardness of seafloor sediments and rocky outcrops. Characterization of the bathymetric terrain and sediments of the harbour could prove to be useful in finding hardbottom substrate for ideal fish habitat.

BACKGROUND

Killary Harbour is a shallow harbour in western Ireland. It has an average depth of 15m and a semidiurnal tidal range of 3.7m (Nunes et al., 2011). Killary Harbour is known throughout Ireland as a fisheries resource abundant with both mussels and salmon. The salmon of this region come to lay their eggs safely up river at the beginning of the summer. Salmon farming in the harbour began only a few decades ago (Rodon et al., 1987). The rocky outcrops of this area are ideal fish habitat. The purpose of this study, is to characterize the sediment of the area in an attempt to find the most ideal habitat for resident fish.

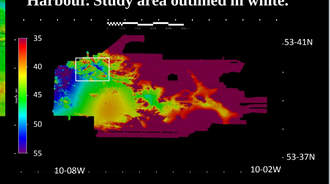
STUDY SITE LOCATION

FIGURE 1



1m CUBE BASE Surface of the entire study area showing Focus Areas A, B, and C, along with profile locations. Depths range from 32 to 58 m.

Google Earth image showing study site off the West Coast of Ireland



1m CUBE Base Surface of Killary Harbour. Study area outlined in white.

RESULTS

- The basins in Focus Areas A and C (Figs. 2a and 6a, respectively), show a very low intensity return, indicating softer substrate.
- Most rocky outcrop areas show high intensity backscatter return, indicating harder substrate.
- The deeper portion of Focus Area B (Fig. 3a), had a strong backscatter return indicating hard-bottom, and suggests it is a high-energy channel, rather than a sediment-filled basin.
- Focus Area B has the highest concentration of both mixed and strong backscatter returns (Fig. 5)

FOCUS AREA A

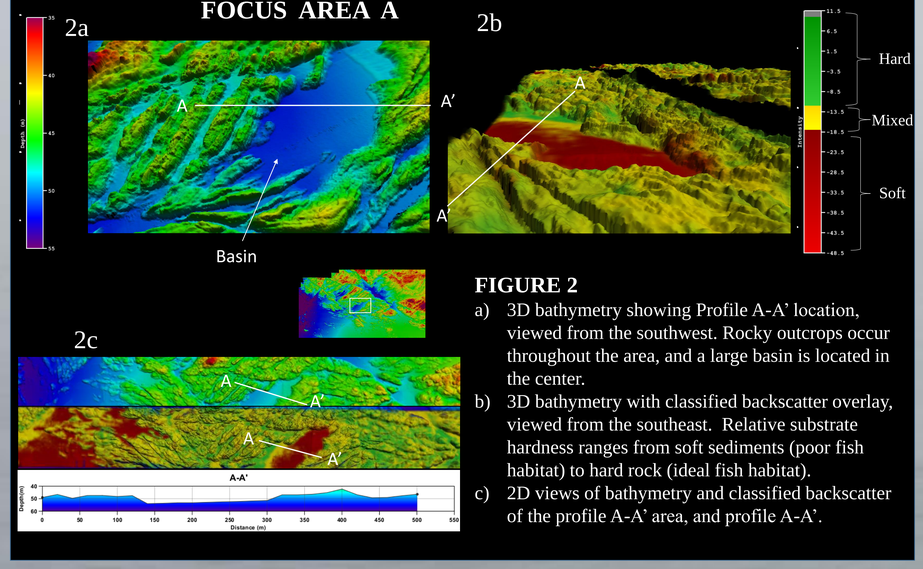


FIGURE 2

a) 3D bathymetry showing Profile A-A' location, viewed from the southwest. Rocky outcrops occur throughout the area, and a large basin is located in the center.
b) 3D bathymetry with classified backscatter overlay, viewed from the southeast. Relative substrate hardness ranges from soft sediments (poor fish habitat) to hard rock (ideal fish habitat).
c) 2D views of bathymetry and classified backscatter of the profile A-A' area, and profile A-A'.

BACKSCATTER CLASSIFICATION

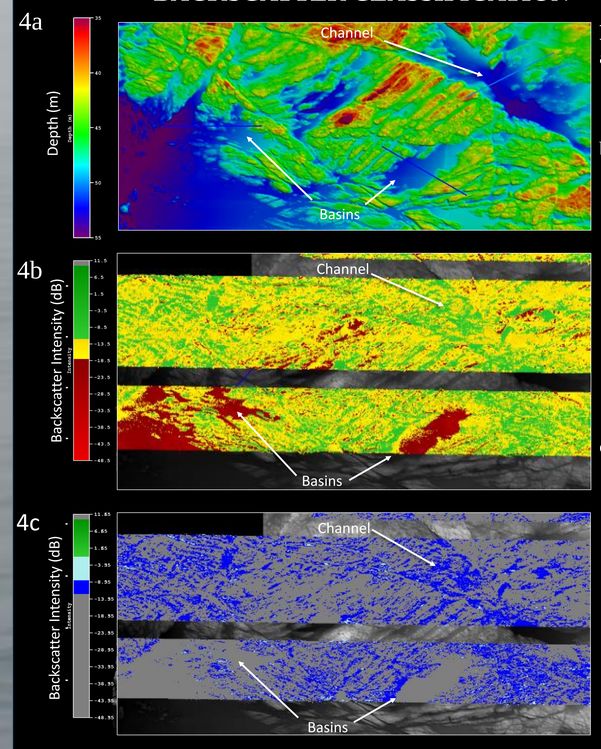


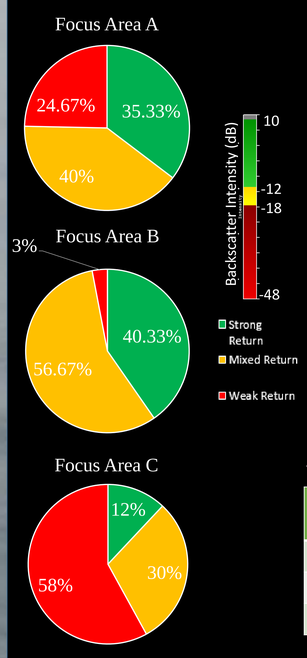
FIGURE 4

a) Bathymetry shows the study area where backscatter data were processed.

b) Classified backscatter intensity shows areas characterized by relatively soft, mixed, and hard substrates. The figure shows the distribution of intensities(dB). Soft (-54 to -18 dB) is shown in red, mixed (-18 to -12 dB) is shown in yellow, and hard (-12 to 10 dB) is shown in green.

c) High intensity (hard substrate) backscatter was further classified in an attempt to find the areas of hardest return, > -12 dB. The figure shows the distribution of intensities, of -12 to -8 dB in blue, -8 to -1 dB in teal, and -1 to 10 dB in green. Most of the hard substrate found in the study area is in the blue range.

FIGURE 5



Focus Areas A, B, and C, and their respective percentages of substrate types.

Area A shows over 35% strong backscatter return, indicating hard-bottom substrate.

Area B (the channel) had the highest concentration of hard bottom substrate (40%), with very little soft substrate (3%).

Area C (the large basin) had the highest concentration of soft substrate with 58% of the area having a weak backscatter return. The hard bottom substrate comprised only 12% of this area.

TABLE 1. Backscatter intensity distribution.

	Focus Area A	Focus Area B	Focus Area C
Strong	35.33%	40.33%	12%
Mixed	40%	56.67%	30%
Weak	24.67%	3%	58%

FOCUS AREA B

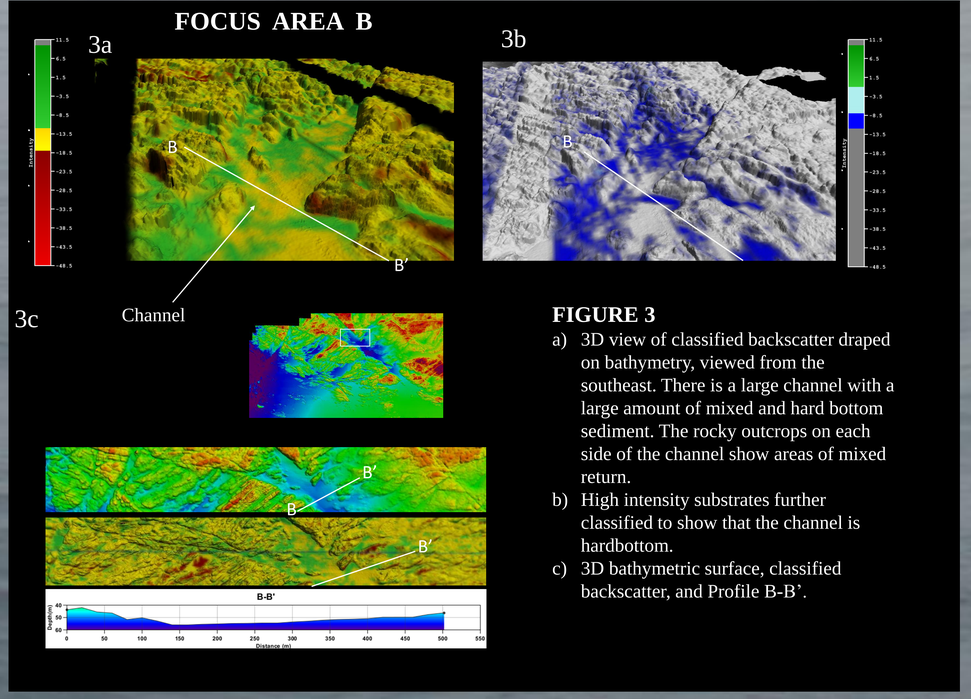


FIGURE 3

a) 3D view of classified backscatter draped on bathymetry, viewed from the southeast. There is a large channel with a large amount of mixed and hard bottom sediment. The rocky outcrops on each side of the channel show areas of mixed return.
b) High intensity substrates further classified to show that the channel is hardbottom.
c) 3D bathymetric surface, classified backscatter, and Profile B-B'.

FOCUS AREA C

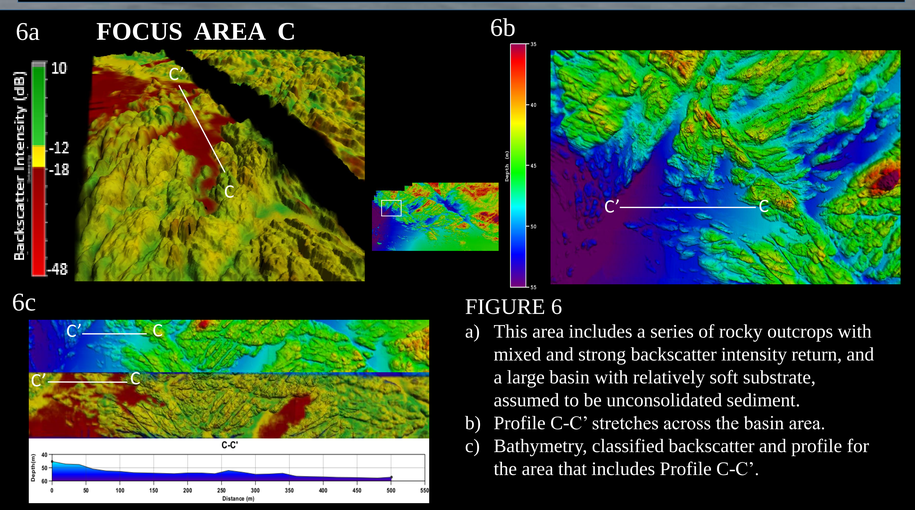


FIGURE 6

a) This area includes a series of rocky outcrops with mixed and strong backscatter intensity return, and a large basin with relatively soft substrate, assumed to be unconsolidated sediment.
b) Profile C-C' stretches across the basin area.
c) Bathymetry, classified backscatter and profile for the area that includes Profile C-C'.

DISCUSSION

Some of the areas of rocky outcrops exhibited a weaker backscatter intensity return relative to the narrow channels in between them. Tidal flows would most likely be channeled through these areas and remove any soft, unconsolidated sediment that had been deposited (Nunes et al., 2011). The deeper channel seen in Fig. 4a most likely has a strong backscatter return for the same reason. The 3.7m semi-diurnal tide must funnel in and out of the area.
The basins seen in Fig. 2a and measured in Fig. 2c most likely have relatively weaker returns because they are open areas where sediment gets trapped in the depressions. Fig. 3c was determined to be a channel and not a basin after examining backscatter strength and the greater depth relative to the other two channels. Hard bottom areas were prevalent throughout the study area, likely because of the area's strong tides. Further research could be done closer to shore in an attempt to characterize ideal mussel and fish habitat.

METHODS

- INFOMAR and the Marine Institute of Ireland, led by chief scientist Kevin Sheehan, collected raw bathymetric data during July and August of 2014 aboard the *R/V Celtic Voyager.*
- A Kongsberg EM2040 multi-beam sonar was used to collect raw bathymetric data and backscatter data.
- CARIS HIPS and SIPS 9.0 was used for data post-processing. A 1m resolution CUBE base surface was generated.
- Backscatter characterization was also done using CARIS HIPS and SIPS 9.0.
- Grids were set up over the profile areas on backscatter surfaces and used to determine the percentage of hard, mixed, and soft sediment.

REFERENCES

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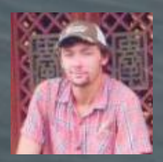

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