PROJECT Nº 96/026: IMPROVEMENT OF THE DEFINITION OF SPECIES-SPECIFIC EFFORT IN THE SPANISH MULTI-SPECIES TRAWL FISHERY OF THE GULF OF CÁDIZ

KEY WORDS
Multi-species, trawl fishery, CPUE, Atlantic, Spain, abundance indicator, monitoring, fishing power.

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OBJECTIVES
The principal objective of this project was to improve estimates of fishing effort for different target species of the trawl fishery working in the Spanish South Atlantic Region, as well as the catch per unit effort (CPUE) estimations for these species, and to use them as better indicators of resource abundance.

This co-operative project consisted of five related tasks that were tackled more or less independently. The main objective of each is specified below:

1. To analyse the discriminant function that defines the multi-species fisheries through the monitoring of mis-classified cases and their effects in the estimation and allocation of specific effort for the main target species in the multi-species fisheries.

2. To improve the ‘species-specific effort allocation matrix’ through the analysis of differences in the seasonal fluctuations of the specific CPUEs by mixed-species fishery.

3. To analyse the relative fishing power of vessels and gears used in the mixed fisheries. Standardisation of relative fishing effort by fishery and its incidence in the estimation and allocation of specific efforts (study of the catchability coefficient).

4. To define fleet components according to respective multi-directional fishing strategies in recent years.

5. To calibrate the annual CPUE series by target species for the period 1993-1997 with the relative abundance data obtained by direct methods (research surveys).

APPROACH AND METHODOLOGY
The demersal fishery in the Spanish South Atlantic Region had long been characterised by a great diversity in exploited species (fish, crustaceans and molluscs) and by the use of a wide variety of fishing gears. Such characteristics are common to shelf and continental slope fisheries, which are multi-gear and multi-species by nature.

The study fishery, initially typified as a unique ‘métier’ i.e. homogenous fleet, was composed of different mixed fisheries, which presented diverse degrees of directionality in the effort applied to the different target resources. From this point of view, the initial estimates of the CPUE by
species obtained from the global effort data, were not good indicators of stock abundance. It was necessary to define specific effort units for each of the target species.

In a previous EU project (DG XIV 94/029), the application of multi-variate analytical techniques allowed typifying 17 mixed fisheries (cluster analysis) and objectively classified the landings and monthly efforts of the individual vessels of each fishery (discriminant function analysis). The allocation of the landings and the total monthly effort by type of fishery was the basis to establish the classification criteria of the specific effort for each of the principal species. On the other hand, a system of objective classification was applied to characterise the trawl fleet in function of the technical characteristics of the fishing vessels (length, horsepower and tonnage). In this manner, the fleet was classified into five types of vessels\(^1\) based on the type of fishery in which the vessel was active. However, the discriminating capability of the classification system was not totally resolute, and the criteria of specific effort assignation showed a lack of formal consistency from a mathematical point of view. This is the main reason that justified the present project.

The improvement of the definition and allocation of the effort applied to the different target species in these multi-specific fisheries is based on the optimisation of the previous classification systems\(^2\) and the allocation of specific efforts. To improve this classification system a new typification of these mixed fisheries was defined\(^3\), based on the specific composition of the landings by vessel and by fishing trip, instead of by month as previously used.

**MAIN FINDINGS AND CONCLUSIONS**

This new analysis defined the 22 types of mixed fisheries or types of fishing trips. It characterised 5 more fishing trip types than in the previous project. Among these fishing trip types, some could be distinguished that directed their effort principally to the catch of a single target species: **ACE** (wedge sole), **LEG** (sole), **CHO** (cuttlefish), **PUL** (octopus), **CIG** (Norway lobster), **G1** (shrimp), **MER** (hake), **JUR** (horse mackerel), **LAN** (prawn), **BÖQ** (anchovy), **ESP** (striped seabream), **EPB** (blue whiting) and **EPR** (monkfish).

Then there were some fishing trips that directed their effort to the catch of two species: **LCH** (sole-cuttlefish), **PCH** (octopus-cuttlefish), **CGA** (Norway lobster-shrimp), **MGA** (hake-shrimp), **JBQ** (horse mackerel-anchovy), and **JPU** (horse mackerel-octopus).

Finally, there were other fishing trips that were characterised by more than two target species, determined by their fishing grounds: **M1** (octopus-wedge sole-hake-mantis shrimp-horse mackerel-cuttlefish), developed principally by the fishing fleet of Sanlúcar that work in shallow coastal waters, **G2** (shrimp-horse mackerel-hake-octopus-elegant cuttlefish), similar to the previous one, but exerted in deeper waters, and **M2** (octopus-striped seabream-cuttlefish-horse mackerel-common pandora-red mullet-squid), fundamentally fished in shallow waters off Isla Cristina.

Of all the fishing trip types, the most important one in terms of the effort exerted, was the fishing trip **M1** (22.3%), followed in order of importance by the types **PUL**, **JUR**, **G2**, **CHO**, **G1**, **BÖQ**, **M2**, **CIG**, **MGA** (between 14.8 and 3.4%). The remaining fishing trip types did not reach 3%. The application of a series of discriminant analysis with the typified fishing trips by type of fishery has allowed to optimise the classification method.

The second objective posed by the project was based in the definition and analysis of the specific fishing effort for each of the chosen target species. Due to the multi-specific character and the multi-directionality of the fishery, the use of a single and independent unit of effort for each

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\(^1\) By correspondence analysis.

\(^2\) By using discriminant functions.

\(^3\) Through cluster analysis.
species was not realistic. To this purpose, analysis of variance (ANOVA) was performed, taking as factors the duration and the type of fishing trip, in order to identify those trips that directed significantly effort towards a determined species, on the basis of a fortnight CPUE evolution. The types of selected fishing trips by species were: wedge sole, _ACE_, _PCH_ and _PUL_; sole, _LAN_, _LCH_ and _LEG_; hake, _CGA_, _CIG_, _EPR_, _G1_, _JBQ_, _MAG_ and _MER_; horse mackerel, _ACE_, _PCH_ and _JUR_; shrimp, _MGA_, _G2_ and _G1_; Norway lobster, _CGA_ and _CIG_; prawn, _ESP_ and _LAN_; octopus, _ACE_, _PCH_ and _PUL_; cuttlefish, _PUL_, _PCH_ and _CHO_. Generalised Linear Models (GLM) were applied to standardise the CPUE and the specific efforts, including in the model the technical characteristics of the vessels, thus obtaining a single standardised CPUE for each of the target species.

The results of the project contribute to a better knowledge of the structure and dynamics of the trawl fleet working in the South Atlantic Region, providing the necessary elements to model the possible technical interactions between ‘métiers’. On the other hand, the estimation of the effort and the specific standardised CPUEs allow a better evaluation of the stocks and the fishery, thus providing a basis for improved management of these demersal resources.