QUANTITATIVE ASSESSMENT OF INTERACTIONS BETWEEN SEISMIC SHOOTING ACTIVITIES AND SMALL PELAGIC FISH IN MIDDLE ADRIATIC SEA

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Abstract

Present study describes the results of a quite large investigation carried out in Middle Adriatic sea during 1996. The study had the aim of assessing potential impact attributable to geophysical seismic prospection with air-gun on distribution and schooling behaviour of small pelagic fish. Results reported show a weak recoverable influence due to disturbance ; for a definitive statement further investigation is needed.

Key-words : acoustics, seismics, biomass, fishes, Adriatic sea

Introduction

In those marine areas where E&P activities are relevant, particular concern is given to the effects elicited by seismic shooting on marine fauna of commercial interest (1). In the Adriatic sea the activities of detection of the crust layers are important. AGIP promoted in 1995-96 a series of studies concerning the assessment of possible effects elicited by air-gun seismic shooting on fishable resources (2).

In particular the task of present study deals with the assessment (by acoustical methods) of the effects elicited by seismic prospection on geographical distribution, of biomass and schooling behaviour of small pelagic fish (*Sardina pilchardus* and *Engraulis encrasicolus*) rising up to 80% of the resource). These items were detected before, while and after the prospection performed by AGIP in the Adriatic sea during the period lasting from February 28th to March 10th 1996.

Material and methods

The study area lies inside the Pescara Basin (Middle Adriatic sea) and it is delimited between 42° and 43° and the depths of 30 and 100 m. The total area amounted to 200 nm^2. The area was sampled in 24 h in order to average the day-night fish behaviour. The surface was delimited by an outer "skeleton" and by an inner path. Sampling design foresaw the covering of outer part before and of the inner path after, in order to ensure a representative sample even if the weather conditions were bad. The total coverage arose to 162 nm^2 (80% of the total area). The values of the biomass occurring in the remainder 20% were interpolated according to "interpolation by numerical approximation" method (5). The same method allows the interpolation of the biomass surrounding the sampled area ; the total interpolated area reached nearly 290 nm^2. The bias about the assessment of the biomass varied about 14 and 25% and it can be attributed to the interpolation process.

The area was sampled as follows : two surveys were carried out before the seismic shooting ; two during profiling and one after the energization. Weather conditions did not allow the performance of the second survey to be carried out one week after profiling, which would have assessed the recovery period.

The echoes given by the pelagic fish were collected by EK-500 system, installed on the R/V *S. Lo Bianco*. The sample frequency generated by the "Split Beam" transducer (ES120-7 model) was equal to 120 kHz. Such a device is able to detect (ping per ping) both multiple echoes (mean volume density : SW) and the single echoes (target strength : TS) due to single specimens of pelagic fish. The TS evaluation enables to assess the size/species (or species groups) of those fish for which the theoretical TS values are available (previously measured in calibration assays). The mean biomass values were detected both on the whole water column and by layers (each layer equal to 10 m). In order to validate the interpretation of size/species data from the TS values, is important the collection of biological samples during the echosurvey (4).

In case of absence of single echoes (TS) the collection of biological samples is needed in order to assess the composition and distribution of the target species acoustically detected (4). The gear employed in present study was a low selectivity pelagic trawl net (stretched mesh 800 mm in the frontal part, 36 mm in the sack). The mouth of the net had a surface of 80 m^2 (6-8 m height, 12-13 m width). The position of the trawl net was regulated and constantly monitored by the ITI (Integrated Trawl Instrumentation System) system (SIMRAD). The information about the position of the net, with respect to the water column allowed the correlation between the biological samples and the echoes (acoustical samples). Each tow lasted 30 minutes at a 4 knots speed. The tows were splitted as follows : 9 were performed during the AGIP air-gun prospecting activities (while surveys), 6 were carried out during the two pre-surveys and 3 during the post survey. The all data collected during the 5 echosurveys were elaborated by software named Geographical Data Base System (GBDS) developed by I.R.PE.M. The elaboration of three kinds of different sets of data was performed :

1) horizontal distribution (biomass density referred to the whole water column, paths of the ship and catches) ;

2) vertical distribution (biomass densities inside selected depth layers);

3) time variations of the total biomass densities and of biomass in each layer.

The energy source used for the trials was formed by one air-gun array made-up by two subarrays consisting in 8 air-guns each developing a total volume equal to 1500 i^3 at 2000 psi, with an intensity of 240 dB//μPa. The interval between two shots was 15 sec.

The acoustical data in each echosurvey were splitted in 4 different depth layers :

1. the first layer includes the whole water column. In such a layer is contained all the pelagic biomass (fish long at least 5 cm). This dimension was established by the frequency employed and by the minimum value of TS chosen by the operator ;

2. the second layer goes from the surface to a depth of 10 m ;

3. the third layer reaches 10 m upon the bottom ;

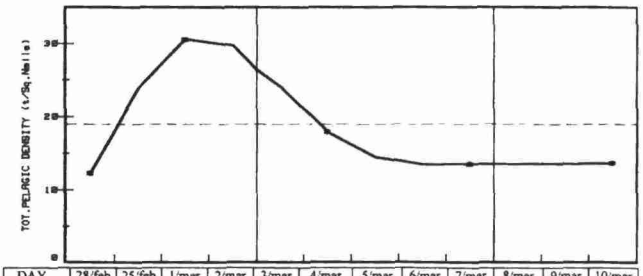
4. the last was the intermediate layer and goes from 10 m upon the bottom as far as 10 m beneath the surface.

The absolute density and biomass were computed in two different ways :

* the first way is based on the computation of a mean TS of all pelagic species ;

* the second way is based on the classification of TS by species according the method of Split Beam, using the calibration data integrated with catch data.

Figures 1 and 2 show the trend of Total Pelagic Biomass and Pelagic Biomass by species, before, while and after the seismic survey.



DAY	28/feb	25/feb	1/mar	2/mar	3/mar	4/mar	5/mar	6/mar	7/mar	8/mar	9/mar	10/mar
density t/SqNm	*12.1	24.5	*31.6	29.8	22.7	*15.7	12.9	13.2	*14.2	14	12.6	*10.7
tomass (t)	3085		9219			4665			4166			3153
Schooled %	26.7		47.6			14.2			29.9			31.4
Dispersed %	73.3		52.4			85.8			70.1			66.6
schools	245		667			137			321			266

Figure 1. Total pelagic biomass trend before, while and after the seismic survey.