Interreg NEXT Black Sea Basin

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EfxINNOs

Establishing and Operating an Innovative Marine Technology Transfer Network for Enhancing the Transition to a Sustainable Blue Economy in the Black Sea Basin

Evaluate the presence of marine litter and marine pollution risk at all study sites

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https://envrio.eu/efxinnos/

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1. Introduction

Marine litter is recognized as one of the principal anthropogenic pressures affecting benthic ecosystems in the Black Sea and Aegean coastal zones targeted by EfxINNOs. This report presents preliminary work on the assessment and mapping of marine litter on the seabed, based on the joint analysis of Side Scan Sonar (SSS) data, images and video footage collected during AUV surveys at the project Greek pilot site. The objective of this activity is to establish a reliable workflow for detecting, cross-verifying and, where possible, georeferencing seabed litter items, as a step towards a harmonized marine litter monitoring methodology compatible with EMODnet and related European marine data infrastructures.

The work described here is based on the dataset of video footage and SSS records acquired during the full survey carried out across the Nea Peramos area, at the Greek pilot site. Screenshots extracted from the video material were used as ground-truth references for litter items visible on the seabed, while the corresponding SSS records were examined to determine whether the same items could be independently identified acoustically. This comparison allowed a first assessment of the strengths and limitations of SSS as a stand-alone tool for marine litter detection.

2. Methodology

Video footage and side scan sonar data were collected simultaneously during the AUV survey operations carried out across the Nea Peramos area. Video material was reviewed frame by frame to identify visible marine litter items on the seabed, and representative screenshots were extracted for each identified item. In parallel, the corresponding SSS mosaics were inspected for the same seabed locations, in order to determine whether the litter items visible in the video could also be resolved in the acoustic imagery.

In order to compare the two data sources for the same seabed location, the video and SSS records first had to be temporally aligned. During this process, a systematic time offset of 5 minutes and 31 seconds (5:31) was identified between the video and the SSS data streams. This lag was taken into account when matching litter items observed in the video to the corresponding position along the SSS track, ensuring that the two datasets were correctly cross-referenced before any visual or acoustic comparison was performed.

For each litter item confirmed in the video, the corresponding location in the SSS mosaic was examined to assess detectability. Items were classified into two categories: (i) litter identifiable in both the video and the SSS imagery, and (ii) litter identifiable only in the video, with no corresponding signature in the SSS data.

3. Results and Preliminary Findings

The comparison between video-derived and SSS-derived litter detections indicates that SSS imagery can reliably resolve litter items only under specific conditions. Items that are relatively large and possess a well-defined, geometric shape, such as box-shaped or rectangular objects, produce a sufficiently distinct acoustic return and shadow to be identified in the SSS mosaic and matched with confidence to the corresponding video observation. Figure 1 below shows an example of a litter item that was independently confirmed in both the video screenshot and the corresponding SSS image. A small, square-shaped box lying on the seabed is clearly visible in both the video screenshot and the SSS mosaic. Its compact, geometric outline and sharp edges produced a strong, well-defined acoustic return and shadow in the sonar image, allowing it to be identified with high confidence and matched directly to the corresponding object seen in the video.



***Figure 1**. Marine litter item identified in both the video screenshot (up) and the corresponding Side Scan Sonar image (bottom).*

By contrast, a substantial proportion of the litter items visible in the video could not be identified in the SSS data. Two limiting factors were observed in this dataset. First, small litter items do not generate an acoustic signature that is distinguishable from seabed texture and background noise, and therefore fall below the effective detection threshold of the SSS system. Second, litter items located within or partially covered by seagrass meadows are effectively masked by the surrounding vegetation, since the acoustic backscatter of the seagrass canopy obscures the smaller or lower-relief signature of the litter itself. In both cases, the items remain clearly identifiable in the video footage, but leave no discernible trace in the SSS imagery. Figures 2 and 3 present two representative examples of litter items that were confirmed exclusively through video screenshots, with no corresponding detection in the SSS data.

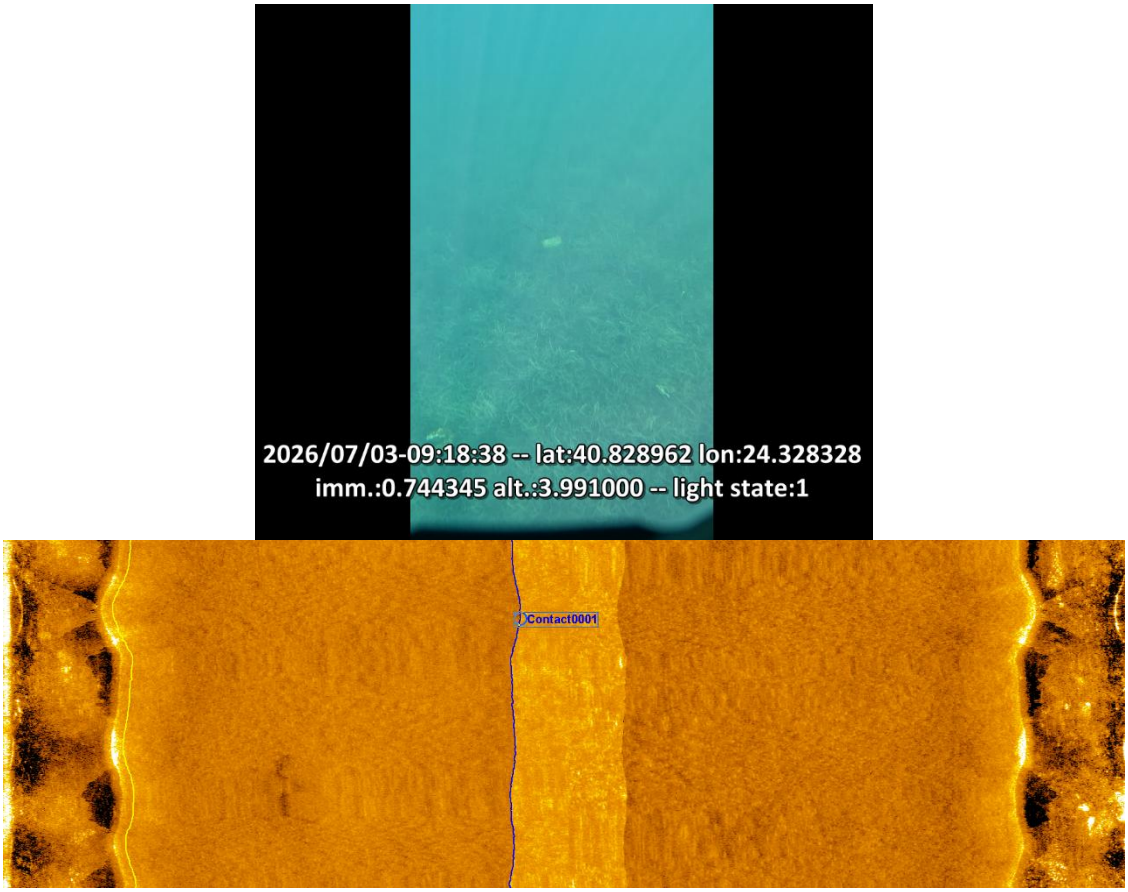
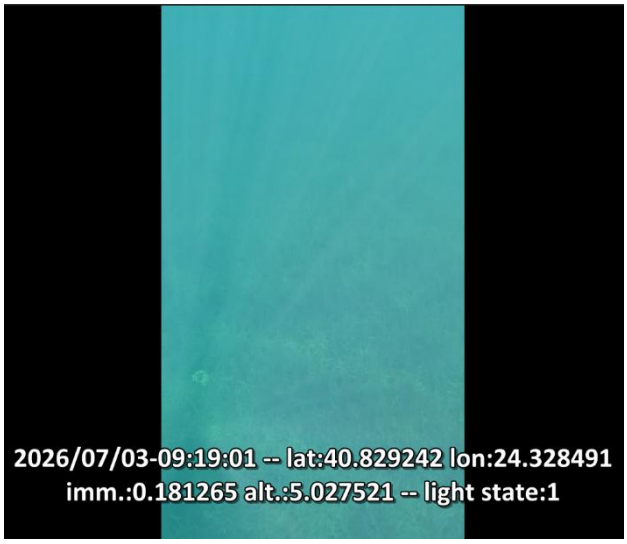


***Figure 2**. Marine litter item identified in the video footage but not detectable in the corresponding Side Scan Sonar image (item obscured within seagrass cover).*



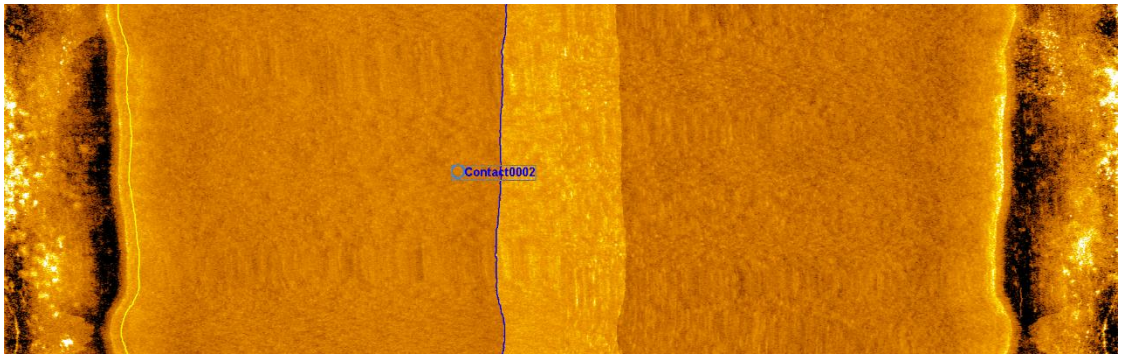


***Figure 3**. Marine litter item identified in the video footage but not detectable in the corresponding Side Scan Sonar image (small item size).*

4. Discussion and Limitations

These preliminary findings highlight that SSS and video/image data are complementary rather than interchangeable sources for marine litter monitoring. SSS provides broad-area coverage and is well suited to detecting larger, geometrically distinct litter items, but it is limited in its ability to resolve small objects or litter situated within structurally complex habitats such as seagrass meadows. Video and image data, while limited in spatial coverage relative to SSS, provide the visual detail required to confirm and characterize items that acoustic methods cannot resolve, including small-sized litter and litter embedded within vegetated substrates.

The identification of the 5:31 time lag between the video and SSS data streams represents an important methodological finding for this activity, as accurate temporal synchronization is a prerequisite for any reliable cross-referencing of the two data types. Consistent application of this correction will be required for all subsequent litter mapping work based on combined video and SSS datasets.

These observations, based on a first exploratory dataset, will be used to inform a combined detection approach, in which SSS mosaics are used to identify candidate litter targets over wide areas, while video and image data are used to validate detections and to characterize the smaller or vegetation-obscured items that fall outside the detection capability of SSS alone.