Distribution and Abundance of Sprat Juveniles in the Romanian Marine Area during 2016-2017 *(Gheorghe Radu, Aurelia Țoțoiu, Cristian Sorin Danilov, Alina Daiana Spînu, Magda-Ioana Nenciu*	**"Cercetări Marine" Issue no. 47** **Pages 194-204**	**2017**

DISTRIBUTION AND ABUNDANCE OF SPRAT JUVENILES IN THE ROMANIAN MARINE AREA DURING 2016-2017

Gheorghe Radu*, Aurelia Țoțoiu, Cristian Sorin Danilov, Alina Daiana Spînu, Magda-Ioana Nenciu

National Institute for Marine Research and Development "Grigore Antipa", 300 Mamaia Blvd., RO-900581, Constanta, Romania, telephone: +40 241 543288
**E-mail: gradu@alpha.rmri.ro*

ABSTRACT

The study of the distribution and abundance of juvenile fish species is an important part of determining the status of the populations of the species concerned. Surveys realized along of the years confirmed that productivity oscillations, namely completion volume, are closely linked with the environmental factors variation, between which decisive are water temperature and quantity and quality of the trophic base. Through modification of the spawning intensity and completion, the fish populations create adaptations of self-control of the shoal size in concordance with degree of food ensuring. A certain coincidence between growth of the fish juveniles and the growth of the trophic plankton sometimes constitute one of the most important factors which determine respective generation productivity. Therefore, the level of completion of the sprat species reserve in the Romanian Pontic waters has been investigated in relation to the dynamics of abiotic environmental conditions and the evolution of the zooplanktonic trophic base. Taking into consideration that in the sampling time with trawl for juvenile fish were observed a high quantity of jellyfish, have been evaluated its biomass in the surveyed area, establishing the influence degree on juvenile agglomerations. In order to determine the intensity of the sprat stock completion at the Romanian littoral, the results of two complex research surveys conducted at sea in May 2016 and 2017 were analyzed by the team of Marine Living Resources Department of the National Institute for Marine Research and Development "Grigore Antipa ", Constanţa. Have been realized 72 sampling haulings with the Danilevski pelagic trawl, designed by the Institute's specialists. In the assessment were used the parameters like: hauling speed; horizontal trawl opening; hauling time and hauling level. The biological samples taken were preserved in formaldehyde 4% and then analyzed in the laboratory to establish the quantitative structure on species. The results were expressed in number of specimens/hauling and specimens/Nm^2 and were used to determine the completion of each fish species reserve. The distribution of the juveniles was

done by marking on the distribution maps of the catch values obtained through sampling haulings with the juvenile trawl. Using observations recorded both in 2016 and in 2017, it can be said that the state of the sprat stock is quite unstable, with major fluctuations, from one year to another, of the relative abundance of the sprat juveniles, determined both of environmental modification and fishing pressure on the sprat population, implicitly on spawning stock. So, the causes of this situation are multiple, the effect of each being difficult to be assessed. The estimated abundance for sprat juveniles in May 2017 was lower than in the same period of the previous year. Considering that sprat has a high reproductive capacity and a short life cycle, sprat stocks, although intensely exploited, can be restored more easily than for other species.

Key-Words: Romanian Black Sea area, sprat juveniles, distribution, abundance, completion.

AIMS AND BACKGROUND

Knowing the mutations in the biology, structure and productive potential of fish species are essential given that the biological features of marine bioresources must be the basis for their conservation and management.

The research of fish juveniles in the Romanian marine area contributes to the knowledge of the changes that took place in the qualitative and quantitative structure of the ichthyofauna, the behavior of the different species of fish (Radu G. et all 1998; Radu E. et all 2002; Radu E. et all 2004; Radu E. et all 2007; Radu E. et all 2008; Radu E. et all 2008). The biological and ethological characteristics of the species, the ecological links between commercially important species and the auxiliary species are important elements for their conservation and management. A first measure to conserve species and maintain population density is to establish the level of completion. In these conditions, the study of the distribution and abundance of juvenile fish species is an important part of determining the status of the populations of the species concerned (Radu G. et all 1998; Radu E. et all 2002; Radu E. et all 2004; Radu E. et all 2007; Radu E. et all 2008; Radu E. et all 2008).

Surveys realized along of the years confirmed that productivity oscillations are closely linked with the environmental factors variation, between which decisive are water temperature and quantity and quality of the trophic base. More or less diversified adaptations give fish populations as many means of responding to fluctuations in environmental factors as to keep them within a range compatible with their sustainability. Through modification of the spawning intensity and completion, the fish populations create adaptations of self-control of the shoal size in concordance with degree of food ensuring (Radu G. et all 1998; Radu E. et all 2002; Radu E. et all 2004; Radu E. et all 2007; Radu E. et all 2008; Radu E. et all 2008).

Therefore, the level of completion of the sprat species reserve in the Romanian Pontic waters has been investigated in relation to the dynamics of abiotic environmental conditions and the evolution of the zooplanktonic trophic base. Since the conditions in which the development of fish are subject to variations, there are large fluctuations in productivity of different generations. But, taking into

consideration that sprat has a high reproductive capacity and a short life cycle, sprat stocks, although intensely exploited, can be restored more easily than for other species.

EXPERIMENTAL

For correctly assessment of the tendencies and changes occurred in the stocks abundance from one survey to the other one, or from one year to the other one, the standard fishing and assessment techniques were utilized, so that the results can be reproduced and compared. The methodologies and techniques used both for data collecting, checking, processing and analysing, and also for assessment of fish juvenile agglomerations were that usually accepted for Black Sea basin, and in compliance with international methodology (Radu G. et all 1998; Radu E. et all 2002; Radu E. et all 2004; Radu E. et all 2007; Radu E. et all 2008; Radu E. et all 2008). In order to determine the intensity of the sprat stock completion at the Romanian littoral, the results of two complex research surveys conducted at sea in May 2016 and 2017 were analysed by the team of Marine Living Resources Department of the National Institute for Marine Research and Development "Grigore Antipa" Constanţa. Have been realized 72 sampling haulings with the Danilevski pelagic trawl, designed by the Institute's specialists, using the research vessel “Steaua de Mare 1” (Fig. 1). Sampling stations were located at 43°50 '- 45°00' north latitude and 28°42 '- 29°45' east longitude, at depths ranging between 10 m (Zaton) and 60-70 m (Mangalia) (Fig. 1).

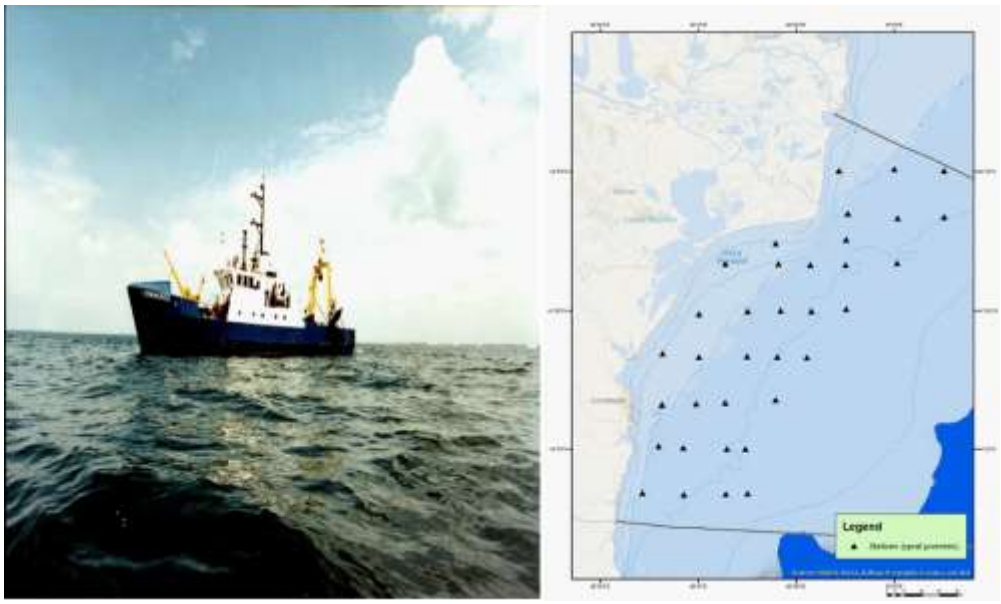

Fig. 1. Research vessel Steaua de Mare 1 and distribution of the sampling points.

Sampling of juvenile fish samples was made using the pelagic trawl for juveniles by surface trawling (0-5m) at 1.5-2 Nd speed, the duration of the trawling being 15 minutes and the horizontal opening of the 14 m trawl (Fig.2,3).

In the assessment were used the parameters like: hauling speed; horizontal trawl opening; hauling time and hauling level.

Fig. 2. Fishing activity with pelagic trawl for fish juveniles.

Fig. 3. Operation of sample discharge from pelagic trawl.

The biological samples taken were preserved in formaldehyde 4% and then analysed in the laboratory to establish the quantitative structure on species (Fig.4 and 5). The results were expressed in number of specimens/hauling and specimens/Nm^2 and were used to determine the completion of each fish species reserve.

Fig. 4. Preservation and analysis of samples.

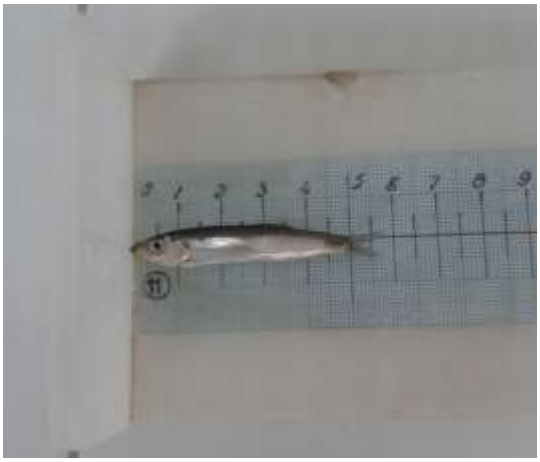

Fig. 5. Measurement of specimens of the sprat juveniles.

The distribution of the juveniles was done by marking on the distribution maps of the catch values obtained through sampling hauling with the juvenile trawl (Fig. 6-9). Taking into consideration that in the sampling time with trawl for juvenile fish were observed a high quantity of jellyfish (Fig.10), have been evaluated its biomass in the surveyed area, establishing the influence degree on juvenile agglomerations.

RESULTS AND DISCUSSION

In May 2016 (18-22.05) a total of 33 samples were collected (from 36 sampling points), of which 27 were preserved with formaldehyde and six samples were preserved by freezing.

The presence of sprat juveniles varied from one station to another, with three stations in which they were not present, the stations being located in the northern part of the Romanian seaside (Chituc and Gura Portiţei) (Fig. 6 and8).

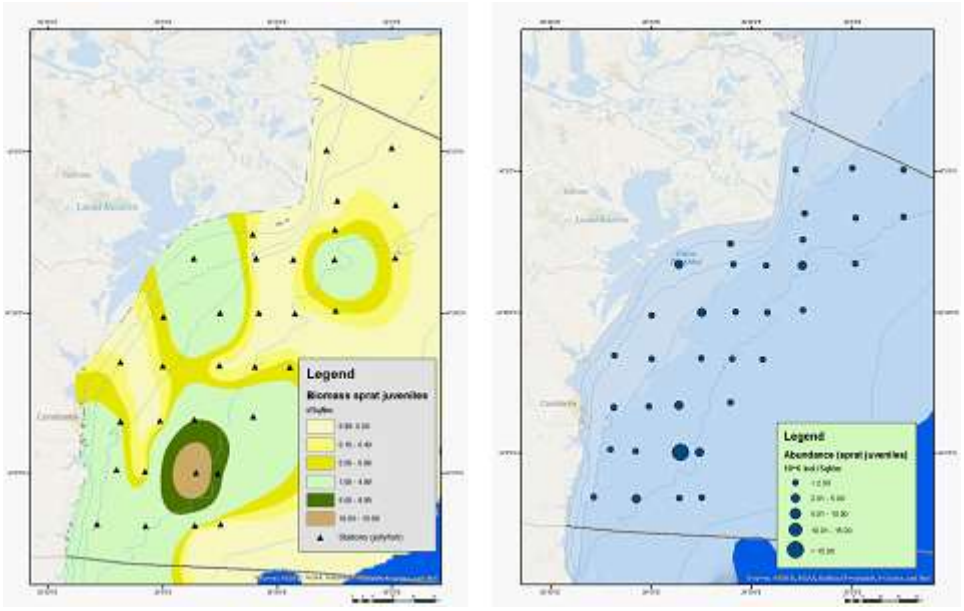

Fig. 6. Distribution and abundance of sprat juvenile in spring 2016.

The average sprat juvenile catches were higher in the isobaths area 30-60m (1.58t/Nm^2) than in smaller depths (0-30m), where averagecatches were only 0.5t/Nm^2 (Table 1 and 7). Sprat juvenile biomass was valued for the investigated area (3279Nm^2) at 4521 tonnes, the highest being found between the isobaths of 30-60m (3978t) (Table 1, 2 and 7). Class length prevalent in analyses was 55-60 mm with an average weight of 1.8g. Trophic zooplankton has been dominated by the copepods group with a density of 2345 ind.m-3 at station 9, followed by meroplankton with maximum values of the density and the biomass in the station 9. During the investigated period, jellyfish was present on the entire surface surveyed, with an average of 11t/Nm^2 on the isobaths of 30m and an average of 5t/ Nm^2 beyond the 30m isobaths (30-60m). On the entire surface surveyed, jelly biomass was estimated at 21124 tons (Table 5). The average surface water temperature was 15^{o}C.

Table 1. Assessment of sprat juveniles biomass (t/Nm^2) in May 2016, pelagic trawl survey, Romanian area.

Depth range (m)	0 - 30m	30 – 60m	Total
Investigated area (SqNm)	762.275	2516.927	3279.202
Variation of the catches (t/SqNm)	0-2.000147	0-17.692203	0-17.692203
Average catch (t/SqNm)	0.544153	1.580497	1.378986
Standard deviation,s	0.710858	3.399461	3.082974
Total in the investigated area (t)	414.7943	3977.9967	4521.973783

Table 2. Assessment of sprat juveniles abundance (10^6 ind./Nm^2) in May 2016,pelagic trawl survey, Romanian area.

Depth range (m)	0 - 30m	30 – 60m	Total
Investigated area (Nm2)	762.275	2516.927	3279.202
Variation of the catches (10^6 ind./SqNm)	0-3.530	0-17.429	0-17.429
Average catch (10^6 ind./SqNm)	0.727544	1.401161	1.270170
Standard deviation,s	1.26438	3.284843	2.996555
Total in the investigated area (10^6 ind.)	554.5888	3526.6222	4165.144793

Biological juvenile samples were much less significant in 2017 than in the previous year. The estimated relative abundance for sprat juveniles in May 2017 was less about 57 times than in the same period of the previous year. Sprat juveniles, with densities lower than last year, showed an average length of 3.0- 3.6 cm and a mean weight of 0.17-0.2g; Considering that the research expedition took place almost a month earlier than in 2016, the average length and average weight per specimen in 2017 was much lower. Overall, sprat juvenile capture was 239 times higher in 2016 than in 2017, and its abundance of 61 times higher (Fig.7-9) (Table (3-4 and 6),

At the same time, in 2017, the total biomass of jellyfish in the area investigated was 12.7 times higher than in 2016, reaching 268345 tons. The jellyfish average in 2017 (t/Nm^2) was 18 times higher at depths exceeding 30m (Fig.10) (Table (6-7). In the period investigated in 2017, the average surface water temperature was around 10^{o}C and the trophic zooplankton reached an average of 8550.8 ind.m-3 of which copepoda 7142 ind.m-3 .

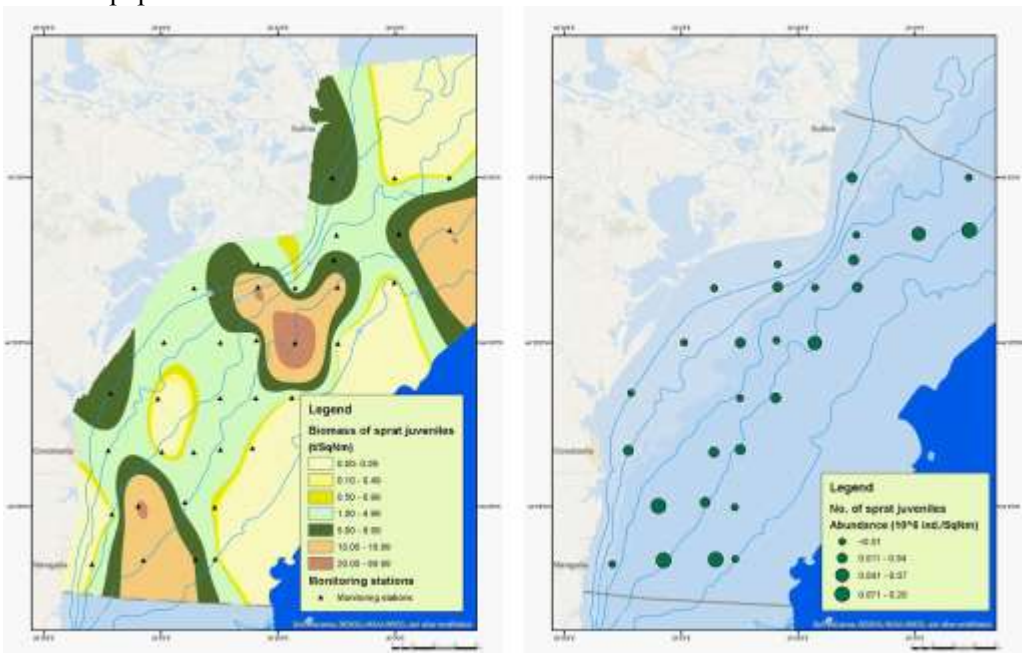

Fig. 7. Distribution and abundance of sprat juvenile in spring 2017.

Table 3. Assessment of sprat juveniles biomass (t/Nm^2) in May 2017, pelagic trawl survey, Romanian area.

Depth range (m)	0 - 30m	30 – 60m	Total
Investigated area (SqNm)	762.275	2516.927	3279.202
Variation of the catches (t/SqNm)	0.002398-0.012769	0.0-0.034641	0.0-0.034641
Average catch (t/SqNm)	0.006132881	0.0054	0.005767698
Standard deviation,s	0.003821	0.008213	0.007855931
Total in the investigated area (t)	4.6749423	13.59262	18.9134486

Table 4. Assessment of sprat juveniles abundance (10^6 ind./Nm^2) in May 2017,pelagic trawl survey, Romanian area.

Depth range (m)	0 - 30m	30 – 60m	Total
Investigated area (Nm2)	762.275	2516.927	3279.202
Variation of the catches (10^6 ind./SqNm)	0.000013-0.0268	0.0-0.105228	0.0-0.095580
Average catch (10^6 ind./SqNm)	0.009373	0.022685	0.0209001
Standard deviation,s	0.00869	0.03225	0.029394
Total in the investigated area (10^6 ind.)	7.144711	57.096	68.53586

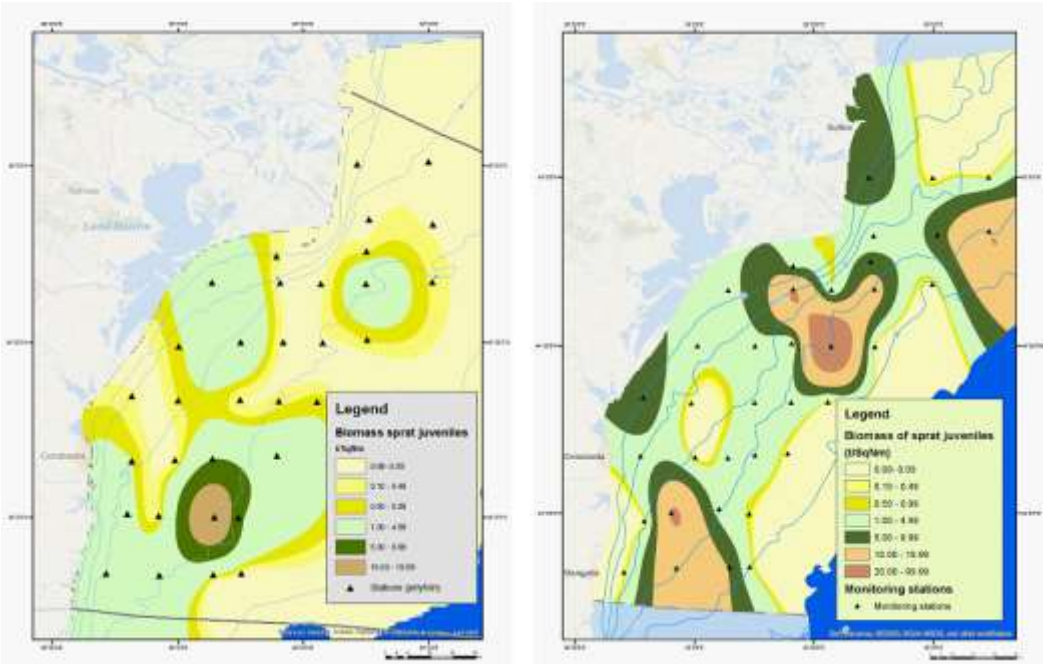

Fig. 8. Distribution of sprat juvenile agglomerations during 2016-2017.

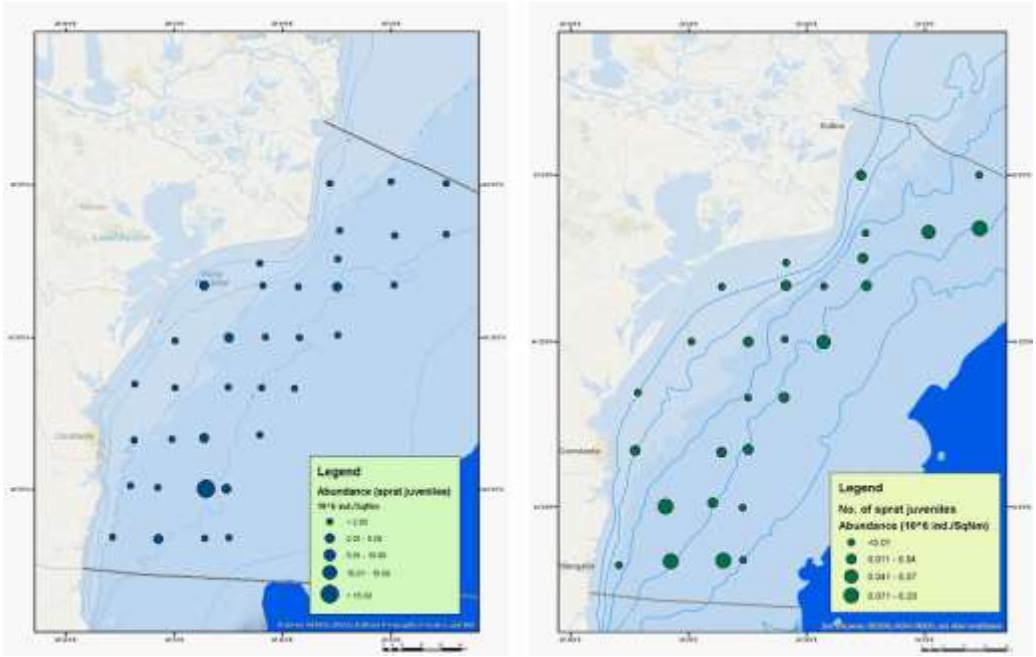

Fig. 9. Distribution of sprat juvenile abundance during 2016-2017.

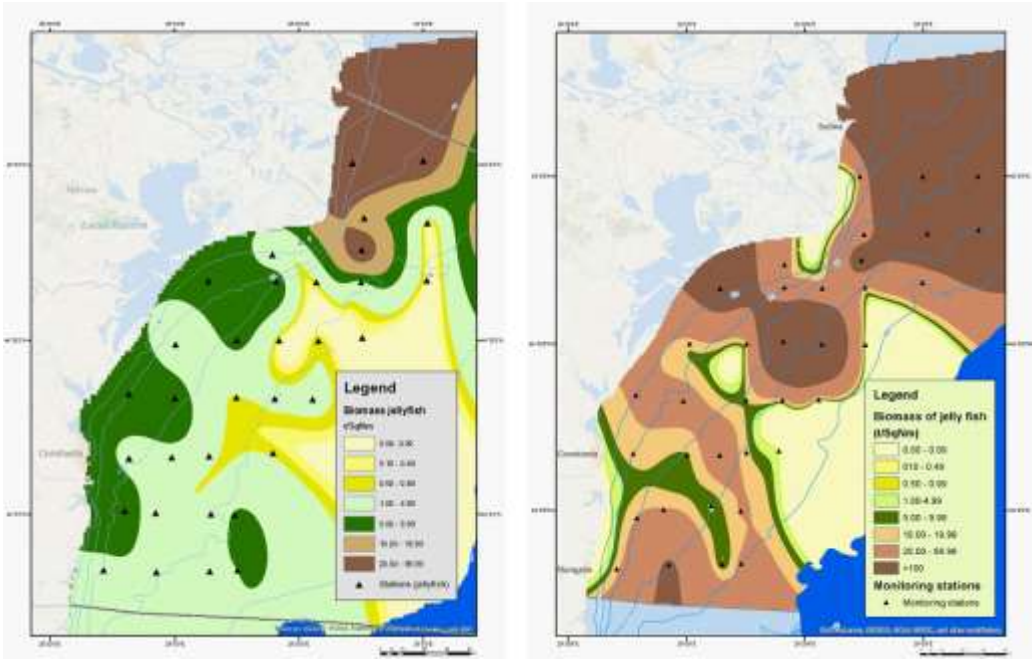

Fig. 10. Distribution of jellyfish agglomerations during 2016-2017.

Table 5. Assessment of jelly fish biomass (t/Nm^2) in May 2016, pelagic trawl survey, Romanian area.

Depth range (m)	0 - 30m	30 – 60m	Total
Investigated area (SqNm)	762.275	2516.927	3279.202
Variation of the catches (t/SqNm)	0-47.062283	0-29.413927	0-47.062283
Average catch (t/ SqNm)	11.86096	5.1333744	6.441813
Standard deviation,s	15.81636	7.584357	9.807815
Total in the investigated area (t)	9041.31	12921	21124.00865

Table 6. Assessment of jelly fish biomass (t/Nm^2) in May 2017, pelagic trawl survey, Romanian area.

Depth range (m)	0 - 30 m	30 - 60 m	Total
Investigated area (SqNm)	762.275	2516.927	3279.202
Variation of the catches (t/SqNm)	12.769-171.293	0.0-661.813	0.0-661.813
Average catch (t/ SqNm)	41.7164731	90.775	81.832447
Standard deviation,s	57.759843	145.125	133.18252
Total in the investigated area (t)	31799.4245	228474.742	268345.126

Using observations recorded both in 2016 and in 2017, it can be said that the state of the sprat stock is quite unstable, with major fluctuations, from one year to another, of the relative abundance of the sprat juveniles, determined both of environmental modification and fishing pressure on the sprat population, implicitly on spawning stock. So, the causes of this situation are multiple, the effect of each being difficult to be assessed.

Table 7. Comparative data presentation of juvenile sprat and jellyfish obtained during 2016-2017.

Sprat juveniles	**Depth (m)**	**2016**	**2017**
Average catch (t/Nm^2)	0-30m	0.544153	0.006132881
	30-60m	1.580497	0.0054
	Total	1.378986	0.005767698
Average catch (10^6 ind./SqNm)	0-30m	0.727544	0.009373
	30-60m	1.401161	0.022685
	Total	1.270170	0.0209001

Total catch in the investigated area (t)	0-30m	414.7943	4.6749423
	30-60m	3977.9967	13.59262
	Total	4521.973783	18.9134486
Total catch in the investigated area (10^6 ind.)	0-30m	554.5888	7.144711
	30-60m	3526.6222	57.096
	Total	4165.144793	68.53586
Jellyfish	**Depth (m)**	**2016**	**2017**
Average catch (t/Nm^2)	0-30m	11.86096	41.7164731
	30-60m	5.1333744	90.775
	Total	6.441813	81.832447
Total in the investigated area (t)	0-30m	9041.31	31799.4245
	30-60m	12921.00	228474.742
	Total	21124.01	268345.126

CONCLUSIONS

The state of the sprat stock is quite unstable, with major fluctuations, from one year to another. The fluctuations are determined both of environmental modification and fishing pressure on the sprat population, implicitly on spawning stock. The estimated abundance for sprat juveniles in May 2017 was lower than in the same period of the previous year. The environmental conditions existing to the Romanian littoral allowed formation and maintaining of very large agglomerations of gelatinous species, especially jellyfish.

ACKNOWLEDGEMENTS

The research leading to the results herein presented has been undertaken in the frame of the project "IntelliGent Oceanographically-based short-term fishery FORecastIng applicaTions" (GOFORIT), funded by the Romanian Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI Contract no. 27/2015) through the ERA-COFASP Programme.

We also thank colleagues **Elena Bisinicu** and **George Harcota** which provided zooplankton data.

REFERENCES

Anton E., Nicolaev S., Maximov V., Radu G., Radu Elena, Papadopol N.C., Staicu I. (2006), Recherches concernant l'influence de l'effort de pêche avec des filets maillants et filets maillants pour esturgeons sur les populations de dauphins du secteur roumain de la mer Noire. *Cercetari marine*. Recherches marines. INCDM. ISSN:0250-3069, **36**: 457-468;

Anton E., Radu G., Radu E., Adam A., Adam Adrian (2012), Research on the selectivity of the pelagic trawls used in the Romanian costal fishery with trawls tonnage vessels. J Environ Prot Ecol, **13** (3A): 1792-1798.