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Autonomous and cabled underwater sensor networks applied to remote monitoring of biological indicators

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Geophysical cycles in the form of daily and seasonal changes in the light intensity and length of the photoperiod in all photic and disphotic zones, plus the marked hydrodynamic patterning of tides impose a strict synchronization of species behavior through natural selection. Rhythmic behavior under the form of massive populational displacements on the seabed and across the above water column, directly affects our perception of continental margin biodiversity and ecosystem functioning. Monitoring biodiversity and the environmental drivers controlling those rhythms at different spatiotemporal scales is a key issue in a context of estimating the effects of the increasing anthropogenic impact.

To comply with the monitoring of biological indicators set by the EU Marine Strategy Framework Directive (MSFD, 2008/56/EC; descriptors: D1= biodiversity; D2= alien species; D3= commercial fish and shellfish species; D6=seafloor integrity and D10= marine litter) and the technical guidance for monitoring (JCR 2014, Report EUR 26499 EN, identifying high-definition cameras as key tools for biodiversity monitoring), the development new methodologies for sampling the composition of communities in relation to species' rhythmic activity and its environmental control trough the coupling of new fixed and mobile multiparameteric platforms, is of pivotal relevance.

In order to increase spatial coverage and allow for strategic and adaptive changes in monitoring, autonomous underwater vehicles (AUVs) and benthic robots (crawlers) will be used, which will work in both spatial (near-area) and time-coordinated fashion via platform communication.

In this scenario, different activities are being executed at the underwater cabled observatory, OBSEA like the H2020 JericoNext TNA action ADVANCE (Automatic Data and Video Acquisition for uNderwater monitoring across Coastal Environments), Spanish National Project RESBIO (Redes de sensores submarinos autónomos y cableados aplicados a la monitorización remota de indicadores biológicos), and MarTERA ERA-Net ARIM (Autonomous robotic sea-floor infrastructure for benthopelagic monitoring).

Networks of fixed and mobile video cameras (i.e. fluctuations in counted individuals can be used as proxy of a populations' rhythms) will be used to enforce real-time and prolonged studies of the dynamics coastal and deep-sea communities in relation to surrounding habitat conditionings (i.e. via a concomitant acquisition of different oceanographic, chemical, and geological data). This multi-parametric monitoring is a challenge to be overcome, in order to have standardized protocols for the acquisition and automation of data processing regarding species composition (i.e. richness), relative abundances (i.e. evenness) and food web structure. Obtained data are of relevance since could be extended as reference for impact monitoring in industrial sectors.