ID26 MULTISENSOR ACOUSTIC TRACKING BENTHIC LANDERS TO EVALUATE CONNECTIVITY OF FISHES IN MARINE PROTECTED AREAS

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ABSTRACT

Deep-sea fishing has been carried out on an industrial scale since the 1950s, and this has had a variety of effects on the environment and its biota. Most benthic species experience a decline in abundance or a constant decline in abundance as a result of direct disturbance of the seafloor, such as its plowing and scraping by hauled nets, with overall impacts on regional biodiversity [1]. Sediment has lost some of its biogenic habitat complexity, and sessile epifauna-provided microhabitat has been destroyed or disrupted [2] and marine protected areas (MPAs) have been widely implemented to address this decline. Marine fish mobility, which is crucial for ecosystem function and is increasingly being researched with acoustic telemetry, has an impact on how well no-take MPAs (i.e., marine reserves) work in terms of protecting and repopulating fish populations [3], [4] Therefore, it is necessary to continuously monitor periodic changes in commercially exploited deep-sea ecosystems in order to gather baseline information, give accurate environmental impact assessments, and derive sound biological indicators for restoration. Using a fixed acoustic ultra-short baseline (USBL) receiver on benthic lander and miniature bidirectional acoustic tags [5], we address three key questions: How far can fish move? Does connectivity exist between adjacent MPAs? Does existing MPA size match the spatial scale of fish movements?

Keywords - Seafloor Ecosystem Monitoring; Acoustic Tracking; Bidirectional Acoustic Tag; Tagged Animals; Benthic Lander; Marine Technology; Marine Instrumentation; Environmental Protection.

INTRODUCTION

Species richness and biodiversity have been monitored using stand-alone devices (i.e., landers) susceptible to temporal intermittent deployments. Examples include the EMSO Generic Instrument Module (EGIM), which was created for stand-alone applications [6] or the installation of moored instruments to track animals that have tags [7]. However, in several cases, underwater acoustic arrays are sizeable, and may require complex handling for deployment at sea. In recent years, benthic landers of various forms have been developed for a number of purposes. Their technological features and models have drawn a lot of interest [8]–[10]. Additionally, to the acoustic tracking, remote underwater video landers are an innovative, non-intrusive way to provide ecological indicators for a variety of marine species, such as time series of counts, local lists, and evenness[11]. Multisensor marine fixed observatories (multiparametric benthic landers) should be arranged into integrated spatial networks for the autonomous monitoring of fishing-impacted deep-sea ecosystems in order to effectively monitor targeted species of fishery interest [12] through optical and acoustic means. Distance can be calculated by using an acoustic signal's time of flight (TOF) and slant range in conjunction with the bidirectional communications capabilities of bidirectional acoustic tags. The tracking precision of species with bidirectional tags is improved by the addition of the bearing information computed by ultrashort baseline (USBL) devices. In addition, the benthic lander could cooperate with Autonomous Underwater Vehicles (AUVs), permanently allocated into mobile Docking Stations (DSs), that can be equipped with acoustic receivers, which act as a virtual LBL and use acoustic modems to measure the target's range [13], and expand the range of autonomous monitoring of fishing-impacted deep-sea ecosystems. In this framework, the developments in BITER will be cantered on a fleet of inter-communicating multisensor landers with acoustic tracking capabilities.

BENTHIC LANDER PLATFORM

The BITER lander is a low-cost modular system, weighing about 200 kg in air, with a large payload capacity, designed to hold autonomous video systems and USBL devices as well as other oceanographic sensors, and equipped with an acoustically triggered sacrificial drop-weight release mechanism that enables resurfacing (see Figure 1). A stainless-steel frame and a specially created buoyancy module made of synthetic foam make up the bulk of the lander. The acquisition module(s) are carried by the frame, a versatile mechanism that can be quickly switched out as needed. The lander's architecture is intended to support multiple deployment scenarios, including: (1) a free-fall mode, where precise landing position control is constrained due to operation with Vessels of Opportunity (VOO) or without ROVs; and (2) a controlled mode.

ACOUSTIC TRACKING SYSTEM

The USBL device from EvoLogics, model S2C R 48/78 USBL [14], is installed on the top of the lander and is oriented at 90 degrees upwards; it is the acoustic array that is taken into consideration in our experiment. At the bottom two cylinders, house control hardware and batteries to operate the platform. The USBL device includes a modem-capable, software-defined ultra-short baseline (SDM-USBL). The external sync-in signals and SDM-USBL option, both introduced by EvoLogics in the context of BITER, make it feasible to gather acoustic samples simultaneously from all channels without disabling the USBL firmware. Finally, we take into account the creation of useful algorithms to obtain precise detections, estimates of the direction of arrival (DoA), and estimations of the positions of bidirectional acoustic tags employing wideband arrays.

Figure 1 Multisensor benthic lander deployed during the summer of 2022 at OBSEA observatory (www.obsea.es)

ACKNOWLEDGEMENTS

This work received financial support from the research project of the Spanish Ministerio de Economía y Competitividad (BITER: PID2020-114732RB-C32) and Generalitat de Catalunya's "SARTI-MAR" 2017 SGR 371.

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