

**IDENTIFICATION OF SPATIAL AND TEMPORAL FISHING EFFORT PATTERNS
USING CLUSTER ANALYSIS OF LINEAR MODEL COEFFICIENTS UNDER CONTIGUITY CONSTRAINTS**

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Fishing fleet dynamics are characterised by the choice of fishing location and the set of target species at a given time of the year. Habitat characteristics, seasonal species migrations, economic changes and weather conditions make fishing activities variable in both time and space. In order to evaluate reliably the impact of a given fishing fleet on a particular resource, it has been argued that taking account of spatial and seasonal characteristics of fishing activities is essential for reliable stock assessments and realistic forecasting models for management purposes.

In this paper we propose a generic method to identify spatial and temporal activity patterns in fleets, catch or catch rate data and apply it to the French trawler fleet operating in the Celtic Sea during the period 1991 to 1998. The fleet consists of 589 trawlers between 12 and 24 meters in length. For each vessel-trip, total fishing time was available per ICES statistical rectangle ($1^\circ \times 0.5^\circ$).

We modelled total fleet fishing time (fishing effort) per statistical rectangle and per month for each year with a Generalised Linear Model including spatial (statistical rectangles) and temporal (months) effects, previous month's fishing effort for a given spatial unit as predictor (to take into account temporal correlations) and spatial correlations in any given month modelled by an exponentially decreasing function. A hierarchical cluster analysis is then performed for grouping levels of spatial (resp. temporal) variables, using the set of dissimilarities produced by the $(1-p)$ -values of the previous F-tests for each pair of factor levels. In addition, a contiguity constraint is imposed in the clustering algorithm, ensuring that only neighbouring spatial units or consecutive temporal units are grouped.

Keywords: generalised linear model, cluster analysis under contiguity constraints, spatial and seasonal pattern, allocation of effort, fleet dynamics.