ID27 OPERATIONAL OCEANOGRAPHY APPLIED TO THE MANAGEMENT OF OFFSHORE AQUACULTURE ON THE BASQUE COAST (SE BAY OF BISCAY)

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ABSTRACT

With the support of the Basque Government, offshore longlines have been used for mussel production in Mendexa ("Bivalve Mollusc Production Area") since 2019. This area is located about 2 nautical miles from the Basque coast (SE Bay of Biscay). Here, an Integrated Marine Observing System (IMOS) has been established to identify toxic HABs. This system includes in situ data, sampling activity, satellite images, numerical models and other external sources of information.

Keywords – Aquaculture, Bay of Biscay, longline, Mendexa, mussel

INTRODUCTION

Offshore aquaculture, and in particular the production of bivalve molluscs, has increasingly attracted the attention of researchers, industry and policy makers as a promising opportunity to diversify marine aquaculture production. Technological advances in this type of farming systems have succeeded in extending aquaculture production to more oceanographically exposed areas, minimising coastal environmental impacts and avoiding conflicts with other marine uses. In 2016, the Basque Government legally declared a "Bivalve Mollusc Production Area" in Mendexa (SE Bay of Biscay), where production of mussels (Mytilus galloprovincialis Lmk.) has been carried out on offshore longlines since 2019. These longlines are located about 2 nautical miles offshore, at a depth of approximately 45 m, where they can withstand waves of up to 9 m in significant height (Fig. 1). However, mussel farming is encountering some difficulties, such as the increasing occurrence of different harmful algal blooms (HABs), that compromise the economic benefit of the activity. Most systems for predicting the occurrence of HABs have been developed for estuaries and bays, while systems for open waters are scarce. Here we describe the prediction system developed for the Basque coast to support the management of the emerging offshore mussel aquaculture sector in Mendexa.

MATERIALS AND METHODS

In April 2016, an Integrated Marine Observing System (IMOS) started to be established for HABs in the Mendexa production area (Fig. 2). At present, this system includes analysis of biotoxins in shellfish by chemical methods (okadaic acid group toxins, azaspiracids, yessotoxins, domoic acid and "Paralytic Shellfish Poisoning" (PSP) toxins), identification of potentially toxic phytoplankton species in water samples, in situ hydrographic measurements with CTD, fluorescence and temperature sensors measuring continuously, a 3D coastal hydrodynamic model (CROCO), a Lagrangian particle tracking model (SOFT), high- and mid-resolution satellite imagery (MODIS-AQUA, MODIS-TERRA, VIIRS, Sentinel-2 and Sentinel-3), and ancillary meteorological (wind, precipitation and solar radiation) and river input observations (flow and nutrients) from nearby meteorological and hydrological stations. Sampling of mussels and water for biotoxins and potentially toxic phytoplankton determination has been carried out at least monthly, but the sampling frequency has increased during high-risk periods.

Fig 1. Map of the Basque coast (SE Bay of Biscay) showing the location of the offshore longlines in Mendexa

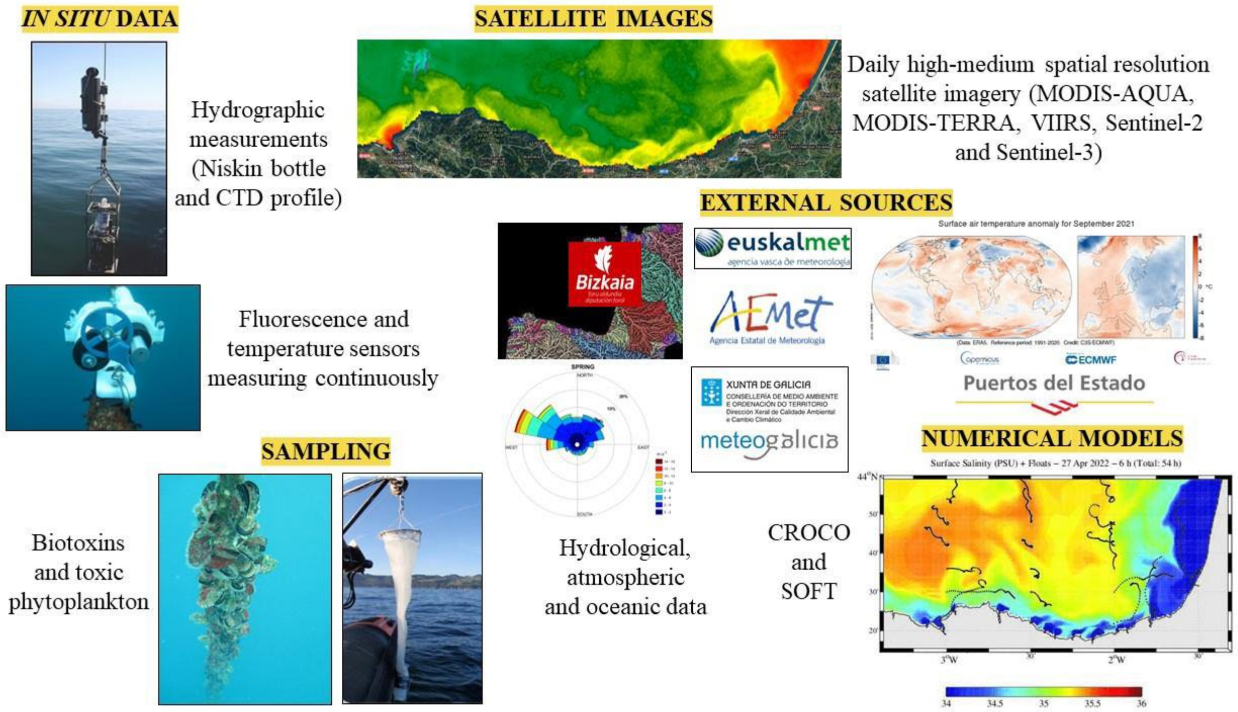

Fig 2. Integrated Marine Observing System established in Mendexa

RESULTS AND CONCLUSIONS

The okadaic acid, a "Diarrheic Shellfish Poisoning" toxin produced by the dinoflagellate Dinophysis acuminata in this area, exceeded its regulatory limit every year in spring. Other dinoflagellates caused the banning of the production on some occasions due to yessotoxins (at the end of spring and autumn) and PSP toxins (in autumn and winter). However, the domoic acid, an "Amnesic Shellfish Poisoning" toxin which is produced by some Pseudo-nitzschia species, was rarely detected, and never the azaspiracids. Spring and autumn were the most affected seasons and, consequently, with the highest risk of closure of the Bivalve Mollusc Production Area. During some toxic episodes, the most likely trajectories of the responsible species were determined in the surrounding area. On the one hand, D. acuminata peaked during the conditions of thermal homogeneity and haline stratification that are typical of the late-winter and spring blooms in the Bay of Biscay. This dinoflagellate appeared in cell densities above an alert threshold of 100 cells L−1 in association with anomalous colder waters and the predominance of northerly winds. The advection induced by these northerly winds could have favoured the transport of D. acuminata from the open sea to the coastal zone. On the other hand, the PSP toxins were close to the banning limit on 18 January 2022. This event coincided with a fluorescence peak and was preceded by conditions of high rainfall and temperatures 10 days before. Centrodinium punctatum and Alexandrium cf. ostenfeldii (potential PSP species) were observed in autumn and could have been the responsible species of this event, in which GTX1,4 accounted for 71% of the toxicity and GTX2,3 for the rest. For this specific event, two possible geographical origins were identified using the SOFT model: (i) the coastal zone near the Ondarroa estuary, if the bloom started 84 hours before the peak measured in Mendexa, and (ii) the northwest offshore area of Mendexa, if the bloom started earlier.

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