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EVOLUTION OF THE SPRAT FISHERY AT THE ROMANIAN BLACK SEA COAST DURING 1950-2014

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ABSTRACT

Sprat, gregarious pelagic species, represented one of the most important commercial fish in the Romanian Black Sea waters.

The paper is a summary of certain elements related to the sprat fishery in the Romanian marine area, such as:

- dynamics of sprat catches and its share in Romanian marine capture;
- evolution of fishing effort;
- sprat stock status and fishing agglomerations biomass;
- environmental conditions influence on the status and distribution of fishing agglomerations;
- evolution of biological parameters of the sprat;
- reproduction and recruitment of sprat in the environmental conditions of Romanian Black Sea waters;
- management measures in the Romanian marine area.

Key words: *sprat, Romanian Black Sea Coast, catch, fishing effort, biomass, spawning, recruitment, fishery management*

AIMS

The aim of this paper is the presentation of the sprat fishery evolution in the Romanian Black Sea area and the reasons which have determined it.



INTRODUCTION

In the Romanian marine area the qualitative and quantitative structure of catches had a variable evolution, depending on the condition of fish populations, fishing effort, the type of fishing gears used and formation and preservation conditions of fish shoals, especially in the coastal area. For over 25 years, the dominant species in the Romanian marine fisheries was sprat, although in recent years the average production of sprat is falling. The drastic decline of sprat catches is due to stock reduction, severe ecological disturbances occurring in the sea, overexploitation of bio resources and, economical and technical reasons.

MATERIAL AND METHODS

The paper includes data about catch dynamics, volume of catches, evolution of the fishing gears and fishing effort, structure of the populations, stocks biomass and maps showing geographic distribution for sprat agglomerations in the last years, reproduction, recruitment and management measures.

Some of the data on catches and fishing effort in the period 1950 - 1990 are based on the papers published by some authors, such as: Cautis (1976), Parcalaboiu (1977), Porumb (1977,), Prodanov et al., 1997, FAO Fisheries Statistics and others.

The evolution of the catches and fishing effort (number of vessels, number of fishing nets etc.) from the Romanian marine waters in the last 25 years was obtained by scientists of the National Institute for Marine Research and Development “Grigore Antipa” (NIMRD) from the profile companies and through interviews with fishermen and included in NIMRD’ Reports and papers published by authors like: Daskalov (1999, 2003), Radu et al.(1996-2014). After EU accession of Romania, data are obtained from Annual Reports realised by the NIMRD in the frame of National Program for Collection of Fisheries Data 2008-2010 and 2011-2014 and STECF/EWG – BS stock assessment Reports (2009-2014).

For assessment of the sprat biomass was used the swept area method, using pelagic trawl 57/63-62m with horizontal opening of 22m, in the annual surveys at sea.

RESULTS AND DISCUSSIONS

Dynamics of sprat catches and its share in Romanian marine capture

At the Black Sea level, the catch of the Black Sea countries increased until 1985-1989 after which a sharp decline occurred (Fig. 1; 2). The sprat catch, oscillated from 1700 tons in 1955; 40.9 (1983) and 105.3 tons (1989)^{1,2,3, 4, 5, 6} (Fig. 1,2).

For the period 1993 to 2013 catches of sprat in the Black Sea increased steadily from a low level of about 17 thousand tons in 1993 to a first peak level of about 72 thousand tons in 2002, and a subsequent peak of almost 121 thousand tons in 2011. Catch during 2013 was only 27 thousand tons,^{7, 8, 9-20, 21, 22,23,24} (Fig. 2). Most of the reported landings of sprat since 2004 for Black Sea were taken by Turkey²³ (47%) (Fig. 3).



Consequently after 1995 the catches increased to levels comparable to the 1980s: 2001-2005 ~70 000 t. Landings have initially (in 2001-2005) reached levels comparable to the 1980s but dropped again in 2006-2007. In 2008 the landing started to increase again due to expending Turkish fisheries that corresponded to a rise in fishing mortality, but in 2012 and 2013 decreased again²².

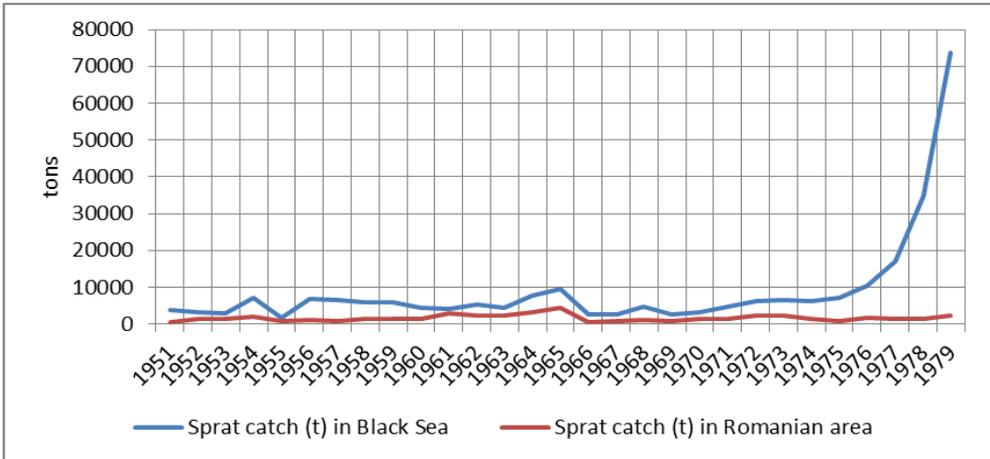


Fig. 1. Romanian catch of sprat compared with the catch for the entire Black Sea, 1951-1979

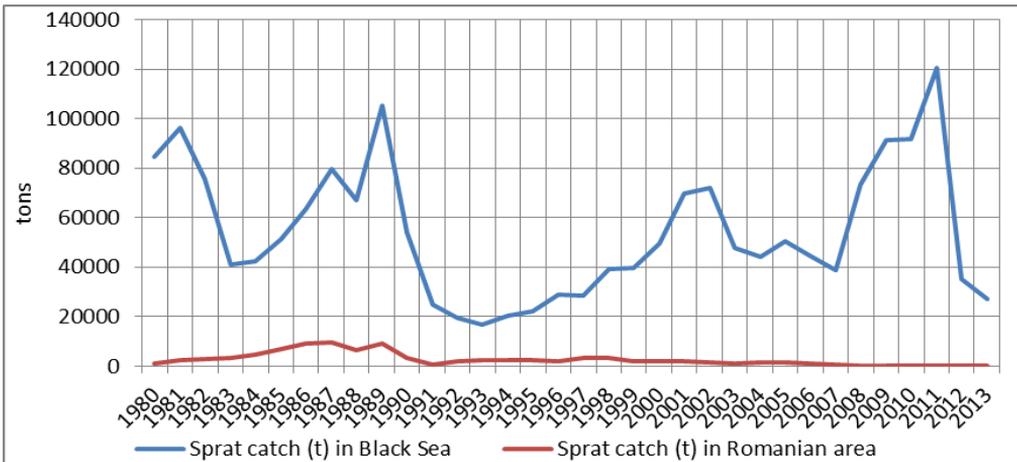


Fig. 2. Romanian catch of sprat compared with the catch for the entire Black Sea, 1980-2013

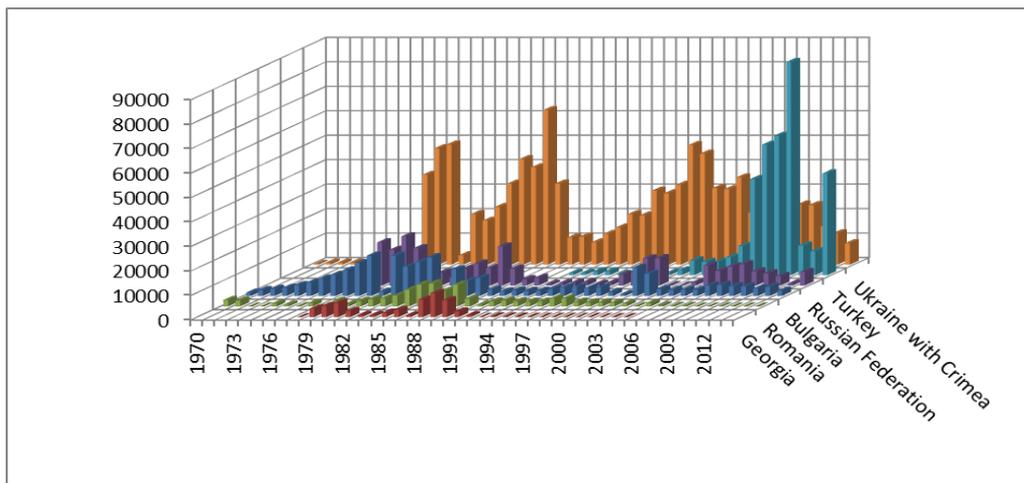


Fig. 3. The Black Sea sprat catches by countries

At national level sprat was and remains one of the main species in the catches on the Romanian seaside.

If, during the 1950-1959 interval, the multi-annual total catch on the Romanian coast was 4,410 t, the following three decades it increased intense, reaching a maximum value of 12,964 t (1980-1989), 16000 t in 1986^{1, 2, 3, 4, 5, 6} (Fig.4; 5). In the following decade (1990-1999), the multi-annual catch declined by about four times the previous one and, in the last decade (2000-2014), it fell to 1.575 t^{9-20, 21, 24}(Fig. 5).

In the same interval, 1950-2014, for the main pelagic species (sprat), the same differences in terms of multi-annual catch were found. Thus, although the dominant species in catches on the Romanian coast, the multi-annual catch of sprat increased in the first decade, reaching a maximum of 5,841 t (1980-1989), maxim 9500t in 1987 then, in the next decade, fell to half that amount, reaching a minimum in the last decade^{1, 2, 3, 4, 5, 6, 9-20, 21, 24} (Fig. 4,5).

Between 1950-1979, fishing on the Romanian coast was done with pound-nets, trap-type tools installed perpendicular to the shore, from Sulina to Mangalia^{1, 2, 3, 4, 5}. The main target of pound-net fishing was represented especially by: anchovy, shads, horse mackerel, sprat and small quantities of blue mackerel. Their number fluctuated from 76, in 1953, to 140, in 1965 (Fig. 6).

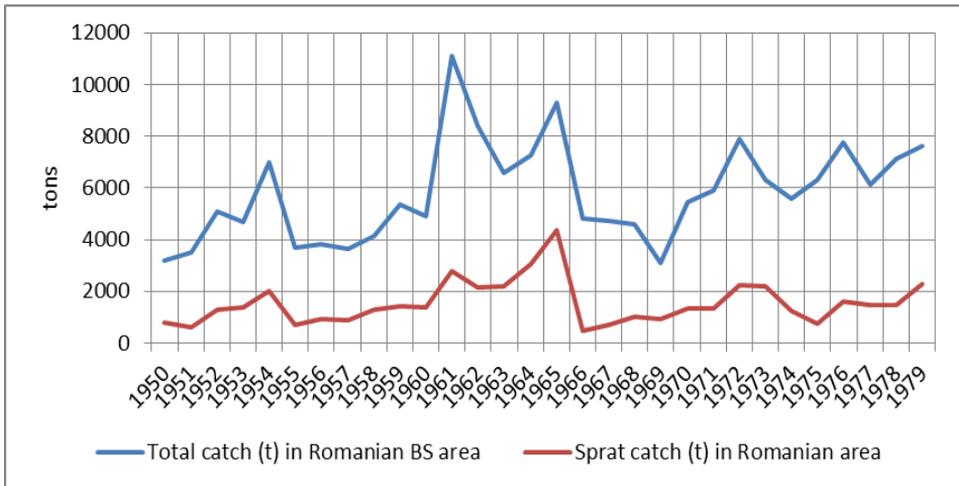


Fig. 4. Romanian catch of sprat compared to the total catch in the Romanian Black Sea area, 1950-1979

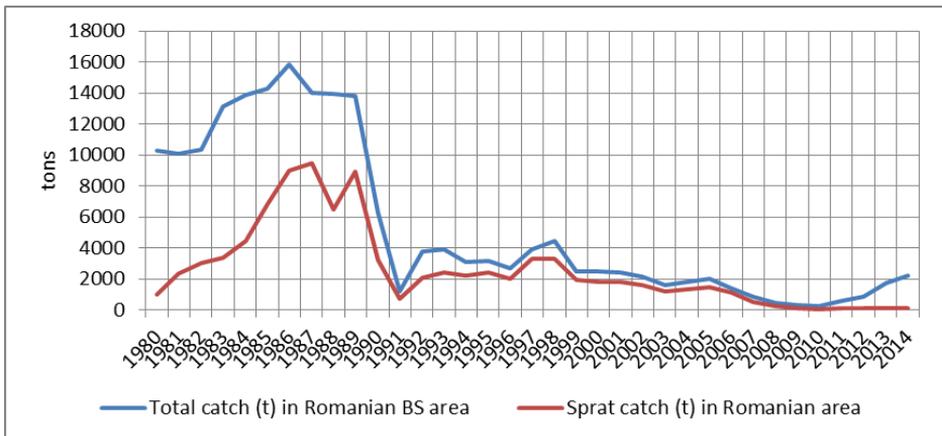


Fig. 5. Romanian catch of sprat compared to the total catch in the Romanian Black Sea area, 1980-2014

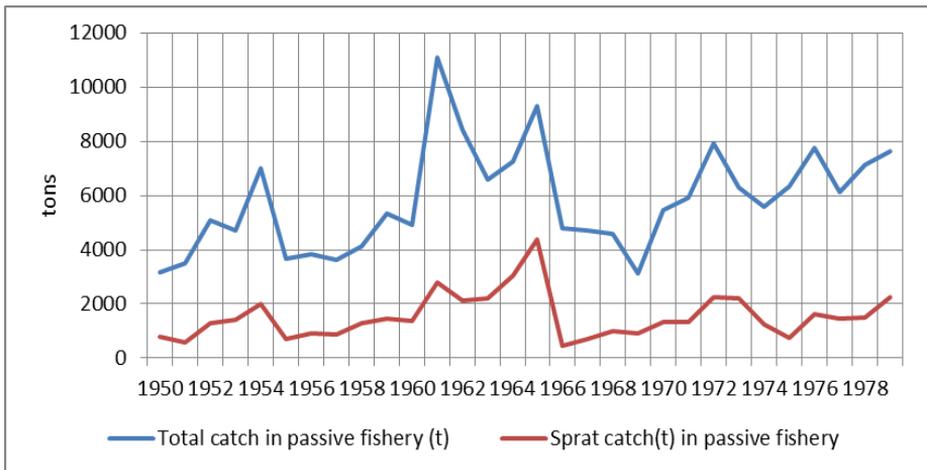


Fig. 6. Romanian catch of sprat in the passive fishing compared to the total catch in passive fishing for the Romanian Black Sea area, 1950-1979

Pound-nets made annually up to 70% of the total amount of catches, during a time when specialized fishing with other tools was also undertaken, either for mullet (1953-1955), or turbot (1953-1956) and blue mackerel and bonito (1954-1958).

Between 1980-1990, catches were more significant for trap-nets (53-100%), except for 1989, when stationary fishing was only 37% of the total catch. In the early years of the following decade (1991-2000), fixed gear fishing remained prevalent (42-83% in the years 1991-1995), while, in the last decade (2001-2014), active fishing clearly exceeded the results of stationary fishing, except for 2009⁹⁻²⁰ (Fig. 7,8).

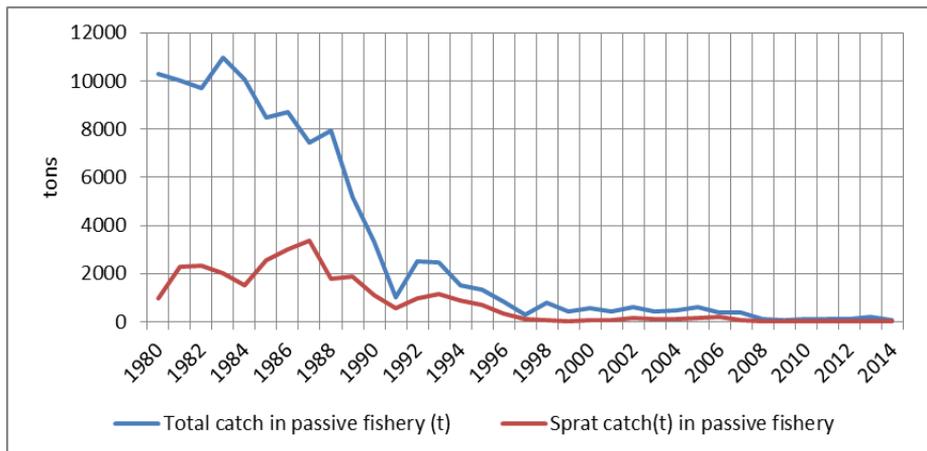


Fig. 7. Romanian catch of sprat in the passive fishing compared to the total catch in passive fishing for the Romanian Black Sea area, 1980-2014



In active fishing, the main fishing species continues to be sprat, along with sporadic occurrences, in the summer months, of anchovies and horse mackerel, and blue fish late in the season (September-October) (Fig. 8). Thus, sprat catches in active fishing, between 1981-2009, ranged from 77 t (1981) and 7,053 t (1989), contributing to the total catch obtained with trawlers with 63 percent (1983) to 96 (1982, 2002 and following years) (Fig. 8).

Overall, in the last two decades fish catches in Romanian marine area continuously decreased, but in the last two years the trend is reversed due to the catches of *Rapana* who began to have an important share^{9-20, 21, 24} (Fig. 5).

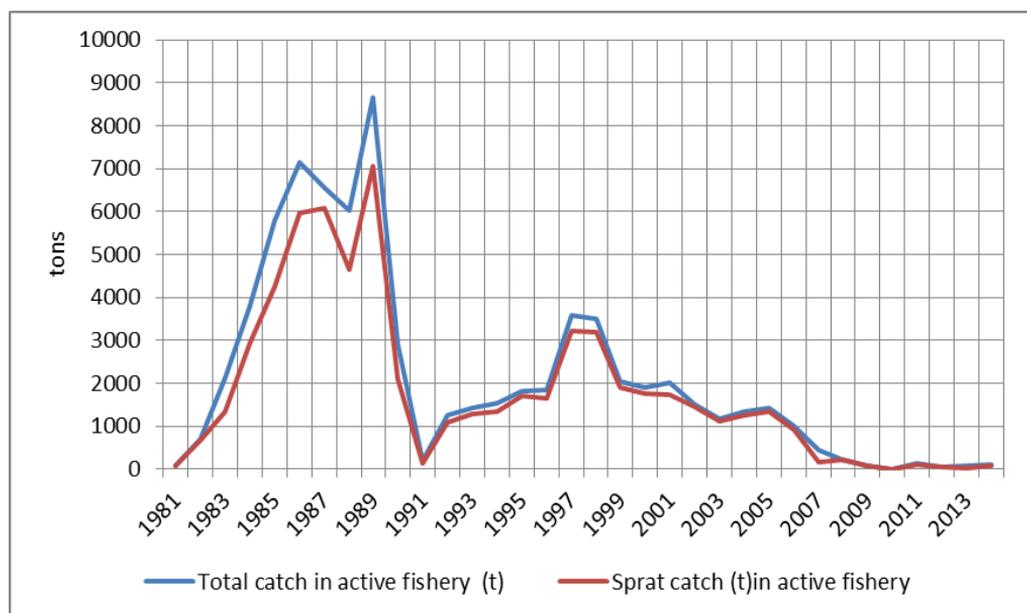


Fig. 8. Romanian catch of sprat in the active fishing compared to the total catch in active fishing for the Romanian Black Sea area

Evolution of fishing effort

In the sprat fishery there are two type of fishing gears for the active and passive fishery practised in our country, in the inshore and offshore coastal fishery.

The passive fishing gears include the equipment for catching in general the fish migrating for spawning and feeding in shallow waters, namely sea pound nets. Their number has dropped from a peak of 140 units in 1965 to 15 units in 2011^{1, 2, 3, 4, 5, 9, 11, 12, 17, 24} (Fig. 9). In 2014 there were 21 pound nets.

In the early '80s, a small tonnage trawler fleet was established. This coastal fishing fleet suffered drastic transformation, yearly fishing gradually decreased, reaching in 2012 of more than 20 ships in the vessels register, only one inshore trawler (FLAMINGO 4) to conduct an active fishing for sprat (Fig. 10). Default and



catches of these vessels fell from about 7000 tons/year to less than 100 tonnes in recent years^{9, 11, 12, 17, 24} (Fig. 8).

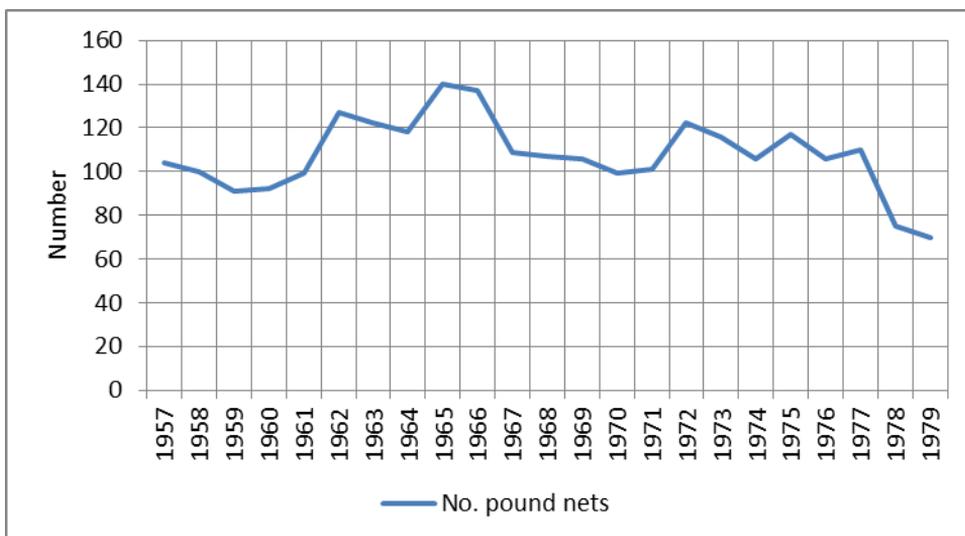


Fig. 9. Number of the pound nets in the Romanian Black Sea area, 1957-1979

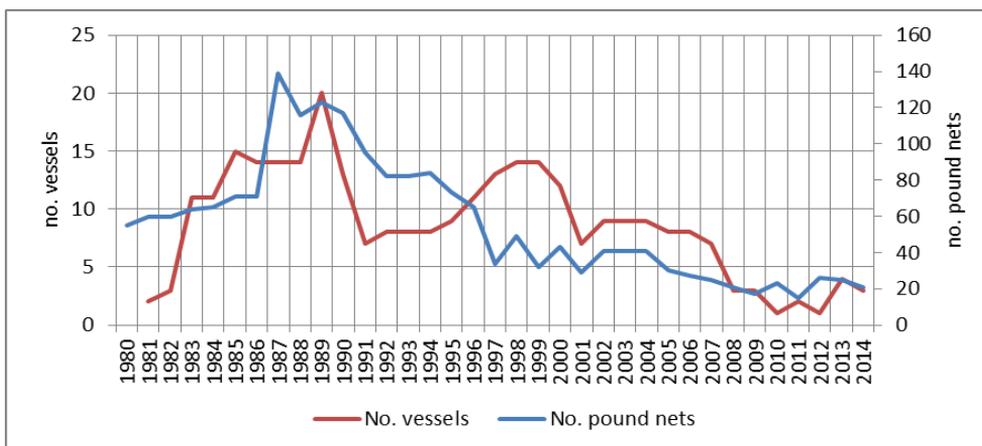


Fig. 10. Number of the pound nets and fishing vessels in the Romanian Black Sea area, 1980-2014

Stock status and geographical distribution

The biomass of sprat stock shows cyclic dynamics with lows and highs over decades. Maxima of recruitment and biomass occurred in the mid 1970s and mid 1980s. In the mid 1990s the sprat stock started to recover and reached previous peak-levels recorded in the 1980s, but catches stayed relatively low because of the stagnated economies of Bulgaria, Romania and Ukraine^{7,8} (Fig. 11).

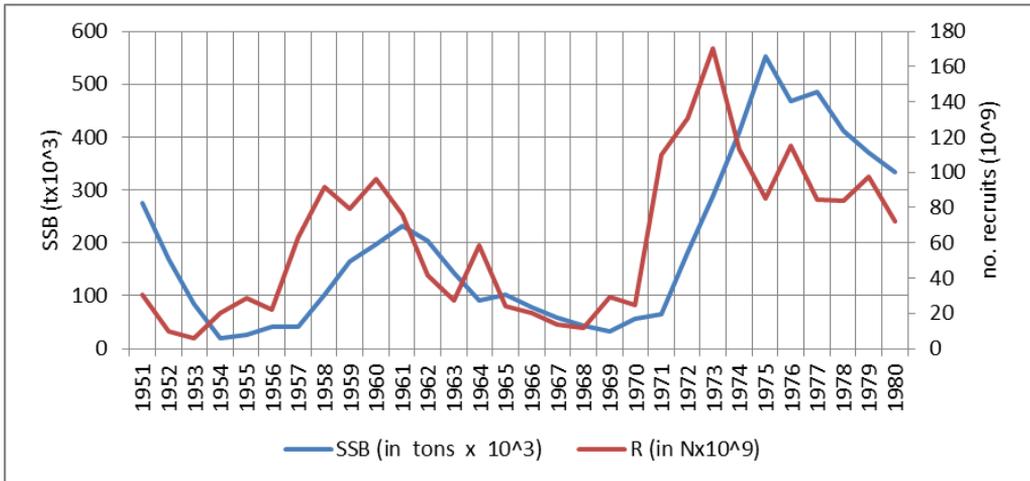


Fig. 11. The relationship recruitment - spawners biomass in the Black Sea²²

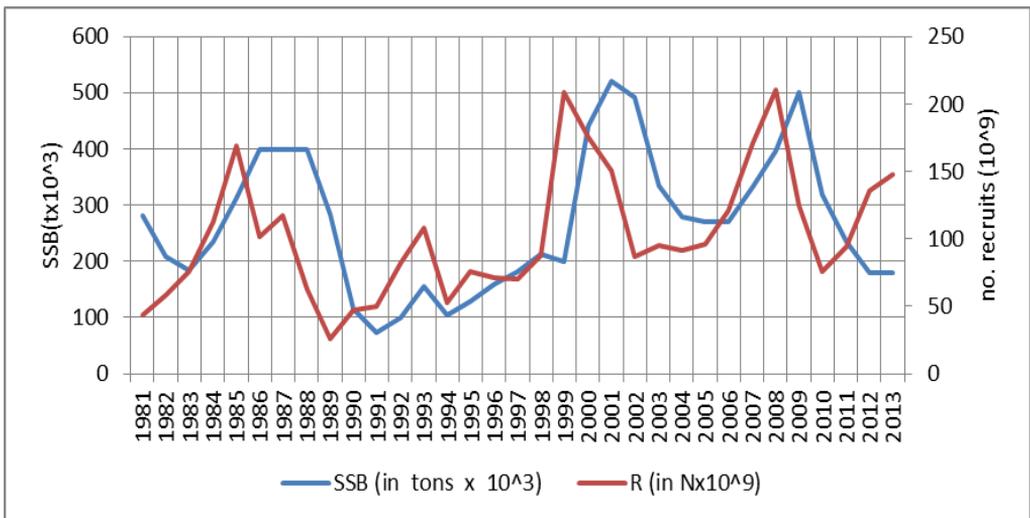


Fig. 12 The relationship recruitment - spawners biomass in the Black Sea^{22, 23}

The year with relatively strong recruitment were followed by years of low to medium recruitment which leads to a relative decrease of the Spawning Stock Biomass (SSB)^{7,8} (Fig. 11,12).

In the recent period SSB has again decreased due to lower recruitment and high fishing mortality. 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^{15, 16}.

On Romanian shelf, the swept area method was used for evaluation the biomass of fishing agglomerations of sprat.



The sprat agglomeration biomass ranged in the last 15 years between 30,000 - 60,000 tons (Fig. 13). In the spring period, the calculated biomass for sprat oscillated between 30917 tons (2008) and 68887 tons in 2012^{17-20, 21, 24} (Fig. 13).

In the Fig. 14 is presented the distribution of the sprat in the 2nd quarter of 2011-2014 in the Romanian waters. Sprat is present over the entire shelf, but the concentration of fishing agglomerations is highly influenced by environmental conditions, especially the direction and intensity of wind, water temperature and the jelly fish agglomerations.

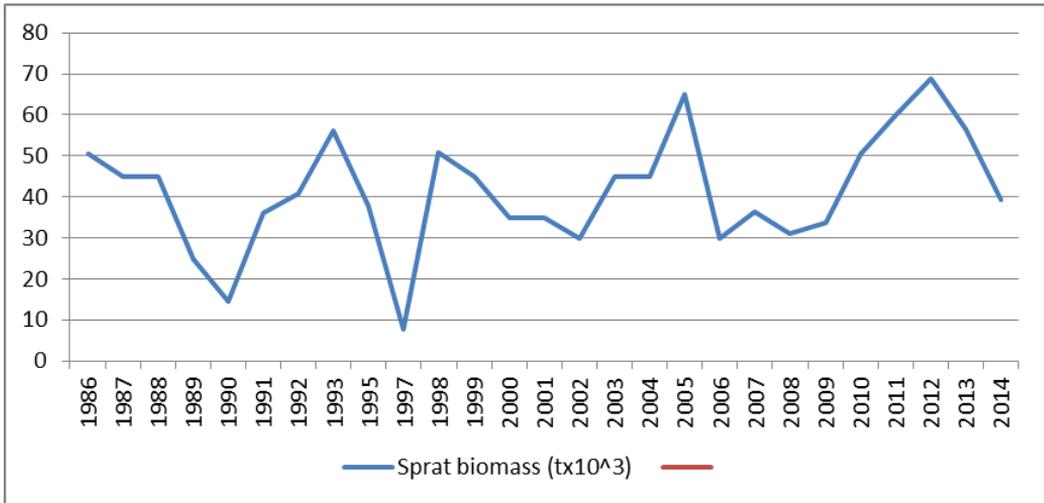


Fig. 13. The sprat biomass in the Romanian marine area calculated with the swept area method

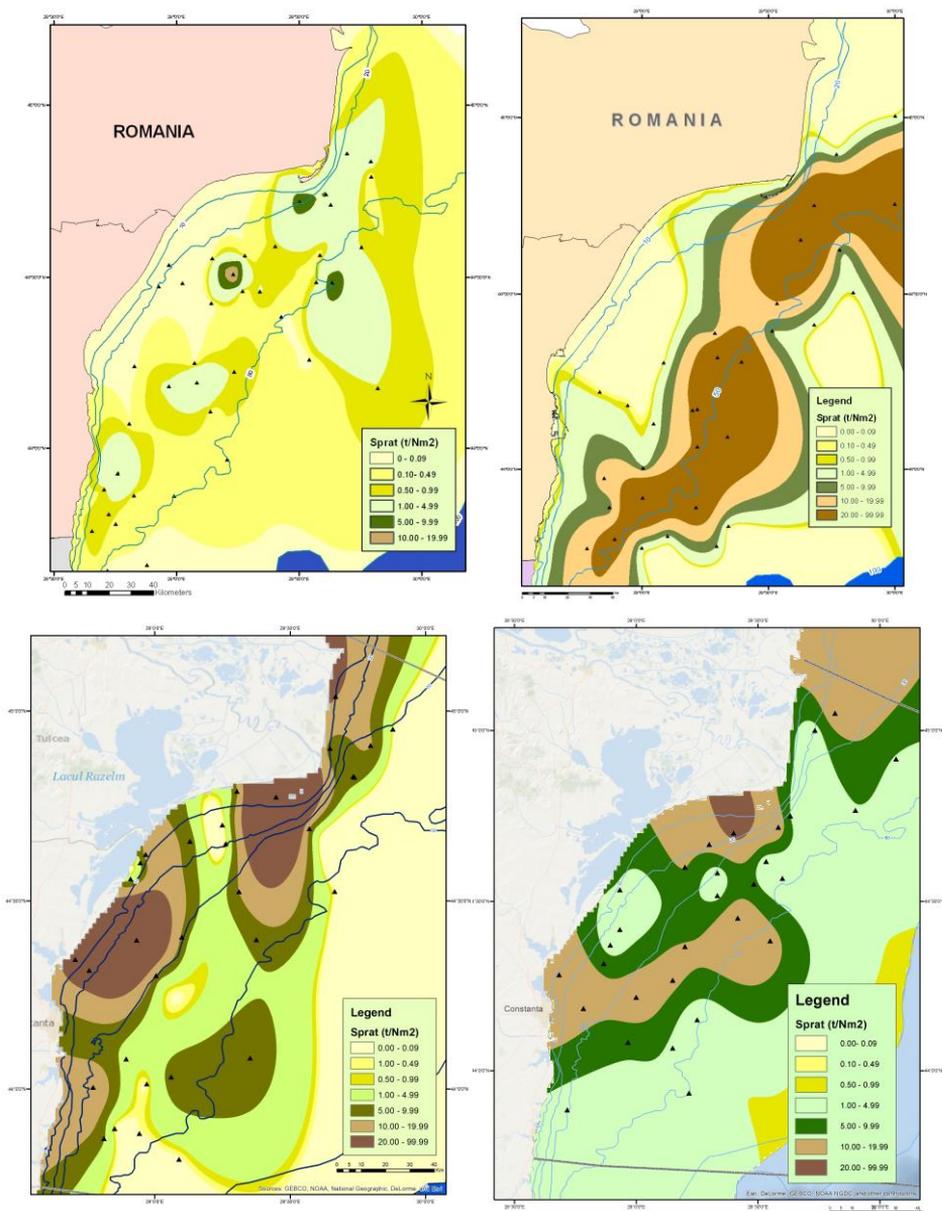


Fig. 14. Distribution of the sprat fishing agglomerations in the period 2011-2014

Evolution of biological parameters of the sprat

The sprat has lengths comprised among 40 and 130 mm, the highest frequency pertaining to the individuals of 70-100 mm lengths (Fig. 15, 16)



The age corresponding to these lengths was 0+ - 4;4+, the ages 2;2+ - 3;3+ having a significant participation. By 1982, the age classes 4;4+ years had a share of 34% from the catch of this species, then the percentage continually decreased up to 1995 when this age was not signalled, meaning the increase of the pressure through fishing exerted on the populations. While the share of this age decreased, the prevalence of 0+ especially 1;1+ ages became increased^{5, 11, 21, 24} (Fig. 15, 16).

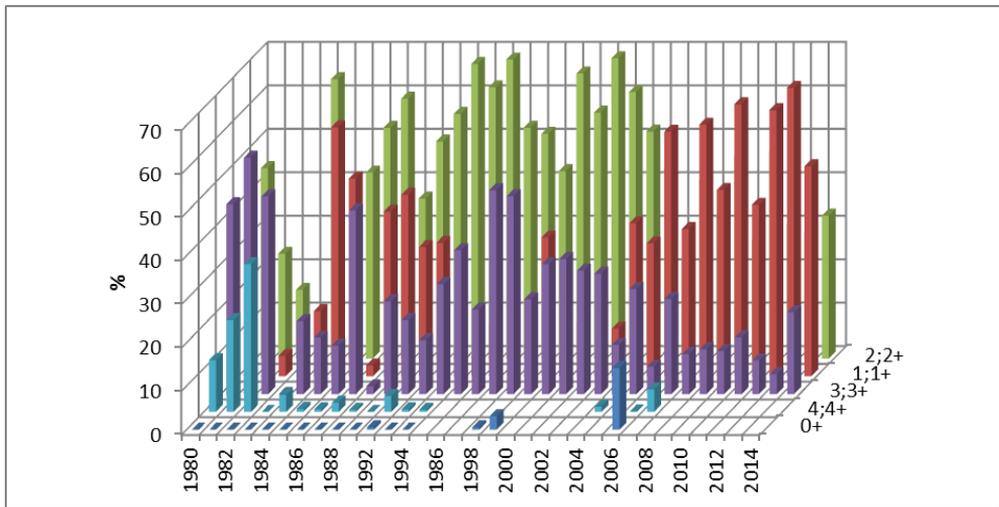


Fig. 15. Structure on age classes of the sprat in the Romanian marine area

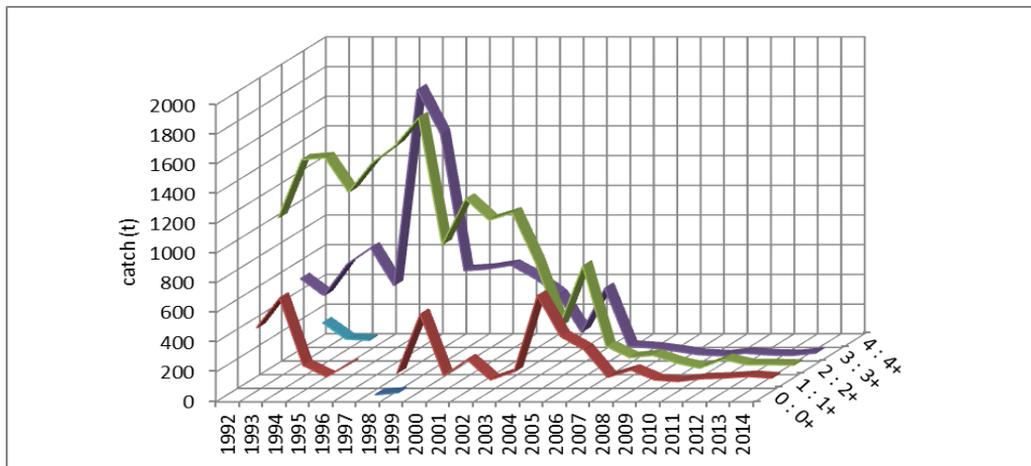


Fig. 16. Sprat catches on age classes in the Romanian marine area

Causes that determined the evolution of the sprat fishery

The causes of this situation are multiple, the independent effect of each being very difficult to be assessed:



- The high value of the percentage of the species sprat and their constancy within the catches explain the high oscillations of the annual catches on the Romanian coast. These oscillations occur even more as the fishing is done in a restricted area of coast where the conditions of maintaining fish shoals are extremely variable.
- The passive fishery uses pound nets and has suffered the strongest impact due to the change of the ecological conditions near the coast zone. Moreover, there are observations attesting the fish migration routes changed during the last 6-7 years. The fish has the tendency to remain in the offing, at a certain distance from the coast zone with the isobaths of 5-13 m where the pound nets are located.
- Heavy fishing on small pelagic fish predominantly by the Soviet Union, and later also by Turkey, was carried out in a competitive framework without any agreement between the countries on limits to fishing. Depletion of the small pelagic stock appears to have led to increased opportunities for population explosion of planktonic predators (jelly fish and ctenophores) which have competed for food with fish, and preyed on their eggs and larvae.
- The environmental conditions existing to the Romanian littoral allowed formation and maintaining of very large agglomerations of gelatinous species, especially jellyfish. Jelly fish and ctenophore agglomerations making difficult the trawl fishery on all hauling level in some years and periods.
- The reduction of the fishing effort as a consequence of the economic changes occasioned by the transformation of the state capital into private capital;
- The limitation of market demands for some periods of the year, mainly amplified by the fact that more than 90% of the production was delivered as salted fish;
- The free market and imported products have caused the limitation of the traditionally prepared products and the reduction of their price until the limit of the profitability.

Management measures

The overall responsibility for fisheries policy in Romania falls under auspices of the National Agency for Fisheries and Aquaculture (NAFA), public institution integrally financed from the state budget subordinated to the Ministry of Agriculture^{14, 19, 24}.

Regarding the sprat, are implemented some general rules like:

- In the economic fishing activity, it is banned to use the trawl in marine zone under the 20 m depths;
- It is banned to utilize the fishing gears with minimum mesh size smaller then: $a = 7$ mm, $2a = 14$ mm respectively, at the room catching of pound nets in the Black Sea Romanian littoral zone; $a = 7$ mm, $2a = 14$ mm respectively at the trawl cod end, in the Black Sea;
- Minimum admissible length of the fish is 7cm TL.
- The transboundary migrations and distribution of the commercial fish species and the lack of on integrated management for whole Black Sea basin cause difficulties in the fishery activity of each riparian country for a short term and can cause collapses for a medium and long term.



- At Black Sea level, the fisheries regulatory framework is promoted by each coastal country being not harmonized at regional level, even in the case of shared or migratory species like sprat.
- The transboundary character of the sprat distribution imposes the necessity for coordinated efforts at regional level for their management.
- Finally, protection of living resources from Black Sea must be realized on the basis of an adequate legal and institutional framework both at national and regional level.

CONCLUSIONS

- Small-sized species like sprat that have been in previous years the main target of fisheries engaged on the Romanian Black Sea coast have experienced significant fluctuations in catches, with the obvious trend of regression or dramatic decreases.
- Sprat is an object of both artisanal and commercial mid-water trawl fisheries.
- At the Romanian Black Sea area, the level of capture and fishing productivity oscillated from one year to other function of the fishing effort, evolution of hydro-climatic conditions, stocks status and socio-economic situation.
- The biomass of sprat stock shows cyclic dynamics with lows and highs over decades.
- The Romanian catch in the last decade is regionally almost insignificant, having a very low contribution at depletion of the stocks.
- The transboundary character of the living resources from the Black Sea imposes the necessity for coordinated efforts at regional level for their exploitation and protection.



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