
6.I Fish stock study on the Ridge of Santa Croce

Research unit

Scientist responsible: dr. Roberto ODORICO

Collaborators: Saul CIRIACO
dr. Marco COSTANTINI
dr. Enrico VINZI

Introduction

The use of acoustic devices for the measuring of the sea bottom, for the purpose of identifying shoals of fish, is part of the hydroacoustic survey. The physical principals that governs this field of science enables us to collect, by means of echo reflection analysis from the target, a high number of samplings in order to identify the areas of density and biomass distribution, the relative acoustic dimension and the reflection and typology of the sea bottom.

In order to obtain an acoustic response to an immersion, an echosounder must send an impulse through the water column; this impulse reaches the target and/or bottom and is reflected in proportion to the matter encountering.

On a preliminary basis, we can consider an *echosounder* as a tool able to generate a beam of light pointing the sea bottom with the capability of quantifying what “illuminates acoustically”.

The result, obtained from successive transmissions of acoustic impulses, is an echogram (Fig. 6.I.1), which represents the longitudinal section, bidimensional, of the monitored mass of water. The echoes of reflection all the objects, acoustically illuminated by the beam and that meet the threshold setting, are all reported on the echogram, as traces.

Modern echosounders enable us to gather many pieces of information such as:

The identification of the fish and/or plankton and evaluation of the relative size,

Density and abundance of the same organisms,

Study of the behaviour and migration of the fish/plankton;

Monitoring the efficiency of the sampling and fishing tools;

The mapping of the sea bottom.

In order to count the shoal of fish in terms of biomass, however, it is necessary to calibrate a certain acoustic response in energetic terms with a certain quantitative of fish (in other words, fishing is needed to verify). Every piece of information,

including those on the typology of sediment and depth, are codified inside the echo signal and obtained together with the GPS data. The results are then analysed and projected on digital paper.

Objectives

The main objective of the present investigation is the characterization of the Ridge of S. Croce in terms of morphobathymetry and distribution of shoals of fish present.

Methodological notes

The modern echosounder is a type of sonar whose acoustic beam is generally directed vertically from the surface to the bottom (MacLennan & Simmonds, 1992). It is a professional echosounder which gives energy as acoustic waves with characteristics stable during the sampling period, such as:

the frequency of emission;
the number of emission per second;
the intensity at the source;
the amplitude of the impulse sent.

This tool, belonging to the remote sensing category, is fixed to the sides of the research boat or towed on a vehicle, capable to send signals from the surface to the bottom. The components equipped are:

- transmitter;
- transducer;
- receiver;
- amplifier;
- computer display.

The main components of a scientific echosounder (seabed; shoals) are reported in Fig. 6.I.2 (images taken from MacLennan & Simmonds, 1992).

The data was collected with the help of 200 kHz biosonic digital echosounder DT6000 split beam (Fig. 6.I.3), installed on a metal supporter. The transducer, connected to a laptop, gathered 4 data per second (for a total of about one hour and half for each sampling) along all six transepts.

The GPS in use, connected to the laptop was a TRIMBLE PROXRS.

The calibration was carried out (as per instruction manual, Fig. 6.I.4) with 1000 pings and a known steel sphere reflection, positioned at 5 metres deep.

As already mentioned, from the echo reflex analyses is possible to collect data both in terms of numbers (it is possible to count the shoals of fish), and in terms of biomass (calibrating a certain response in energy with a certain quantitative of fish,

according to a relation for which the biomass B is proportional to DEng reflex according to a straight relation).

The sampling plan foresaw the implementation of six transects parallel one another and a maximum distance not more than 100m (Fig. 6.I.5).

In order to exclude the artificial reefs from the biological sampling, the result of a series of previous samplings was used, aimed to investigate the reefs: this morphobatimetric survey of the seabed was then taken away from the biological sampling echo to filter all the artificial elements (see Fig. 6.I.6).

Four samplings in 2006 were carried out, besides the series executed the previous year during which significant variations were reported, we then summed and averaged the relative data.

The collected data was:

- analysed using the Visual Analyser software supplied by Biosonics Inc., which enables the elaboration of data, determination of the target strength and identification of fish density values for each layers and columns;
- exported in matrixes divided by levels of depth.

Each datum associated to the respective latitude and longitude values (georeferenciation).

The tables were then put in Excel for preliminary analyses and then exported in a text file (csv) to be inserted into cartography with the help of the two latitude and longitude columns.

ARCGIS (ESRI) software with SPATIAL ANALIST and 3D ANALIST extensions was used for the mapping.

The text files were imported as points and rastered¹ with IDW (INVERSE DISTANCE WEIGHTED) and KRIGING interpolation.

Results

The work carried out enabled us to point out some interesting aspects of the distribution of shoals of fish on the Ridge of Santa Croce.

The most relevant matter is surely the “spotted” distribution of shoals with a clear spatial predisposition for areas with presence at the sea bottom of structures variously formed.

It is well known that the differences in the form of the shoal are so peculiar to be exploited by the operators to recognise the target species.

1 A raster is a regular matrix of values, which may represent fairly good values of a continuous field or image pixels.

In the three echograms, presented herewith, it is possible to see the three types described; echogram of “little stick”-shaped shoals (Fig. 6.I.7); non vacuolated echograms of shoals (see Fig. 6.I.8); vacuolated echograms of shoals (see Fig. 6.I.9). The names are imaginative, but their typical shape is well described and recognizable.

Each type of shoal corresponds approximately to different species: for the first ones, those thin and long, is generally blue-fish; for the other two types (referring to observations previously made for similar works carried out at the Marine Reserve of *Miramare*) it is grey mullets (*Liza spp.*), when the shoals are vacuolated and tend to rise from the bottom according to the acoustic disturbance from navigation noise, striped bream or sparids, if the shoal resulted highly reflecting and lacking internal vacuolisations.

These two last types are those mainly present in the area of the Ridge.

It is not possible up to today to analyse statistically the relevance of such aggregations since similar and synoptic samplings are missing in an area (perhaps adjacent and extensively the same), which enabled the comparison; on this basis then, it is possible to point out that it is indeed necessary to repeat the researches according to the conclusive observations of the present study.

The abundance of the relative fish density is, as it can be seen, higher especially in the shoals of the seabed layers from 8 to 14 metre (see Fig. 6.I.10). The data were analysed, both according to column, summing the relative values along all the column, and for depth layer; in the end we divided between summation of the whole column and summation below 5 metres of depth (excluding therefore, the superficial layer) (Figs. 6.I.1; 6.I.2; 6.I.3).

From what was observed above, we may easily deduce that the areas covered by artificial reefs coincide with those areas with more relative density, but also that at least one area with no submerged structures resulted rich in fish density.

It must be borne in mind that for its own nature, the Ridge is an aggregating structure and it is therefore difficult to extrapolate, if any from the artificial reefs, an added value of tigmotrophic capacity.

What is possible to state is that in the presence of the Ridge (area circled in red - Fig. 6.1.12) the factor bank resulted in dominating the aggregation; where the profile of the sea bed degraded, instead, the presence of a wreck (circled in blue) seemed to have an aggregating effect more efficacious than in the rest of the area. Some observations and findings carried out in the years previously showed the presence (June) of shoals of *Maena smarís* (blotched picarel) near the bottom evidently laying and adapting to the substrate uncovering the clayey sand and removing the superficial gravelly layer.

Further investigations are needed to confirm such hypothesis, providing a comparison with non protected areas and maybe an analysis of the sea bed characteristics aimed to establish any correlations between presence/absence of fish and typology of sea bed (soft or hard).

The 9-metre layer showed a rather peculiar situation where highlighting only the data beyond the standard deviation resulted only the two areas shown in Fig. 6.I.13.

Conclusions

As observed, significant relative density and biomass (data acquired by echosounder as opposed to the data obtained with the fish catch) around artificial reefs is used, wherever possible, to carry out samplings aimed to monitor the spatial distribution of the shoals.

Both the counting of the echo and the eechointegration, are ideal tools to follow the evolution of the shoals of fish on a time basis (daily and seasonally) and would represent the right subsequent steps to this preliminary investigation for a correct ecological evaluation of the area.

The impossibility to collect species in the area, under protection (F.I.P.S.A.S.), makes it difficult for both the conversion from relative values to absolute density values, and the identification of the species involved in the shoals.

To this end then an instrumental sampling could be useful followed by visual census sampling to valuate the species present in the shoals.

A further supply of information could be given by the sea bottom analysis (always by echosounder), which separates hard from soft substrates aiming to evaluate any correlations between sea bed and presence of species.

The added value could be the comparison of data of the Ridge with a “white” external area, but with much more similar possible characteristics; distance from coast, depth, etc.