

IAMU AGA26

Conference Book

26th Annual General Assembly of the International
Association of Maritime Universities

*Human-centred digital oceans:
Educating safe & green global maritime
professionals*

7–10 October 2026

Split, Croatia

43°30' N · 16°26' E

Program Editor

Dr. Tina Perić

Vice Dean for Science

Faculty of Maritime Studies
University of Split, Croatia

A publication of the
International Association of Maritime Universities

For the Publisher

Faculty of Maritime Studies, Croatia

ISSN: 2706-6762

(Electronic Version)

Energy Consumption and Environmental Impact Assessment in Bottom Trawling: Baseline Characterization and Digital On- Board Monitoring in a Commercial Trawler

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Keywords: bottom trawling; energy efficiency; baseline characterization; decarbonization; maritime digitalization; high-resolution sensor monitoring

The fishing sector is increasingly challenged by international decarbonisation targets and environmental regulations, while a substantial share of coastal and Mediterranean fishing fleets continues to operate with legacy propulsion systems lacking advanced digital monitoring capabilities (IMO 2021; UNCTAD 2023). Bottom trawling is among the most energy-intensive fishing activities, primarily due to the hydrodynamic drag and benthic disturbance generated by conventional heavy steel trawl doors operating in permanent contact with the seabed (Cheilari et al. 2013).

This study presents the first phase of a comprehensive research project focused on the digital characterization and baseline energy profiling of the commercial bottom trawler *Germans Maura* (19.55 m LOA, 294 kW main engine), operating from the port of Llançà in the north-western Mediterranean Sea. The primary objective of this stage is to establish a high-resolution, empirical baseline model of fuel consumption, engine operational parameters, and vessel dynamics under real fishing conditions using conventional trawl gear (see Figure 1).

The methodology is based on direct, continuous monitoring using a Yacht Devices Voyage Recorder integrated with the engine management system and vessel navigation units, enabling real-time logging of fuel flow, engine speed (RPM), torque, and operational positions. Simultaneously, an Inertial Measurement Unit (IMU) with integrated GPS is deployed to capture vessel motion and dynamics, allowing the exact correlation of fuel consumption and greenhouse gas (GHG) emissions with sea states, vessel movements, and specific operational phases (navigation versus trawling).

This initial characterization phase provides a robust, empirical benchmark for the energy performance and carbon footprint (emissions per mile and per kilogram of catch) of the Mediterranean trawl fleet. Furthermore, this baseline serves as the indispensable scientific foundation for a planned future phase, in which new semi-pelagic (flying) trawl doors will be installed and instrumented with acoustic sensors. This future stage will enable a comprehensive, direct comparative assessment to accurately evaluate hydrodynamic resistance reduction, fuel savings, and seabed impact mitigation. The current results contribute directly to the EU maritime decarbonization strategies and EMFAF objectives by delivering transferable digital monitoring frameworks for artisanal and coastal fleets (European Union 2021; Generalitat de Catalunya 2022).

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Acknowledgment

This work is supported by the European Maritime, Fisheries and Aquaculture Fund (EMFAF) through the funding scheme for local development operations under Operational Programme 2021ES14MFPR001 (ARP 393/24/000578 GALP Costa Brava). The research is also financed by Nippon Foundation through the IAMU Organizational Research Project under Grant Agreement YAS202605_FNB-UPC.

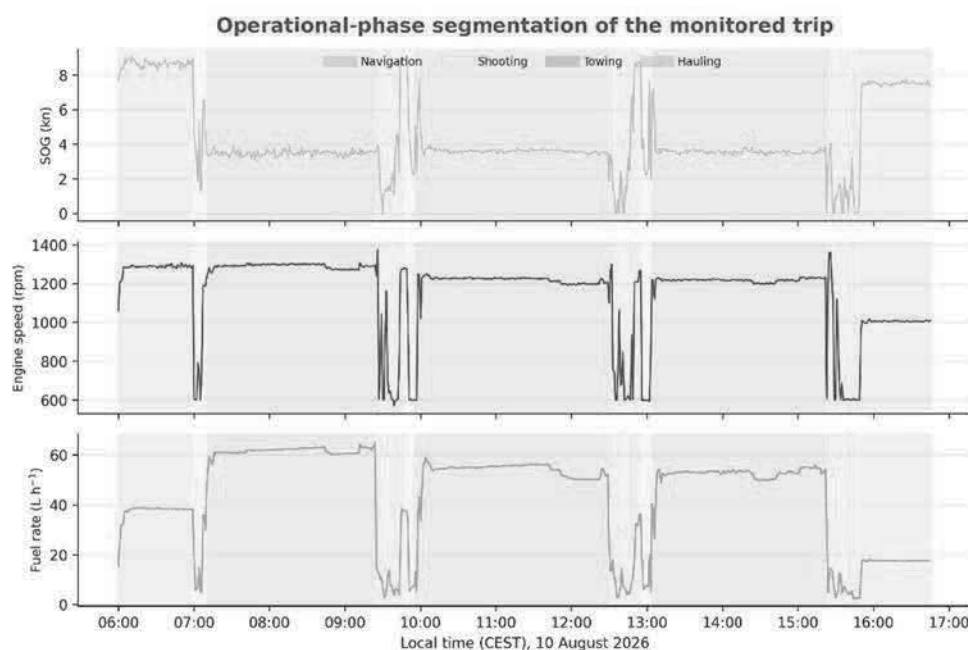


Figure 1. Example of Operational segmentation of the monitored trip on 10 August 2026. Colored backgrounds indicate phase intervals derived from the operational log; SOG, engine speed and fuel rate were used for verification.