EFFECTS OF “EL CACHUCHO” MPA IMPLEMENTATION ON FISHING EXPLOITATION PATTERNS

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Introduction

In the Central Cantabrian Sea, south of the Bay of Biscay, lies the Le Danois seamount (44°03´N-004°53´W), located more than 60 km off the Asturian coast of Llanes. The presence of large vulnerable species (corals, gorgonians and sponges) make it a highly representative area of habitat-1170, a habitat of great ecological value included in Annex I of the Habitats Directive (Sánchez et al., 2017). Its summit is located at a depth of less than 500 metres and its internal basin, a depression between 800 and 1000 metres deep, favours its isolation and the appearance of habitat-forming species (HFS). Its geological structure and the effects of the slope currents in the area favor the appearance of fish species of great interest for the Spanish fleet, such as the greater forkbeard (*Phycis blennoides*), the blue whiting (*Micromesistius poutassou*), the monkfish (*Lophius* spp.) or the red bream (*Beryx decadactylus*), which find in this area an essential habitat for spawning, breeding and feeding. Due to the great importance of the habitats-1170 present in the “El Cachucho” area, in December 2008 the area was closed to all bottom fishing activities and three years later (December 2011) “El Cachucho” was declared a Marine Protected Area (MPA). This protected area is divided into two well-defined regions, the Le Danois Bank and its buffer zone, located between the bank and the Cantabrian Sea´s continental shelf (Fig.1).

This study analyses the effect of the first high seas MPA declared in Spain, "El Cachucho", on the spatial distribution of bottom fisheries effort and on the evolution of fisheries in the area of influence of the MPA, in terms of fishing intensity (h/km^2), catches (kg) and CPUE (kg/h) between the years 2009-2021.

Materials and Methods

Fishing data obtained from VMS, a satellite based monitoring system that provides information related to the location, heading and speed of vessels, roughly every 2 hours, and logbooks, which contain information of fishing trip (gear used, ...) and daily landings (kg, species). Both datasets were combined to obtain the spatial distribution of fishing activity (h/km^2) and to allocate landings for each fishing trip for vessels over 15 m in length belonging to four bottom fishing gears: Bottom Otter Trawl (OTB), Bottom Pair Trawl (PTB), Set Longlines (LLS) and Set Gillnets (GNS) (Punzón et al., 2016). In addition, fishing time was obtained for each period where activity was detected for use as a measure of fishing intensity (h/km^2) and to calculate Catch Per Unit Effort (CPUEs). Data covering the period of 2009–2021 for the study area (“El Cachucho” MPA and area of influence of the MPA) were provided by the Spanish Ministry of Agriculture, Food and Environment (MAGRAMA). For the analysis of fishing activity grid of 0.01° × 0.01° was used (c-square). Fishing intensity (FI) was expressed as the sum of fishing time spent in each cell per square kilometres (h/km^2) and was calculated for each year analysed. The mean FI for the period was calculated and mapped (Fig. 2). In order to assess the spatial and temporal fluctuation of the fishing, in terms of fishing intensity (h/km^2), landings (kg) and CPUE (kg/h), a nested General Linear Model (GLM) was performed. With this model, a temporal trend of fishing intensity (h/km^2), landings (kg) and CPUE (kg/h) was obtained for each grid cell. The resulting correlation tendency (positive or negative and their significance) was plotted for each variable for gear (OTB, PTB, LLS, GNS) across the study area (Fig. 3).

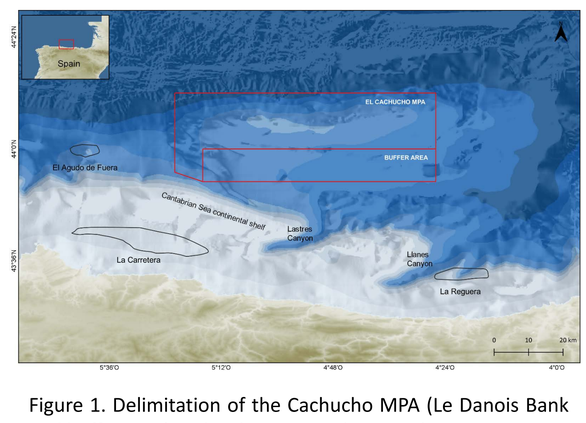

Figure 1. Delimitation of the Cachucho MPA (Le Danois Bank and buffer area) and its location in the Cantabrian Sea.

Spatial changes in fishing effort by gear

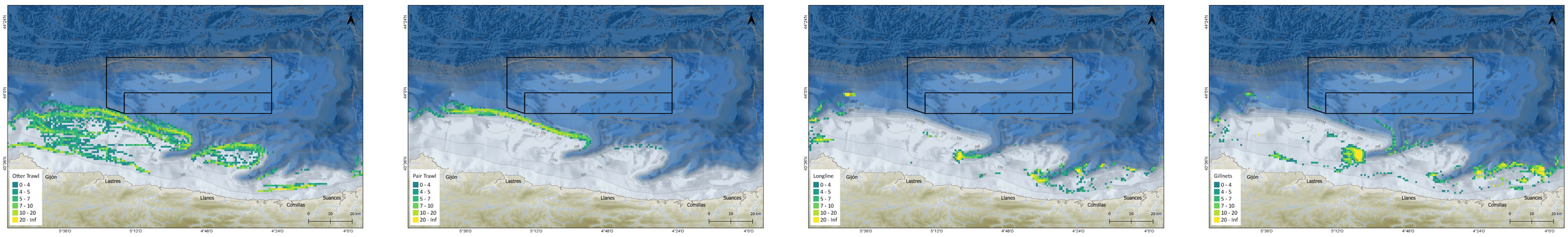

Figure 2. Mean fishing effort (h/km^2) in the period 2009–2021 for Bottom Otter Trawl (OTB), Bottom Pair Trawl (PTB), Set Longlines (LLS) and Set Gillnets (GNS). The effort is estimated from VMS and logbook data as total hours in grid cells of c-square (0.01x0.01).

Spatio-temporal trends of fishing effort (a), landings (b) and CPUE (c)

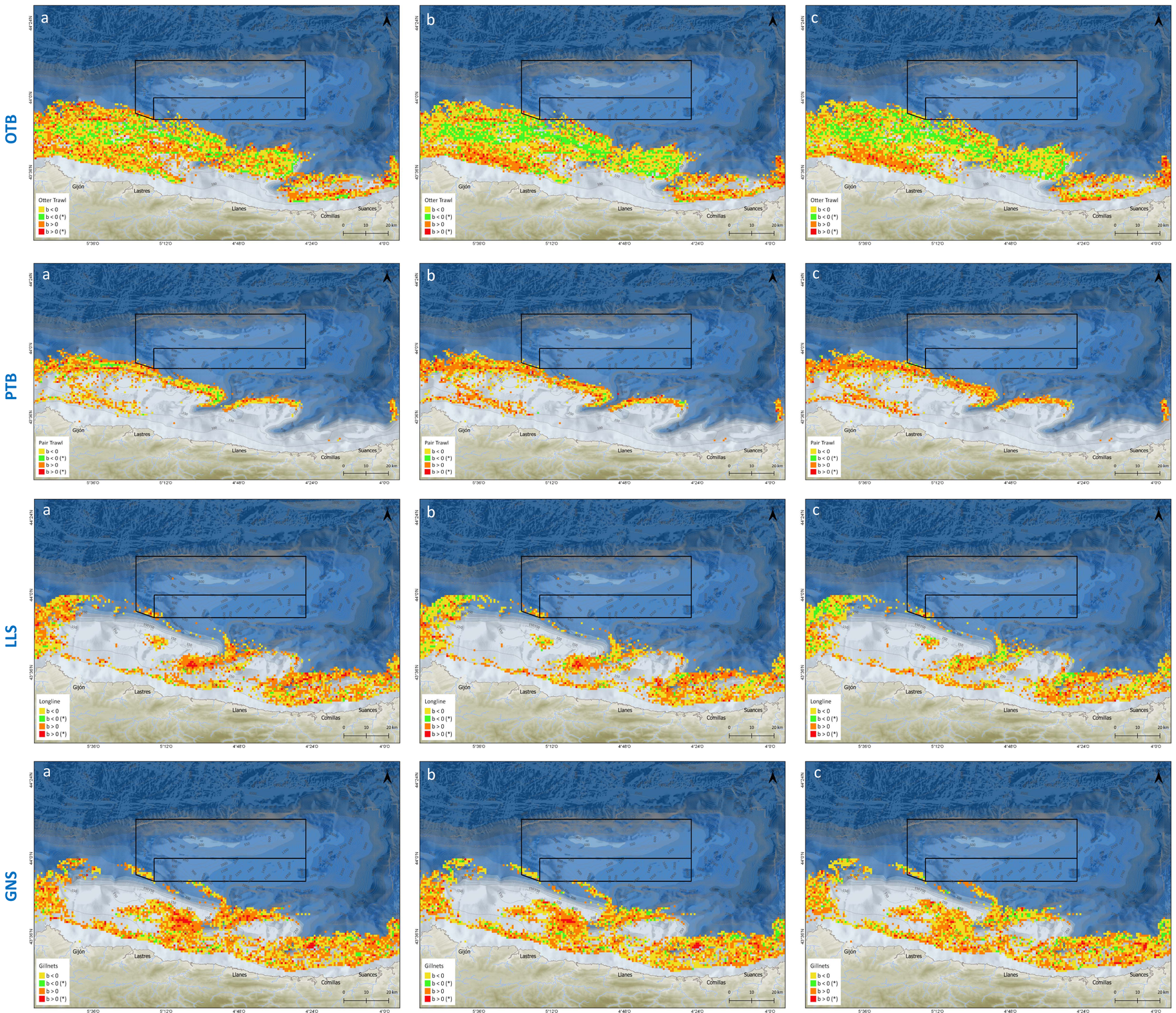

Figure 3. Spatial distribution of the correlation’ trends and their significance (*) resulting from the lineal model for the period 2009–2021. Green and yellow grid cells represent a negative trend of fishing effort (h/km^2), landings (kg) and CPUE (kg/h/km^2) over time, while orange and red grid cells represent areas where fishing effort (h/km^2), landings (kg) and CPUE (kg/h/km^2) increases over time. Green and red regression has p values <0.1.

Results and Conclusions

The results show changes in the spatial distribution of the mean fishing effort of bottom-fishing gears (OTB, PTB, LLS, GNS) since the implementation of the MPA (Fig. 2). No bottom fishing activity is observed either in the MPA (bottom fishing gear exclusion zone) or in the buffer zone, an area located far from the upper part of the Le Danois bank, in the intraslope basin, where fishing is authorized to a closed list of longline vessels.

By gear, bottom trawl fishing effort (OTB and PTB) is concentrated in the soft bottom fishing grounds, the southwest of the MPA, especially on the edge of the upper slope shelf (150 to 600 m deep), where species such as blue whiting and mackerel (*Scomber* spp.) are caught. In OTB there is also another area of high effort southeast of the Lastres Canyon and northwest of the Llanes Canyon, where species such as hake (*Merluccius merluccius*) are caught. Bottom longline effort is concentrated almost exclusively at the head of the canyons, especially in the Lastres and Llanes canyons, where there are rocky bottom fishing grounds where species such as hake are caught. The high intensity of effort observed in the fishing grounds of El Agudo de Fuera, an area where blackspot seabream (*Pagellus bogaraveo*), goatfish and monkfish are caught, is noteworthy. As in the LLS, the greatest effort in the GNS is located at the head of the canyons, mainly in the Lastres canyon, and in fishing grounds such as La Reguera, to the southeast of the MPA, where monkfish and scorpionfish (*Scorpaena* spp.) are caught.

The analyses and plotting of the correlation values resulting from the multiple linear regression models of fishing effort and landings of OTB show a decreasing trend in the southwest of the MPA, on the edge of the bathyal upper slope, and in the area between the Lastres and Llanes canyons. However, there are exceptions, such as the region west of the Llanes Canyon and La Carretera fishing ground, where effort, landings and CPUE tend to increase. In the case of PTB, a significant downward trend in effort is observed in the northeast of the Lastres Canyon and a positive trend in landings and CPUEs in a localized strip (200 to 400 m depth) of the shelf southwest of the MPA. As in OTB, in La Carretera fishing ground, there is an increasing trend in landings and CPUEs over the study period. As for static gears, the LLS tends towards an increase in effort and landings in the head of the Lastres and Llanes canyons, and towards a decrease in landings and CPUEs in the central axis of the canyons and in the west of the MPA, in the area of Agudo de Fuera and its nearby fishing grounds. In the case of GNS, there is a trend towards an increase in effort, landings and CPUEs to the northwest and at the head of the Lastres Canyon, and in the surroundings of La Reguera fishing ground, to the southeast of the Llanes Canyon.

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