Bathymetric and Geomorphologic Characterization of the Mouth of Shannon, Ireland

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ABSTRACT

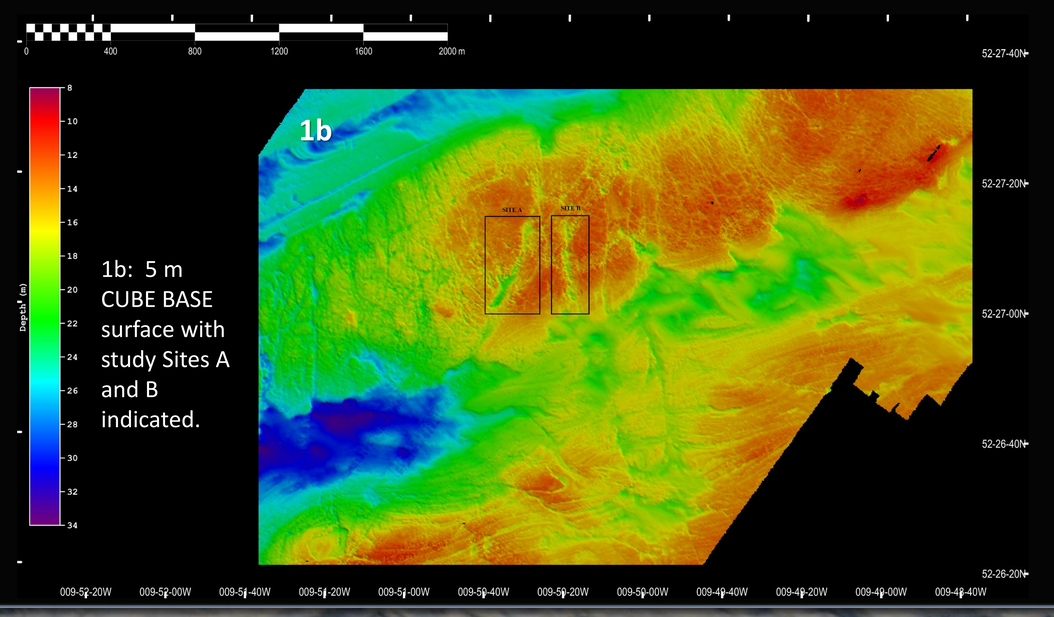
The Shannon Estuary is located on the west coast of Ireland where Ireland's longest river, the River Shannon enters the Atlantic Ocean. In late July of 2011, the Marine Institute of Ireland surveyed the 15 km wide estuary mouth between Loop Head and Kerry Head, which narrows to just over 3 km between Kilcredaun and Kilconly Headlands. Data were collected aboard the Institute's R/V *Celtic Voyager* using a Kongsberg EM3002 multibeam echo sounder and were processed using CARIS HIPS & SIPS 8.1 to map the basin's geomorphology. Marine development opportunities and sheltered deep-water add ecological and economical value to the Shannon Estuary. This study characterizes the seafloor of the southern portion of the estuary mouth, using bathymetric data. For example, bathymetric data revealed a significantly large area potentially consisting of bedrock buried under soft mud extending to both edges of the mouth at approximately 20 meters. Creating a slope image, using Base Editor 4.1, reveals steep edges inferring that they are rocky outcrops.

INTRODUCTION

INFOMAR is a joint research program between the Geological Survey of Ireland and the Marine Institute, and is the successor to the Irish National Seabed Survey (INFOMAR, 2011). The Marine Institute's R/V *Celtic Voyager* commenced data acquisition of a near shore seabed at Mouth of Shannon, Ireland (Figure 1) on July 19, 2011. During the course of the two week survey, the Mouth of Shannon was mapped up to the 10 m contour. Acoustic surveying took place during daylight hours as it is within a Special Area of Conservation (SAC) for resident bottlenose dolphins (INFOMAR, 2011). Sheltered deep-water also provides for a host of biological specimens such as squat lobsters, brittle stars, shrimp, crabs, and solitary corals (INFOMAR, 2011). The Marine Institute advocates a better understanding of how dredging projects interact with the marine environment by conducting surveys to study the physical and biological environment (Marine Institute, 2011). This study will contribute precise characterization of these rocky outcrop environments, as they are essential for fish that are dependent on the marine ecosystem to provide optimal conditions for growth, successful reproduction, and survival. The purpose of further researching the Shannon Estuary is to provide accurate knowledge of surrounding sediments, as they contain records of past climate change, they are important biological habitats, and they are sinks for offshore pollutants (Ulster, 2015). Shannon Estuary marks the path for the vessel import/export industry which must be managed, as heavy traffic requiring future dredging can potentially interrupt the ecosystem. Furthermore, this information will review the importance of sediment, hard bottom seafloor, and marine biodiversity all of which make up an ecosystem (Cronin et al., 2006).

Figure 1: Location of Study Area

1a: Google Earth image, showing study area on the west coast of Ireland, within the Shannon Estuary.



1b: 5 m CUBE BASE surface with study Sites A and B indicated.

SITE	PROFILE	RELIEF (m)	WIDTH (m)
A	A-'A	4.5	85.0
	B-'B	4.5	25.0
	C-'C	4.5	35.0
B	D-'D	3.4	30.0
	E-'E	3.2	25.0
	F-'F	3.1	30.0

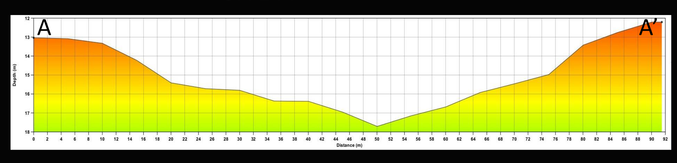
Table 1: Profile measurements for Sites A and B. To determine width, measurements were taken from the west to east edges where the slope began to even out .

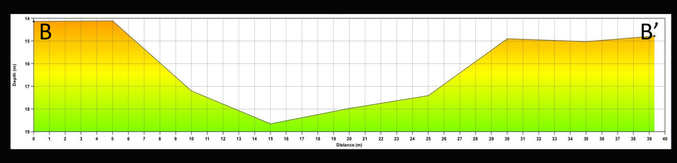
METHODS

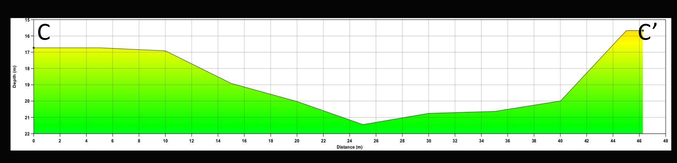
- The Marine Institute's R/V *Celtic Voyager* surveyed the southwest portion of the Mouth of Shannon in July 2011.
- The ship was equipped with a Kongsberg EM3002 multibeam sonar system.
- The acquisition software used was Kongsberg's Seafloor Information System (SIS).
- CARIS HIPS & SIPS 8.1 was used to create a 5m resolution CUBE BASE surface.
- Profiles were created and analyzed using Base Editor 4.1.

Figure 2: Profiles for Sites A and B (locations are shown on Fig. 3b) were studied to distinguish suitable habitat and help visualize relief. Both Sites share areas of similar channel widths.

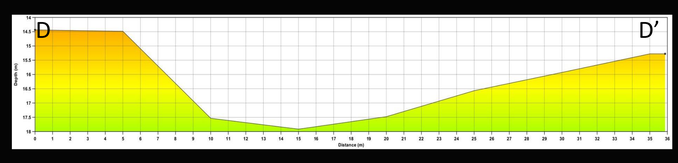
SITE A

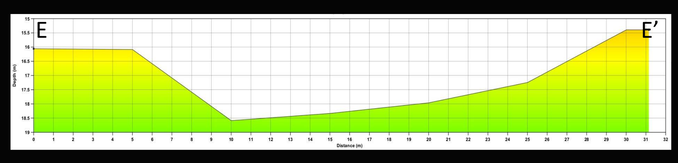


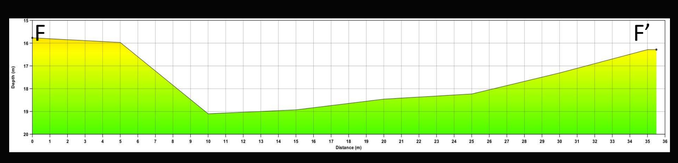


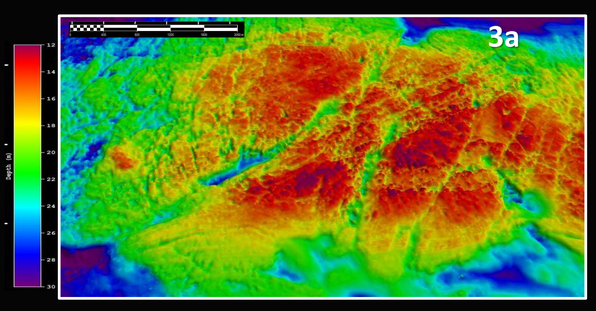


SITE B







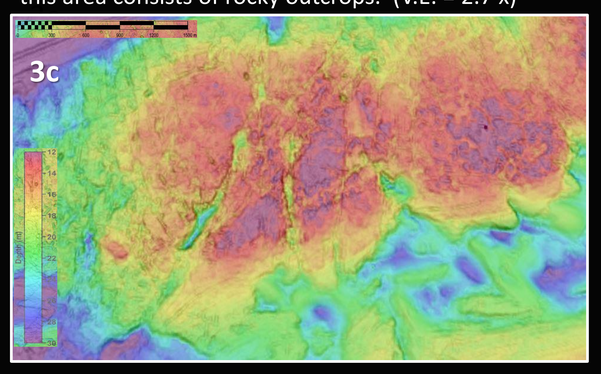


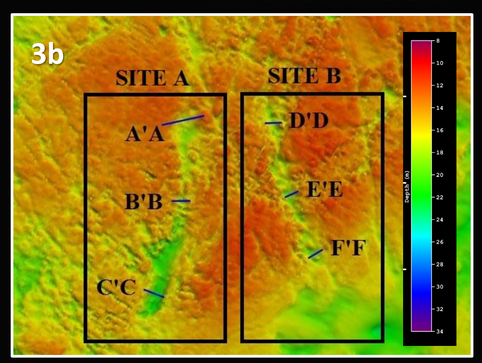
3a: Oblique view of study area (V.E.=2.7x)

Figure 3: 3D 5m CUBE BASE Surface

3b: Profiles A-A' through F-F' were taken to measure relief within their respective joint channels. The profiles were created along each Site's channel axis.

3c: Base Editor slope image overlain on depth layer. Steep slopes along these erosional channels suggest this area consists of rocky outcrops. (V.E. = 2.7 x)





RESULTS

- Bathymetric high: 8.24 m Bathymetric low: 33.24 m (Figure 1b)
- Bathymetric and slope data were used to characterize a variety of seabed features and revealed areas of shallow rocky outcrops (Figures 3a and 3c).
- Sites A and B reveal erosion channels within rock outcrop joints which have created protected habitats (Figure 3b).
- Profiles A-A', B-B', C-C', D-D', E-E', and F-F' have channel ledges with 2.5 to 5.0 m relief (Table 1) and surface depths ranging from 17.6 to 21.4 m (Figure 2).
- Site A channels have an average width of 48.3 m and Site B has an average width of 28.3 m (Table 1).

DISCUSSION

Hard-bottom sea beds are ideal habitats for species that need to attach to the substrate, such as sponges and cold water corals. Small organisms such as juvenile fish and crabs also require hard substrate to find overhangs and pits that offer protection from predation. Soft sediment can settle around these rocky outcrops allowing organisms to create surface mounds or burrow within the substrate, which is important for the recycling processes essential to ecosystem stability (Thrush, 2002). Further data collection is needed to generate backscatter images to better interpret sea bed substrate in this area.

Profiles A-A' through F-F' all exhibit shallow depths and low relief (Table 1) that would be affected by the hydrodynamics associated with dumpsites. Sediment transport is influenced at dispersive sites which can result in material settling at a distance from where it was released (Cronin et al., 2006). Dredging of the estuary promotes a direct ecological influence to habitat structure, function, and marine biodiversity as dredged material disperses contaminants which reflect long-term pollution within an oceanic environment. Sediment composes approximately 70% of the earth's seafloor and plays a crucial role as it contributes to an ecosystem's processes where thresholds are threatened by human disturbance (Thrush, 2002). Depending on the nature and/or quantity of dredged material, the type of substrate and its associated marine communities, a dumpsite proximal to sites such as Special Areas of Conservation, sensitive ecosystems, or protected species may increase the ecosystem sensitivity rating (Cronin, et al., 2006).

After analyzing the Shannon Estuary, erosional channels within rock joints having edges of low relief were identified. It can be suggested that these sheltered areas create the ideal habitat for various marine biota. The Shannon River's high vessel traffic will require dredging to maintain safe harbor depths which could influence the habitat area of Sites A and B.

REFERENCES

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