

## Integrating data from Vessel Monitoring System and fish landings in Mediterranean small fleets, using a PostgreSQL database with PostGIS extension.

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**Abstract** – Geospatial technologies represent an advance in the knowledge of marine ecosystems, allowing us to approach the study of the potential effect of world fishing fleets and their dynamics. Nevertheless, their application to fisheries science is recent and its use is not widespread. Our procedure uses GPS position data from the VMS-Vessel Monitoring System (or "blue boxes"), implemented in most fishing boats and is based in a previously methodology developed by ICES institution. The junction of VMS, fishing logbooks and landings data enables us to obtain, among other results, maps of fishing effort, fishing fleet behaviour and precise location of fishing grounds in European waters. This study has aimed to develop and apply a methodology to study fishing effort on species of commercial interest in the Catalan coast, using scripting PL/SQL procedures of PostgreSQL system database with PostGIS extension.

**Keywords** – Geospatial, PostgreSQL, PostGIS, Vessel Monitoring System, landings, fishing effort, Mediterranean Sea.

### I. INTRODUCTION

Geospatial technologies represent an advance in the knowledge of marine ecosystems, allowing us to approach the study of the potential effect of world fishing fleets and their dynamics. Nevertheless, their application to fisheries science is recent and its use began to spread when the ICES (International Council for the Exploration of the Sea) proposed one methodology [1] to study fisheries and their impact in Atlantic Ocean ecosystems in 2008. The ICES procedure is based on the use of position data from "blue boxes" (VMS-Vessel Monitoring System [2]). This system is mandatory since 2006 due to a European regulation [3] and is now implemented in most fishing boats. The junction of the VMS, fishing logbooks and landings data enables us to obtain, among other results, maps of fishing effort, fishing fleet behaviour and precise location of fishing grounds in European waters. However, the methodology was designed for the large trawlers and long-liners fishing in the extensive Atlantic areas. It is not suitable for the Mediterranean, where the boats are much smaller, have lower mobility, and work in small fishing

areas. This study has aimed to develop and apply a methodology (ICES-based) to study the fishing effort on species of commercial interest in the Catalan coast, using scripting PL/SQL procedures of PostgreSQL [4] system database with PostGIS [5] extension.

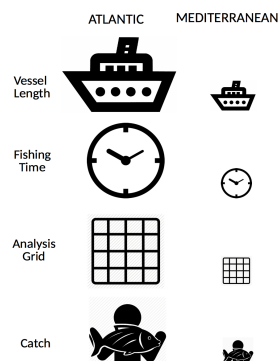


Fig 1. Differences between fisheries in the Atlantic Ocean and in the Mediterranean Sea.

### II. MATERIAL AND METHODS

The process of creating a map for the study of fishing effort begins with data collection from three main routes: VMS from EU or Spanish government, daily landings from fishermen or regional administrations, and logbook data also from fishermen.

Briefly, the steps for obtaining the VMS data are as follows. First, the ships equipped with VMS send signals to the satellite from their position. Then, the satellite reboots the signal to a receiving station in land, and these position data are stored in the databases of a relevant administration (EU or national administration).

On the other hand, the fishermen's associations store data of their daily sales by species (usually sorted by sales category). These data are aggregated and transmitted to the regional administration databases. The last dataset used in this study were logbook data. The logbook is a register of

all fish operations on board, kept by the fishermen, which contains estimates of fish catches (in weight) associated to GPS positions.

The three sets of data are requested annually to the various administrations and institutions involved. Then, they are dumped in a PostgreSQL database with PostGIS extension, after evaluating the data quality (see process in Figure 2).

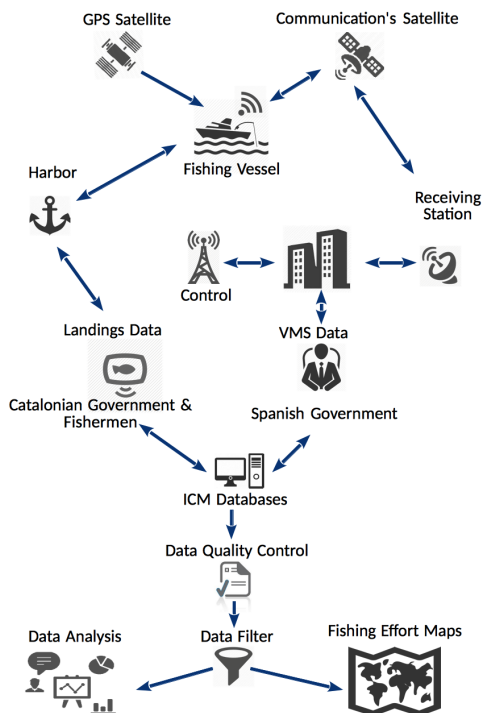


Fig 2. Process of fishing data collection.

The next step is to create a spatial grid for data analysis in QGIS [6], emulating ICES [7] squares on a smaller scale. Then, we generate a polygon filter for each studied species, based on their biological characteristics. Finally, we use SQL queries to calculate fishing time, to assign each catch value from the landings data to a VMS point in our dataset, and to filter by speed and polygon. See Table 1 with two simple examples of spatial SQL. The whole filtering process is presented in Figure 3.

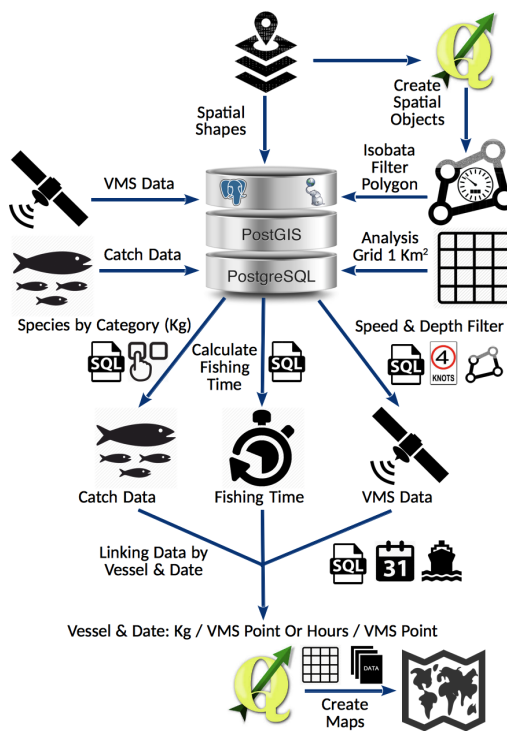


Fig 3. Process of spatial data generation for fishing effort analyses.

### Check Polygon IN Points

```
SELECT vms_point.id_data,
       vms_point.id_nri,
       vms_point.date,
       vms_point.latitude,
       vms_point.longitude,
       vms_point.course,
       vms_point.speed,
       vms_point.vms_point
FROM vms_point, vms_spatial_filter
WHERE vms_point.speed >= 1.0::double precision
AND
       vms_point.speed <= 4.0::double precision
AND
       vms_spatial_filter.ogr_id = 1
AND
st_contains(vms_spatial_filter.filter_polygon,
           vms_point.vms_point) = true
ORDER BY vms_point.id_data;
```

### Dump Polygon Points

```
SELECT g.gid, (g.gdump).path AS p_order,
       ST_AsLatLonText(ST_Transform((g.gdump).geom, 4326)
) AS point FROM
(SELECT gid,
       ST_DumpPoints(analysis_areas.the_geom) AS gdump
FROM analysis_areas) AS g;
```

Table 1. Two spatial SQL code examples: filter by speed and polygon and list the point coordinates of a filter polygon.

### III. RESULTS

In this section we show a first approximation of a cloud of

191,309 points from the VMS system (2005-2015), filtered by speed and spatial polygon for the Mediterranean hake (*Merluccius merluccius*, Linnaeus 1758). This species is caught mainly between 50 and 400 meters depth. With this information, we generated the filter polygon (Figure 4).

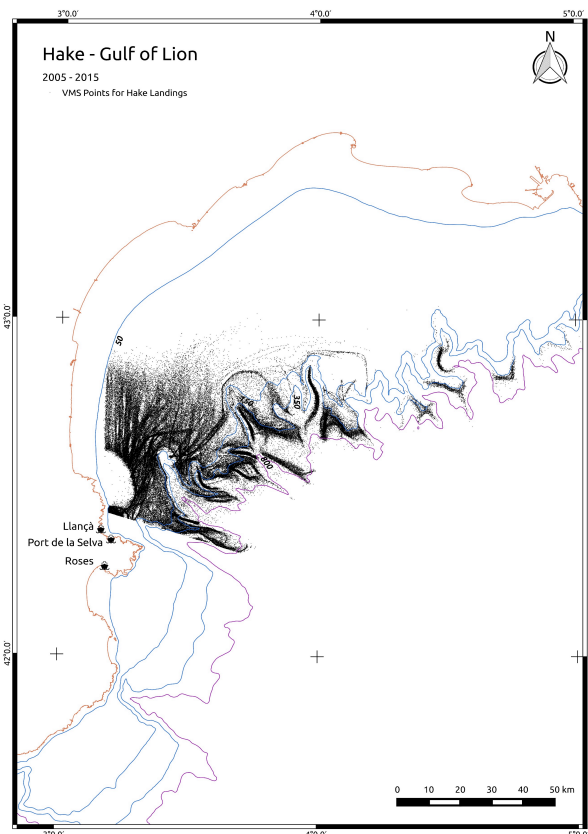


Fig 4. Hake filtered VMS points of the Gulf of Lion.

The following map shows the results for the hake fishery in the studied area, and was obtained by spatially aggregating data using the analysis grid in QGIS. We can clearly distinguish the areas where these ports fleet mainly acts. Besides showing the fishing effort on one species, this method can also be used to compare fishing effort data of two or more species.

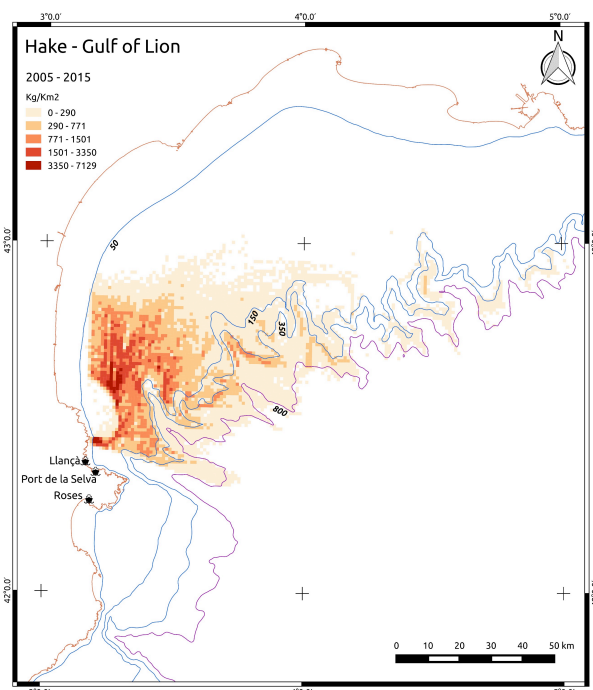


Fig 5. Hake fishing effort map of the Gulf of Lion.

#### IV. DISCUSSION

The use of standard computer software is not widespread in the scientific world. In this paper we used and adapted an existing methodology for the study of marine species with commercial importance. To do so, we worked with free software tools used in enterprise environments to study and store a diverse range of spatial data.

We tried to prove, that the use of these tools is also valid in scientific environments. Besides, it allows us to work directly with IT engineers and cartographers without the need to train specialists in tools developed for very specific purposes. These tools often entail budget and support problems due to their limited distribution. The tools we used in this study are widely known and supported by communities of free software and enterprises. This fact allows us to reduce personnel training time and project budget.

#### V. CONCLUSIONS

Using standard tools of free software is possible without adding any complexity, as they are becoming more versatile and diverse.

It is also valid to use free databases and GIS software in different science disciplines.

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Administration and the Spanish Ministry of Agriculture  
and Fisheries over the years 2005 to 2015.

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