Mapping fish accumulations as additional environmental data during a hydrographic survey with a multi-beam echo sounder

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Introduction

Modern multi-beam echo sounders (MBES) are advanced devices for active underwater acoustic surveys. Their versatility allows to perform various environmental studies:

- **Bathymetric measures** to cover efficiently large surfaces [1];
- **Acoustic imagery** to inspect natural and artificial structures [2];
- **Seabed classification** based on bottom roughness, depth and backscatter [3];
- **Water column imagery (WCI)** to investigate several components present between the surface and the seabed [4].

Compact MBES, such as the R2Sonic 2022, allow to realise this four types of studies. In shallow waters, their WCI are resolute enough to reveal fishes - individuals and schools, even if this device is not dedicated to the fishery sciences (Fig 1).

Main goals

- Exploit the WCI to inventory fishes present during a hydrographic surveys
- **Map the fish accumulations**
- **Classify the detected fishes**
- Correlate the detected fishes with the seabed classification

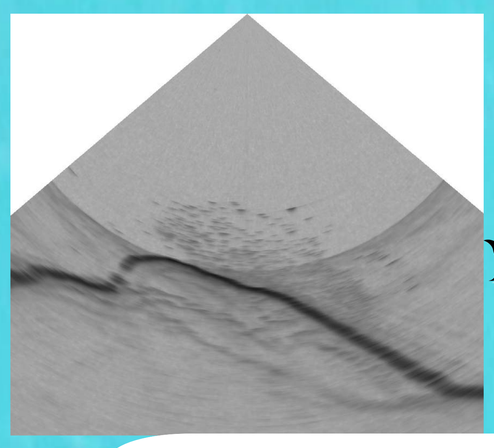


Fig 1. This is a portion of a WCI presenting the seabed bottom (dark line) and a fish school.

WCI Processing

- **Truncate** the WCI to a Region of Interest (arcs in yellow in Fig. 2)
- Fix a **threshold** value to binarize the WCI for the whole area
- **Segment the objects** in the WCI (in blue in Fig 2.)
- **Compute features** for each objects (size, centroid, signal intensity)
- Sort the objects to **keep only the fishes** (fishes are in circle in Fig. 2)
- Map the fish accumulation.

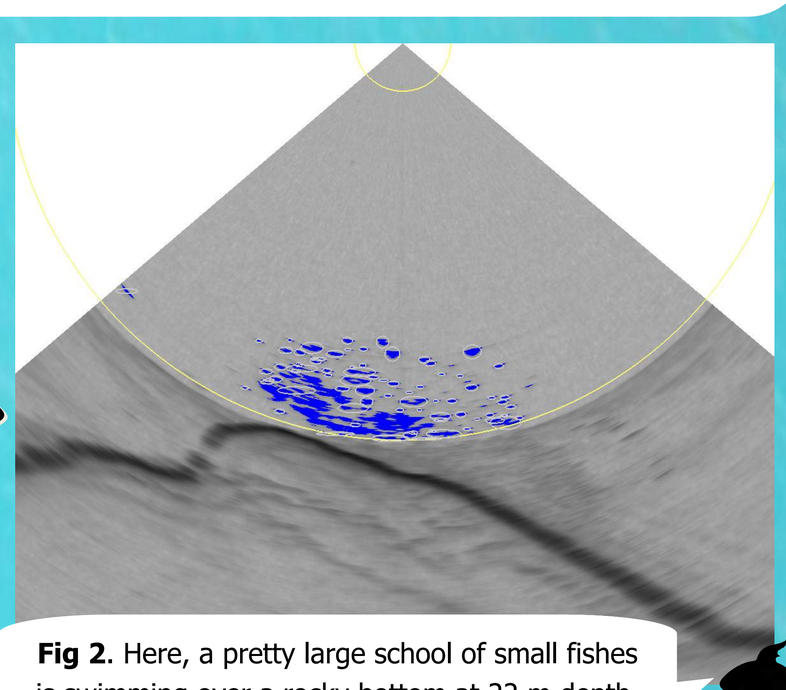


Fig 2. Here, a pretty large school of small fishes is swimming over a rocky bottom at 22 m depth.

Application to a specific area

1 A study site was selected in the La Ciotat bay (Fig. 3) for its various depths and marine habitats.

2 The bathymetry was collected in summer 2016 as well as the acoustic imagery. The seabed classification allows to distinguish different marine habitats (Fig. 4).

3 The WCI was exploited to map the fish accumulations (Fig. 4).

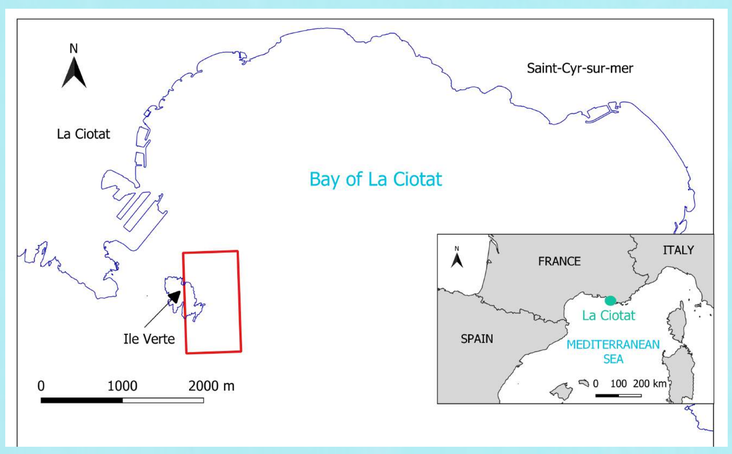
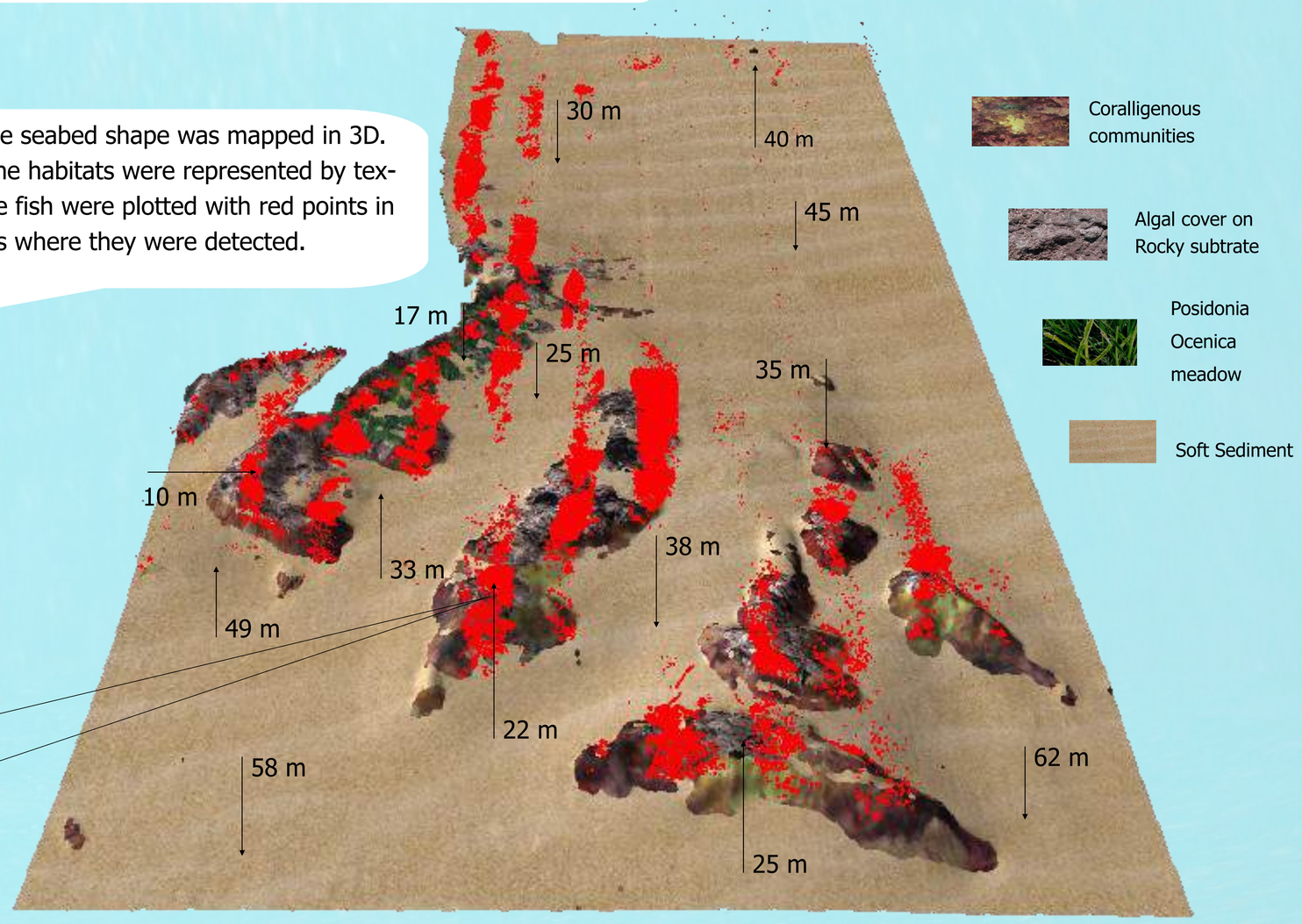
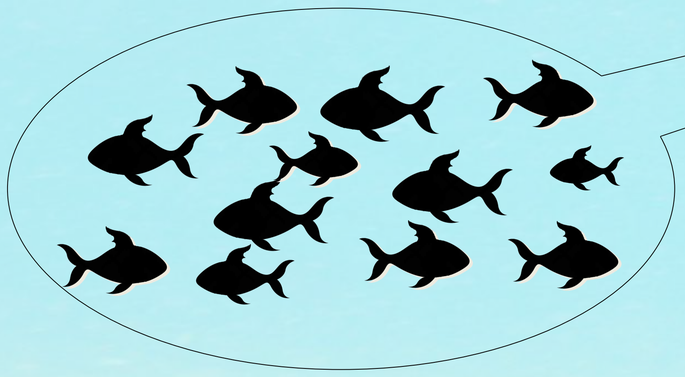


Fig 3. The study site is delimited by the red rectangle.

Fig 4. The seabed shape was mapped in 3D. The marine habitats were represented by textures. The fish were plotted with red points in the places where they were detected.



It is not possible to determine the fish species through the WCI, but it is possible to estimate their quantity and to observe that they accumulate on complex seascapes rather than on flat areas.



Conclusion

In a single acquisition, it is possible to have a review of a study area: seabed topology, identification of marine habitats and anthropogenic structures and fish accumulations detection.

The process can be even more automatized to allow to go faster and further in the analysis.

Reference

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