

SOME REMARKS ON THE REPRODUCTION OF THE *CYSTOSEIRA BARBATA* (GOOD ET WOOD) J. AG. ALGA IN THE BLACK SEA

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ABSTRACT

The dynamics of development of reproduction organs and of the gametes maturation of *Cystoseira barbata* on the Romanian shore of the Black Sea is discussed. The reproduction process takes place during the course of the whole year with a first maximum of intensity in spring time and a second, less marked maximum, in the autumn. In winter and summer, short periods of stagnation of gamet elimination were recorded.

The perennial brown alga *Cystoseira barbata* populates the rocky infralittoral along the Black Sea shores. It is considered the largest alga in this basin, the thallus reaching in some cases up to 1.5 m length. According to the opinion expressed by the soviet authors SABININ and SCIAPOVA (1954) who studied the growth rate and the age of this alga, it lives 8 to 11 years and some individuals may reach even the age of 19 years.

While the first works on the alga flora living in the Black Sea include mostly elements of morphology and systematics on the *Cystoseira* genus, the information published on the biology of this alga increased with time. In the recent times, considering the ever greater emphasis put on the problem raised by the practical use of sea and ocean biologic resources, the interest stirred by the complex study of all sea organisms

capable of being used by human economy increased too. Among the species living in the Black Sea and lending themselves to such uses one should count also Cystoseira barbata.

Biochemical researches carried out by some authors (DALEV, DANCHEV and LIDZHI, 1957; IATENKO, 1963 ; MIRZA, 1972) outlined the presence in this alga of some important amounts of mannitol and alginic acid the usefulness of which is well known.

Although investigations on the sexual maturation stage of Cystoseira barbata samples collected in various periods of the year were already conducted along the romanian shore (CELAN, 1935, 1948), we were interested mainly in learning the dynamics of the reproduction intensity and the frequency of fertile branches along the thallus during the whole year.

The present report supplies the reader with the results of observations and morphologic, anatomic and embryologic analyses conducted during the 1971-1972 period on the formation and maturation of the reproduction organs on the above mentioned species.

Material and Method

As a material for study algae sampled from the populations existing at a depth of 1.5 to 2 m, at Agigea were used. All investigations were conducted on a living plants. To be sure that the material investigated belongs to the Cystoseira barbata species, seedings were made in laboratory conditions. Embryologic characteristic features, such as oospere sizes, zygote size, number and shape of primary rhizoid that appeared during the first development stages of the zygote, supply very accurate indications about the species of the Cystoseira genus (GUERN, 1962; CELAN and BAVARU, 1968). For this reason, the embryologic method was applied to the determination of both the fertile individuals which served as a research material, and the thallus fragments presented as an illustrative material in fig. 2-4. The percentage monthly frequency of fertile branches on the thallus was obtained by analysing 20-40 plants.

Results and Discussions

Studies conducted on a large number of Cystoseira barbata showed that in the complex, physical, chemical and hydrometeorological conditions prevailing on the Romanian shore, the reproduction process of this alga proceeds during almost the whole year. From January to December, except for a short period of interruption during the summer and one in winter, the thallus tip of ramifications bears receptacles and conceptacles where anteridia and oogonia can be found in various maturation stages (fig. 1).

At the end of January and beginning of February the maturation stage is reached by the first sexuate elements, capable of giving birth to a new plant. The next month, the number of receptacles on the

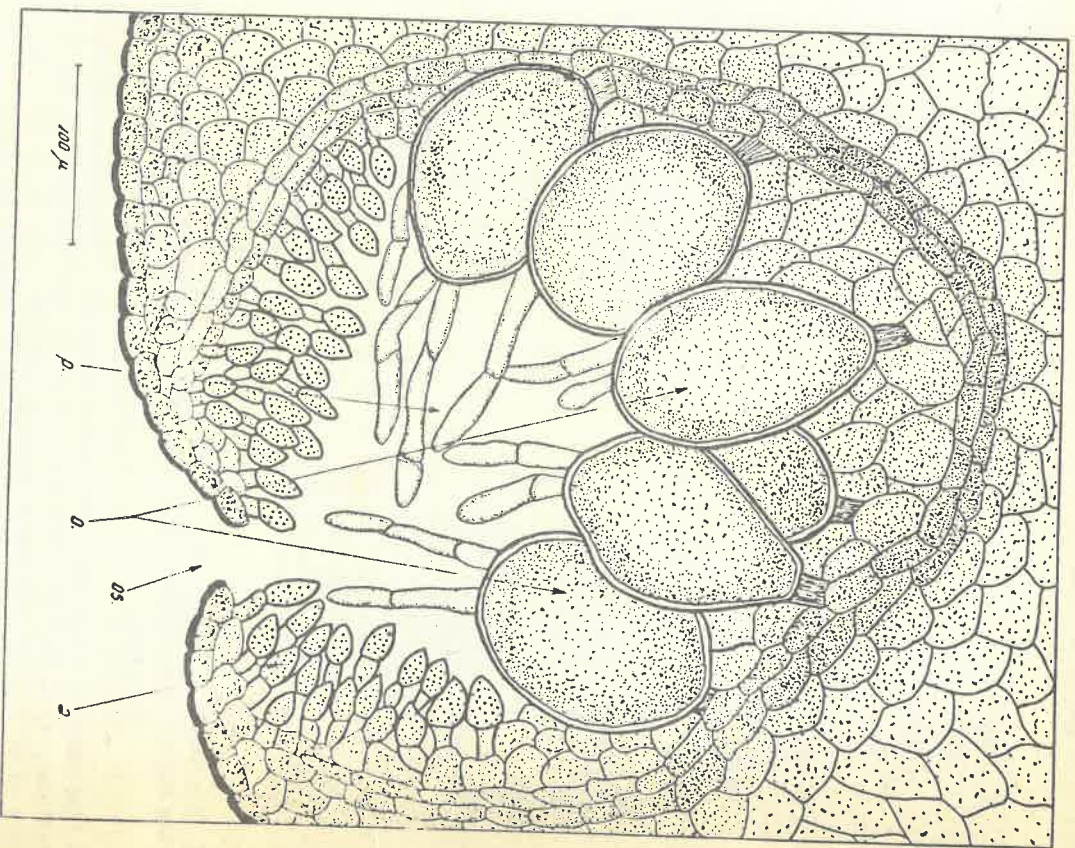


Fig. 1 - Cross - section through a mature conceptacle of Cystoseira barbata. o - oogonium; a - anteridium; p - paraphysis; os - ostiole.

thallus very much increases to reach a maximum in April when the plant has a very characteristic appearance (fig. 2-3).

On its branches numerous airvesicles can be seen, and the tip is ended by a fertile receptacle. In this month of an intense reproduction,



Fig. 2 - General appearance of a spring thallus with vesicles and receptacles

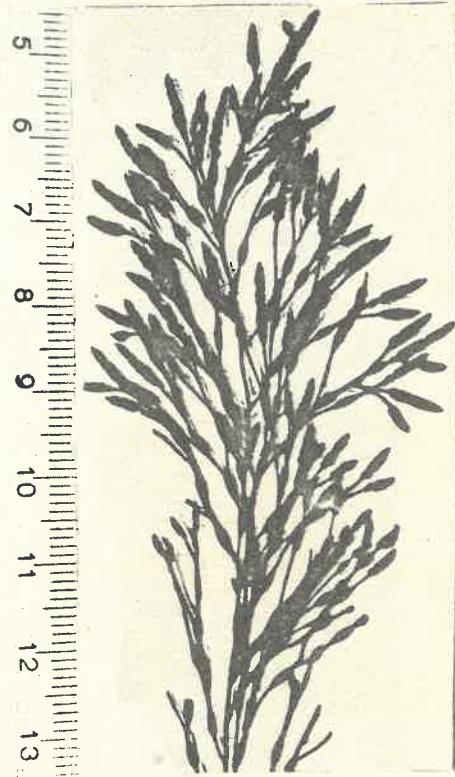


Fig. 3 - Spring branch with fructifications (detail)

the frequency of II-nd and III-rd order branches, which bear mature fructifications, is of 90-95%. The average length and thickness of the receptacles is of 6 to 10 mm and 1 mm respectively, but there are also individuals where these formations can reach a length of 43 mm.

Receptacles are cylindrical in shape, simple or branched, either with a pedicel or directly attached on the vesicles and sometimes they are interrupted over sterile sections.

In summer, the appearance of the plant is very much changed since part of the branches grown during winter and spring time fall and are replaced by other, young branches. During July and August, the presence of mature reproduction organs is seen more seldom, the proportion of fructification branches being less than 5 per cent.

Once the summer season is ended and the autumn begins, for the second time during the same year on the thallus other receptacles are differentiated; these are carrying anteridia and oogonia which reach the maturation stage in September (fig. 4).

Receptacles developed during this time are, as a rule, more delicate and thinner like the ramifications on which they grow. For this reason, on the fertile thallus their identifications is more difficult. The

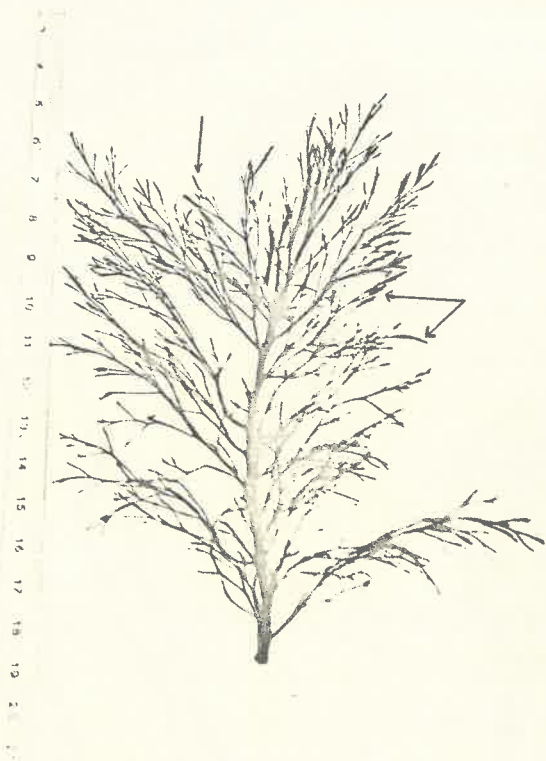


Fig. 4 - Autumnal fertile thallus

largest number of autumnal fructifications is reached in October. And yet, thallus ramifications carrying mature reproduction organs are not more than 30-40 per cent of the total. Gametes elimination is less intensive than in spring time owing to the reduced number of receptacles and also owing to their generally smaller sizes.

To check for the fertility of the reproductive organs developed during spring and autumn, seedings were made in laboratory conditions. During the whole 1972, from the anteridia and oogonia arrived at a maturity stage, gametes were obtained, which through blending, yield zygotes. Zygotes germination was then followed in vessels and then the growth of the plants to 500 - 700 microns, in laboratory controlled conditions (fig. 5).

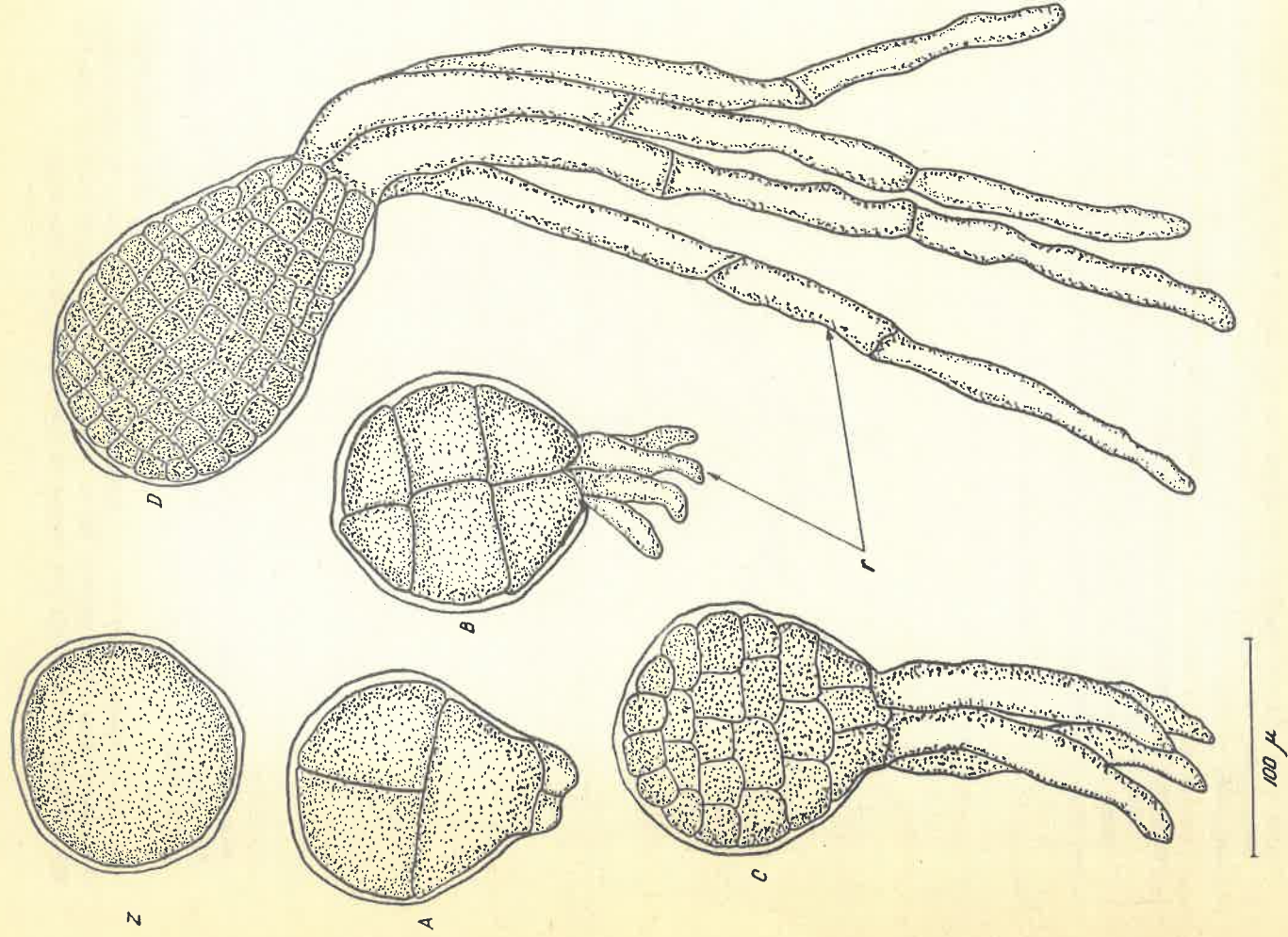


Fig. 5 - First development stages of the embryos of *Cystoseira barbata*
 Z = fixed zygote; r = primary rhizoids; A-C = 1-3 day-aged embryos;
 D = 6 - day old embryo

Towards the middle and the end of the autumn a new branch loss can be witnessed. Part of the branches grown during spring time and summer fall of the thallus. In December, on the thallus, other, more vigorous ramifications are developed, carrying vesicles (aerocysts) and buds of receptacles. Gametangium formation and gamet maturation may be followed during the months of December and January, at the same time with the growth of new branches.

The annual dynamics of gamet formation, maturation and elimination, when graphically represented, shows a curve with two alternating peaks and depressions (fig. 6). The spring time reproduction period, with

*Fructification
branches percentage*

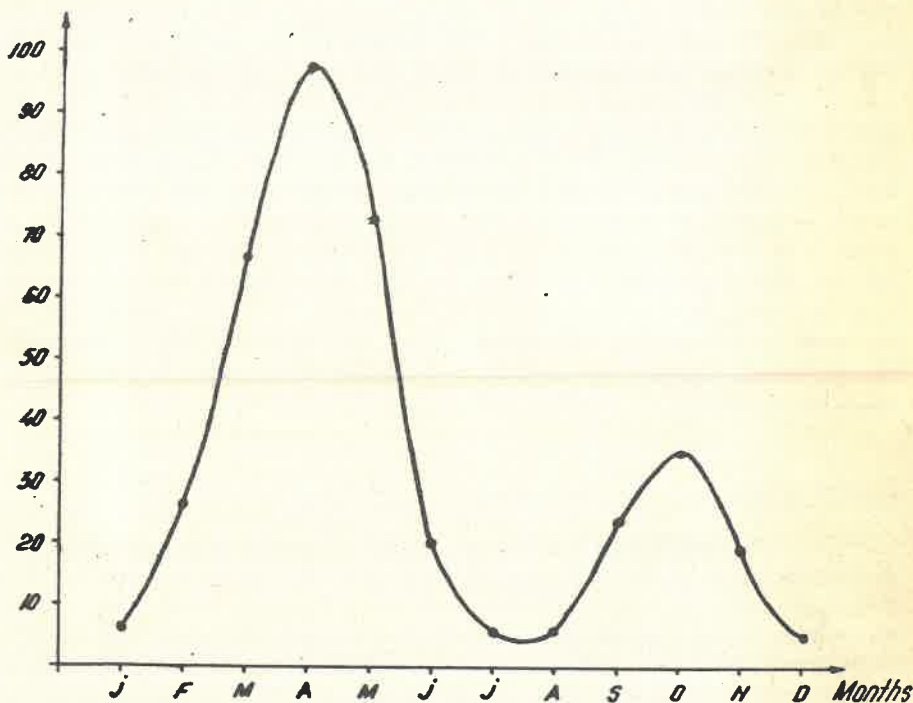


Fig. 6 - Annual dynamics of reproduction intensity of Cystoseira barbata

its maximum in April, is much more important as time and intensity than the autumn period. The two more intensive seasons of sexual activity are followed by intervals where the reproduction phenomenon undergoes a stagnation together with a partial fall of those branches on which the reproduction organs were developed. During the year, there are two short periods of time (December-January and July-August) when thalli with mature gametes are very seldomly encountered. This notwithstanding, during

the periods when the reproduction phenomenon shows a regression, it can be seen that the algae are still growing since new ramifications and receptacles are developing.

The results of our investigations and analyses agree with some results published before (CELAN, 1935 and 1948). The partial fall of the branches signalled out during the summer and autumn is a phenomenon which has a general character for the species studied, since it was outlined both in the Black Sea area (SABININ and SCIAPOVA, 1954) and in the Adriatic Sea area (SPAN, 1969).

The reproduction periods of the *Cystoseira barbata* species living in the ecologic conditions specific to the rocky infralittoral of the Romanian shore are not coincident with the fructification periods of the same species, but living in other aquatic areas. Thus in the Adriatic Sea, this species has a single reproduction period, during the summer, lasting 4-5 months (SPAN, 1969). As for the *Cystoseira stricta* in the Mediterranean Sea, the presence of thallii with fructifications during the May-September period is to be mentioned (PELLEGRINI and PELLEGRINI, 1971).

A confrontation between our data and the biochemical data published for the *Cystoseira barbata* of the Romanian sea-shore (MIRZA, 1972) shows a direct relation existing between the alga reproduction activity and the accumulation of energetic and reserve substances. The characteristic of the frequency of fertile branches on the stipe shows a path almost parallel with the curves established for the seasonal variation of the mannitol and alginic acid contents in the thallus. It is clearly outlined that during the two more active periods of vegetation, when the maturation and the gametes elimination take place, there is a considerable increase in the percentage content of mannitol and alginic acid, which reaches maximum annual values.

Conclusions

Investigations carried out in the formation and maturation of sexual elements of *Cystoseira barbata* showed that in the course of the year, the species has two more intensive periods of reproduction, i. e. : during the spring time, when a maximum is reached and the proportion of fertile receptable branches exceeds 90 per cent; and during the autumn, when a second maximum is reached, the proportion of fertile branches being of 30-40 per cent. During winter (December - January) and summer (July - August), mature gametes are very seldom on the thallus.

Cystoseira barbata is an alga with a positive balance sheet all over the year. This is emphasized by the continuous formation of new branches and receptacles bearing anteridia and oogonia. Twice every year, in summer and autumn, the alga thallus loses part of the branches grown during the previous season.

Those periods which have a more intense fructification, when the entire metabolism is led towards gamet generation and maturation, correspond to the annual maxima of mannitol and alginic acid accumulation in the alga.

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