LIFE-HISTORY STUDIES IN THE GENUS BRYOPSIS (CHLOROPHYCEAE) III*. THE LIFE-HISTORY OF BRYOPSIS MONOICA FUNK

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SUMMARY

Bryopsis monoica from Banyuls appeared to have a heteromorphic biphasic life-history. Zygotes from anisogametes grew into creeping filamentous germlings (the sporophytic phase) that produced stephanokontic zoids. The stephanokontic zoids directly developed into new *Bryopsis* thalli (gametophytic phase).

The cell walls of the gametophytic phase positively stained with zinc-chlor-iodine and Congo red, whereas the cell walls of the sporophytic phase did not.

1. INTRODUCTION

Investigations on the life-histories of a number of *Bryopsis* species have shown that the genus *Bryopsis* includes at least one species with a well-developed sporophytic phase (the *Derbesia neglecta* phase) in its life-history, namely *Bryopsis halimeniae* (HUSTEDE 1964), and species with a diminutive creeping filamentous sporophytic phase as observed in *Bryopsis plumosa* collected in several localities on southern shores of Europe (RIETEMA 1969, 1970). Furthermore, *Bryopsis plumosa* from Zeeland (RIETEMA 1969) appeared to produce zygotes that grew into diminutive creeping filamentous stages which did not form spores but from which new *Bryopsis* thalli sprouted directly. The filamentous stage of *Bryopsis plumosa* from Zeeland was considered fundamentally similar to the filamentous sporophytic phase of southern populations of *Bryopsis plumosa*, although it did not have the capacity to form stephanokontic zoospores (RIETEMA 1970).

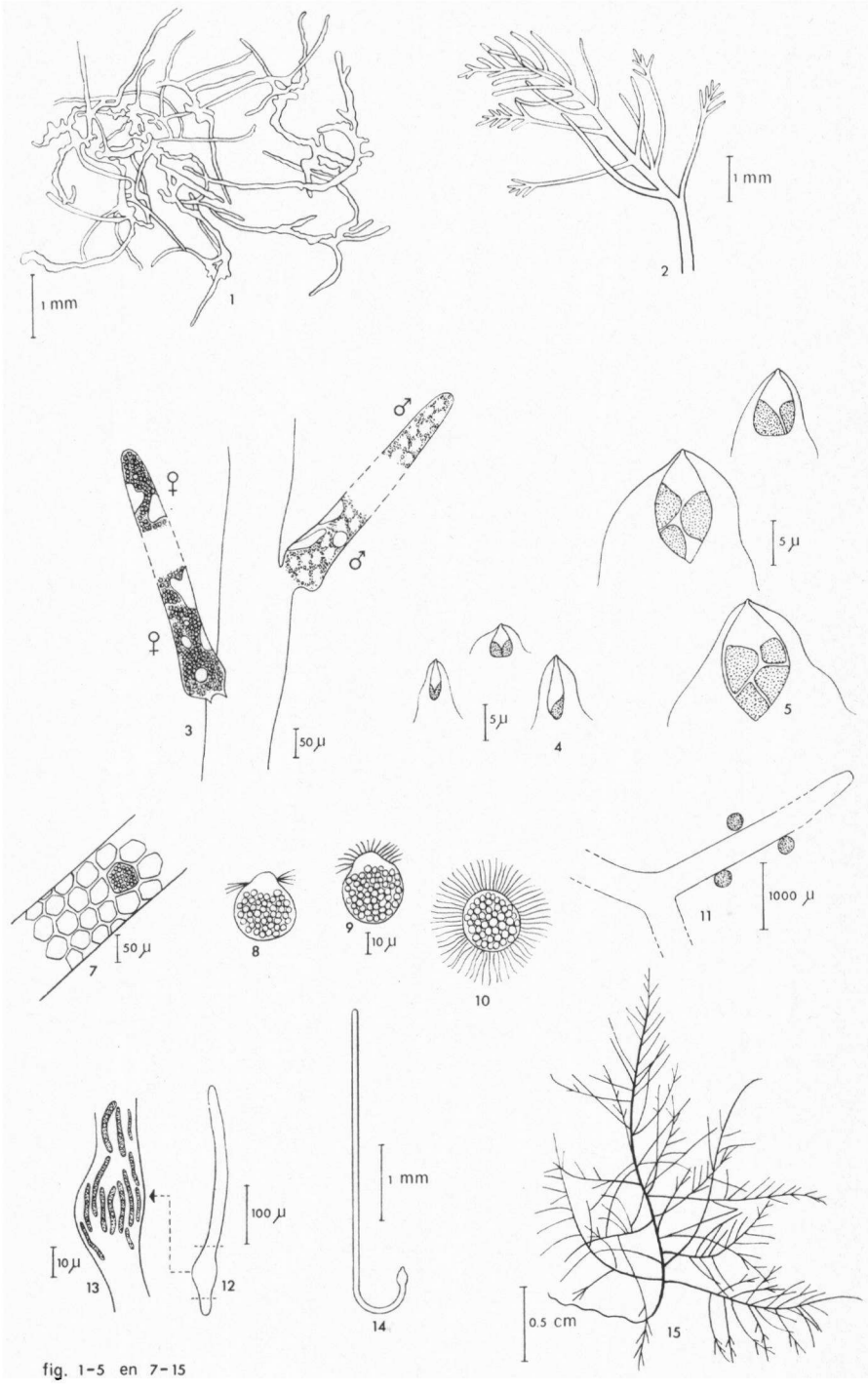
In this paper the results of an investigation on the life-history of *Bryopsis monoica* will be reported, and in a series of forthcoming papers the results obtained in studies on the life-histories of a number of other species will be described.

2. MATERIAL AND METHODS

The material investigated was collected from the following localities:

a. Banyuls, Grotte du Troc; September 1967; epiphytic on *Gigartina acicularis*, *Dictyota dichotoma*, and *Cystoseira mediterranea*; depth about 0.5 m.

* The two papers: RIETEMA (1969), Acta Bot. Neerl. 18, and (1970), Acta Bot. Neerl. 19 are to be considered as number I and II of this series.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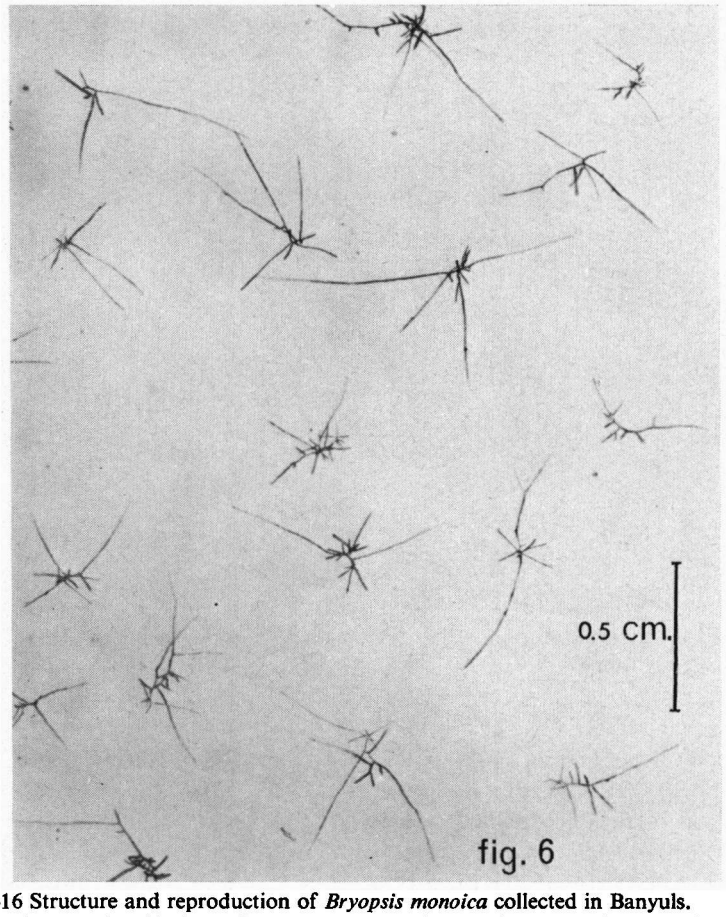

Figs. 1–16 Structure and reproduction of *Bryopsis monoica* collected in Banyuls.
Fig. 1. Three weeks old plant of *Bryopsis monoica* (grown, in culture, from the tip of a determinate lateral).
Fig. 2. Habit of *Bryopsis monoica* collected in Banyuls.
Fig. 3. Detail of a thallus with two gametangia, one female, the other male.
Fig. 4. Male gametes.
Fig. 5. Female gametes.
Fig. 6. Outlines of about three months old germling phases (sporophytic phases) before the beginning of cleavage into stepanokontic zoids.
Fig. 7. Contents of a filamentous sporophyte cleaved into the initials of stephanokontic zoids.
Fig. 8. and 9. Stephanokontic zoospores in side view.
Fig. 10. Zoospore, shortly after coming to rest, viewed from above.
Fig. 11. "Ghost" of an emptied filamentous sporophyte, with stephanokontic zoids attached to its outer surface (coloured with a congo red solution).
Fig. 12. A germinating stephanokontic zoid (three days old).
Fig. 13. Detail of a germinating zoid.
Fig. 14. A juvenile *Bryopsis monoica* plant, 7 days after germinating of a stephanokontic zoid of which the form is still discernable.
Fig. 15. Habit of a c. two weeks old *Bryopsis monoica* plant (grown, in culture, from a stephanokontic zoid).

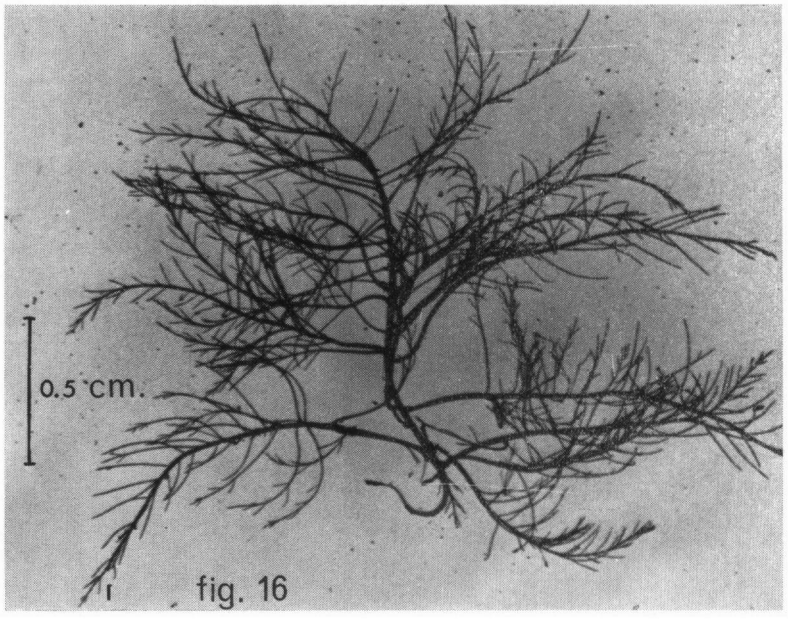

Fig. 16. Habit of a c. three weeks old *Bryopsis monoica* plant (gametophytic phase grown, in culture, from a stephanokontic zoid).

b. Banyuls, Anse du Troc; September 1967; epiphytic on *Cladostephus verticillatus*; depth about 4 m.

The life-histories of one plant from each of the two localities were studied.

For morphological characteristics of *Bryopsis monoica* from Banyuls see FELDMAN (1937).

For methods of isolation of unialgal cultures and for culture methods see RIETEMA 1969 and 1970. If not stated otherwise, cultures were kept in a 16 $\pm$ 1 °C culture room and under a long day regime (16 hours light – 8 hours darkness).

The reaction of cell-walls of germling phase, mature thalli, and zoids attached for some days to the ghosts of emptied zoidangia to staining with Congo red and zinc-chlor-iodine was investigated. Both stains are considered more or less characteristic for cellulose (JOHANSEN 1940; CONN 1961; JENSEN 1962).

3. RESULTS

3.1 Life-history of Bryopsis monoica

After two or three weeks the tips of isolated determinate laterals had grown into plants with an irregular morphology (*fig. 1*). These plants differed morphologically from the original plants from nature (*fig. 2*).

In plants from nature determinate laterals developed into gametangia, some into male, others into female gametangia (*fig. 3*). In the plants cultured from the

tips of laterals male (*fig. 4*) and female (*fig. 5*) gametes were produced by separate parts of these irregularly formed thalli.

Only mixtures of swarms of male and female gametes produced large numbers of filamentous germlings. After about three months these germlings were about 6 mm long (*fig. 6*). After transfer into fresh Erdschreiber medium and short day conditions (8 hours light – 16 hours darkness; 30 germlings observed) these germlings started to divide their contents into numerous stephanokontic zoids (*fig. 7*) within three to four weeks of the transfer. The motile zoids were released through pores in arbitrary places in the walls of the germling phase. After about eight hours the swarming zoids (*figs. 8, 9* and *10*) attached themselves especially to the bottom of the slanted culture tubes or to the outer wall of an emptied zoidangium (= germling phase; *fig. 11*). The stephanokontic zoids within three weeks grew into plants morphologically comparable to the original plants from nature (*figs. 12, 13, 14, 15* and *16*).

Germlings kept in a 12 °C culture cabinet with short day conditions (8 hours light – 16 hours darkness) produced stephanokontic zoids after three months of observation (5 germlings observed).

3.2 Staining reactions of the cell walls of the Bryopsis phase and the germling phase to zinc-chlor-iodine and Congo red

The cell walls of *Bryopsis monoica* thalli stained red and violet in a Congo red and zinc-chlor-iodine solution, respectively. The germling phase, on the other hand, remained uncoloured in both solutions. The cell wall of an emptied zoidangium (i.e., the ghost of the germling phase) remained also uncoloured but the zoids attached to it (*fig. 11*) for a few days stained red and violet with a Congo red and zinc-chlor-iodine solution, respectively.

4. CONCLUSIONS AND DISCUSSION

Bryopsis monoica has a diminutive creeping filamentous sporophytic phase in its life-history; this phase is capable of forming stephanokontic zoids that grow directly into new *Bryopsis monoica* plants. *Bryopsis plumosa* plants collected at Banyuls and along some other South European shores have the same type of sporophytic phase in their life-histories. Lower temperature (12 °C) only retards the production of stephanokontic zoids in the germling phase of *Bryopsis monoica*.

Both *Bryopsis monoica* and *Bryopsis plumosa* show a positive staining reaction to Congo red and zinc-chlor-iodine in the cell-walls of the gametophytic phase and a negative reaction in the cell-walls of the sporophytic phase.

The life-history of *Bryopsis monoica* much resembles that of *Bryopsis plumosa* from relatively southern European shores (Roscoff, Biarritz, Banyuls, Naples).

It is interesting that the stephanokontic zoospores of *Bryopsis monoica* under the present culture conditions always grow into normal thalli, whereas vegetative isolates (from cut-off determinate laterals) grow into abnormal, irregularly branched filaments (cf. *figs. 14* and *15* with *fig. 1*).

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