4 Technological developments (ToR d)

4.1 Towards monitoring and recovery of fishery impacted species in deep-sea marine ecosystems: a joint effort between biology and technology within the Mediterranean BITER, PLOME and LIFE-ECOREST projects.

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The trawling fishing activity constitutes today half of all EU fisheries and its use is one of the main drivers of ecosystem degradation of demersal ecosystems (Puig et al., 2012). Trawling removes the sediments and endangers demersal fragile sessile organisms, being long-lived species replaced by short-lived ones. In the Mediterranean, many demersal stocks are overexploited, reducing the economic benefits of fisheries and the ecosystem services associated with cultural aspects of iconic species.

Given this situation, ecological networks of Marine Protected Areas (MPAs) as no-take reserves, are being created to preserve *Nephrops norvegicus* stocks, according to the principles of habitat connectivity, with appropriate scales of geographic proximity for larval dispersal (Vigo et al. 2021). Although the primary aim of MPAs is the conservation of *Nephrops* stocks, they also allow the recovering of the associated sessile fauna, that trapping the sediment accelerates the whole habitat restoration process. The repopulation of soft bodied cold water corals by badminton technique is the main goal of the LIFE-ECOREST Project.

Marine robotic is increasingly allowing the monitoring of benthic and pelagic ecosystems by means of cabled video-observatories, stand-alone landers and Internet Operated Vehicles (IOVs) as crawlers or AUVs (Aguzzi et al. 2019). These platforms can be used for synergetic data collection on *Nephrops* stocks demography and their environment, when organized into local networks (Masmitjia et al., 2020). In this scenario, cabled video-observatories, acquiring multidisciplinary oceanographic and biogeochemical data without power and bandwidth constraints, has been a key element to monitor marine ecosystems via the use of HD cameras (del Rio et al. 2020). However, the area of study is circumscribed to the deployment location, and the monitoring radius can be expanded by docked mobile platforms. The major goal of the BITER project is to use an autonomous lander for the advanced environmental monitoring, to gather video (i.e. optoacoustic) and environmental multiparametric information on *Nephrops* stocks recovery at a high-frequency and over prolonged duration (i.e. over diel, seasonal and multiannual scales). Information is transmitted to shore by pop-up buoys to enforce autonomous and remote measuring

procedures. In a second step, the PLOME project has been conceived to add to this lander up to 5 satellite fixed optoacoustic video-stations, plus a docking for AUVs (Girona 1000) battery re-charge and data transmission. Future research will use docked crawlers and to reduce the seabed tracked wheels' footprint, also biomimicking crab-like platforms (e.g. Silver2; Picari et al., 2020).

Such a spatially-replicated image and environmental data collection will be used for the extraction of ecological indicators related to the fishery of *Nephrops* (e.g. abundances and biomasses through the counting and sizing of individuals) in an ecosystem-based compliant fashion; i.e. by gathering information not only for *Nephrops* but also of all its predators and preys (Aguzzi et al. 2020). Produced data could be in the next future complemented with standard UWTV surveys, performed in the NW Mediterranean according to the guidelines set by the WGNEPS.

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4.2 Acoustic tracking of *Nephrops norvegicus* update

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Behavior of *Nephrops* was investigated during the autumn of 2020 on two areas in Jökuldjúp ground in SW Iceland at depths of 115 and 195 m (Fig. X). On each ground 16 animals were tagged with acoustic tag, glued to the back of the carapace. Nine hydrophones were put down on a grid with 100 m distance. An acoustic doppler current profiler was put down to monitor currents and temperature in each area. The animals were tagged at the end of August and hydrophone retrieved in the end of November. Data was received from all tags, but 10 to 11 animals were estimated to be alive on each area. Six animals on each location were estimated to have