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CHRYSOMERIS RAMOSA (CHRYSOPHYCEAE) IN DENMARK AND IN THE NETHERLANDS

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SUMMARY

Chrysomeris ramosa (Chrysophyceae) has been found in samples from one locality in The Netherlands and two localities in Denmark. The alga was found in spring in moist, brackish areas with a well-developed algal vegetation. The composition of the algal vegetation of the Dutch and Danish localities suggests an unstable mesohaline habitat.

1. INTRODUCTION

In 1937 Carter described several new taxa of small algae found in brackish water in artificial pools on the Isle of Wight. In the new Chrysophycean genus *Chrysomeris* she described two new species: *C. ramosa* and *C. articulata*. These initially form monosiphonous filaments in which each cell possesses a separate delicate membrane of its own (*fig. 4*); the whole filament is enclosed in a continuous firm cylindrical envelope. Every cell may divide in several planes and parts of filaments thereby become multicellular in cross-section (CARTER 1937) (*fig. 2* and *3*).

Carter also detected the swarmers of both species, but, according to GAYRAL & HAAS (1969), her descriptions were inaccurate. These authors studied the zoids of *Chrysomeris ramosa* using several techniques, and detected two flagella of different length and structure: a longer pleuronematic flagellum (with numerous fine lashes) and a shorter acronematic flagellum. Under the electron-microscope the fine lashes proved to have a complex structure; apically they are divided into three very fine projections, one longer and two shorter. CARTER (1937) did not observe an eye-spot in the zoids of *C. ramosa*, but she found one in the zoids (and in fact in every cell of the filament) of *C. articulata*. However, GAYRAL & HAAS (1969) observed an eye-spot in the zoids of *C. ramosa*, too.

The zoids are formed inside the filaments of *Chrysomeris*, from which they escape through lateral openings in the outer envelope. Multiplication also takes place by means of aplanospores and of special multicellular bodies (*boutures*) formed inside the filaments. These vegetatively reproductive bodies are liberated by decomposition of the outer wall of the filament, by fragmentation of the filament, or through any chance aperture (GAYRAL & HAAS 1969). The latter authors made a detailed comparison of *Chrysomeris ramosa* with *Giraudiopsis stellifer* P. Dangeard, another Chrysophycea. The latter was originally described as a member of the Phaeophyceae (DANGEARD 1965a, 1965b), but later detailed studies (LOISEAUX 1967; 1970) showed that it is more

correctly placed in the *Chrysophyceae*. The zoids of both these species are very similar, even in details of morphology, such as the fine lashes on the pleuronematic flagellum. However, general features of morphology and cytology are sufficiently different to maintain the species in separate genera, although both are placed in the same family (GAYRAL & HAAS 1969; GAYRAL & LEPAILLEUR 1971).

Apart from the work of Gayral and colleagues (op. cit). relatively little subsequent attention has been paid to these organisms. Carter herself noted *Chrysomeris articulata* on only a few occasions in the type locality and it has never since been reported. *C. ramosa*, the subject of the paper by GAYRAL & HAAS (1969), was previously reported, also in France, by MAGNE (1957). This alga has recently been detected by one of us (P.P.) in the course of studies of saline areas in Denmark and in The Netherlands.

In The Netherlands *Chrysomeris ramosa* has only been found in the area "Het Noorden" (Texel) which was regularly sampled by means of transects. The latter method was possible because in this area there existed a clear zonation of other vegetation. In several other areas in The Netherlands (Vlissingen, Den Helder, De Bol – Texel) permanent sample-plots were regularly studied for more than a year, but there *Chrysomeris ramosa* did not seem to occur.

The alga was also found at two localities on the East coast of Denmark, but it was not present in samples from Skallingen on the Danish West coast.

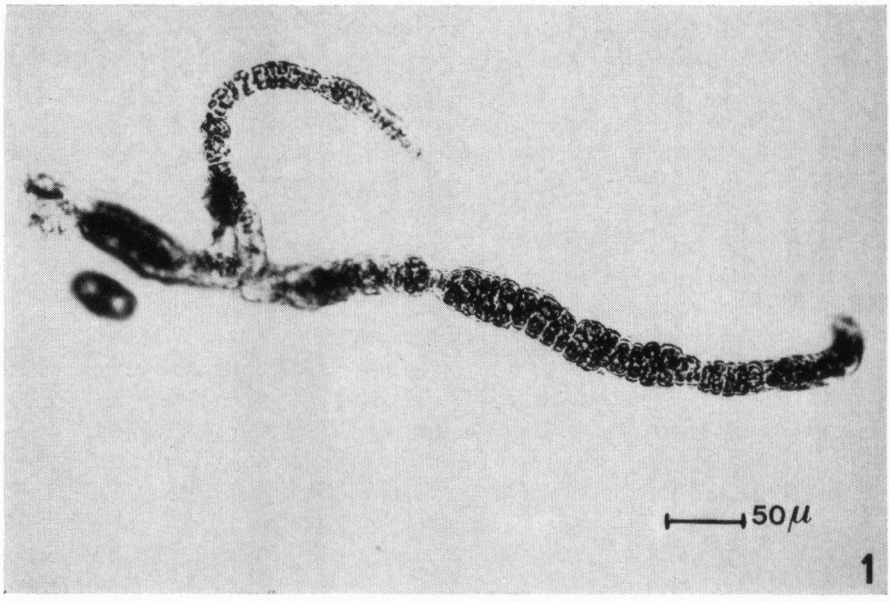

Fig. 1. *Chrysomeris ramosa* N. Carter, habit; from sample T. 181.

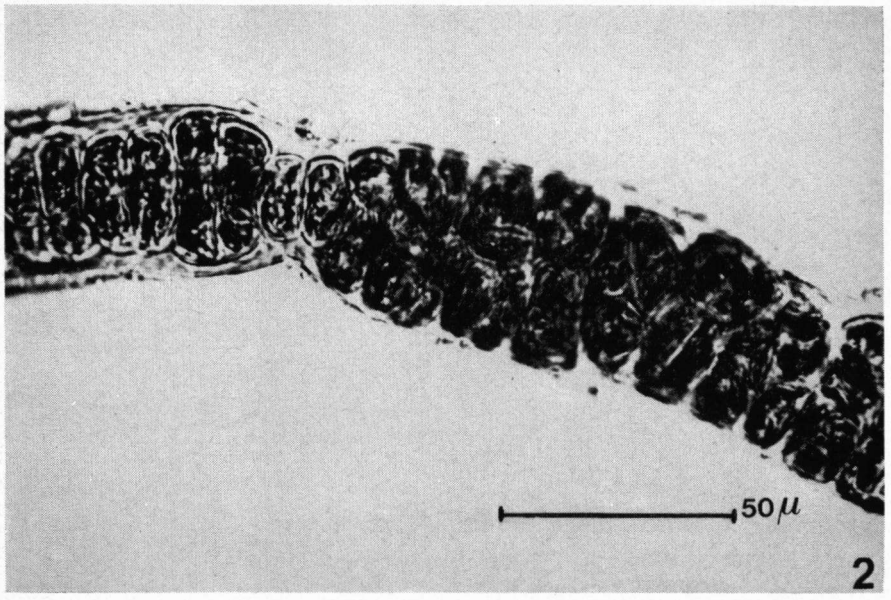

Fig. 2. *Chrysomeris ramosa*, detail of *fig. 1*, showing two cells that did not divide by longitudinal walls to form a thallus that is multicellular in cross-section.

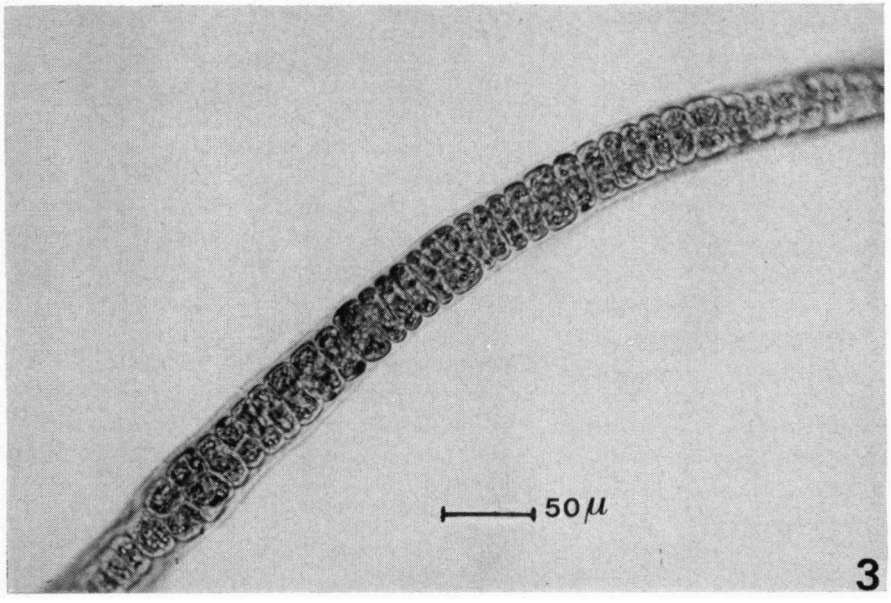

Fig. 3. *Chrysomeris ramosa*, habit, only a few longitudinal walls have been formed; from sample K 52.

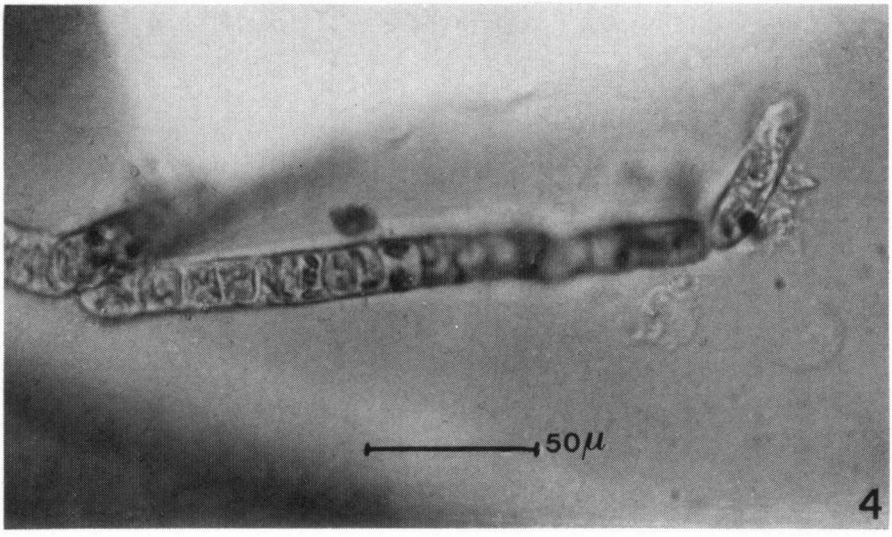

Fig. 4. *Chrysomeris ramosa*, part of a branched specimen. In some cells the three-lobed chromatophore is visible; from sample K 52.

2. METHODS

For the transect method, squares of 50 × 50 cm were usually chosen; these were positioned in each zone of vegetation along a transect line across the area concerned. The higher plants and mosses were surveyed using a modified Braun-Blanquet scale, in which 2a means 5–12.5% and 2b 12.5–25% covering. This method was not appropriate to the algae* detected. Three types of algal mats could there be distinguished: those of the filamentous green algae, of *Vaucheria* spp., and of blue-green algae. The total area covered by each type was estimated as a percentage cover. Samples of about 3 cm^2 were taken from areas covered by different types and carefully examined at several magnifications under the microscope, both to check the estimates made in the field and to determine the species involved. For both reasons, micro-samples were taken from each type of algal mat until no new name had to be added to the species list and we could be reasonably certain that further micro-samples would reveal no new species. The percentage cover finally deduced for the different algae was established by a combination of estimation and counting methods. In *table 1* the quantities of each species are given by special symbols, as follows:

* No attention was paid to the Diatoms.

Symbol used	Average number of specimens in a microsample	
–	not found	
0	< 2	covering < 5%
1	2– < 10	
2	10–100	
3	> 100	
4	forming algal mats, covering > 5%	

In cases where the symbol 4 is used the species together form the algal mat. The percentage of total cover then established for the species is given in brackets after the symbol. For example, in sample K 51 the total cover of the algal mat was 100%. Of this total 50% represents cover by *Vaucheria* spp. and the remainder mainly by filamentous green algae. One half of the latter group (25% of the total cover) was of *Rhizoclonium riparium*, the other half of *Percursaria percursa*.

In the table the symbol "sp" is used for indicating the presence of oospores of *Vaucheria* species.

The samples were stored in controlled conditions at 4°C in a light regime of 10h. (light): 14h. (dark). Generally the samples were analysed without delay (within 2–3 weeks) but occasional samples had to be stored for a longer period. In such cases it is possible that the algal vegetation in the sample did not have precisely the same characteristics when examined as when collected. For each sample the time between collection and final analysis is given in the following section.

3. STATION LIST

T 144: The Netherlands, Isle of Texel, Polder "Het Noorden" near the dike of the Waddensea, along the side of a ditch, 8-1-1972 (final micro-analysis: 28-7-1972).

T 80 IV: same locality, 13-4-1971 (analysed within a week of collection).

T 165, T 167: same locality, 18-3-1972 (final micro-analysis: 25-7-1972).

T 181, T 183: same locality, 20-5-1972 (mostly analysed within a week of collection; final micro-analysis: 25-7-1972).

K 19, 20, 26: Denmark, Salt-marsh of Kalø, NE. of Aarhus, 17-4-1972 (analysed within a week).

A 3 Denmark, Salt-marsh of Kysingfjord near Norsminde, S. of Aarhus, 21-4-1972 (analysed within a week).

K 50 – K 53: Denmark, Salt-marsh of Kalø, NE. of Aarhus, 5-5-1972 – transect (analysed within a week).

4. RESULTS

The general results are represented in *table 1;* those particularly pertaining to the algae are discussed in detail below.

Table 1. Analysis of the samples. For explanation of the symbols see text under methods.

	T144	T80IV	T165	T167	T181	T183	K26	K19	K20	A3	K50	K51	K52	K53
Total covering Phanerogams in %	30	80	90	95	100	100	50	40	50	75	30	30	50	70
Salicornia europaea L.	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Puccinellia maritima (Huds.) Parl.	3	5	5	5	–	5	3	–	–	5	–	2a	3	4
Spergularia marina (L.) Griseb.	–	–	+	–	–	–	–	–	–	–	–	–	–	–
Spergularia media (L.) C. Presl	–	–	–	–	–	–	1	–	–	–	–	–	–	1
Plantago maritima L.	–	1	–	–	–	2a	1	+	+	–	–	2a	2a	2a
Glaux maritima L.	–	–	–	–	1	1	1	+	1	–	–	+	1	–
Agrostis stolonifera L.	–	–	–	–	2a	–	–	1	–	–	–	+	–	–
Triglochin maritima L.	–	–	–	–	2b	1	–	–	–	–	1	1	r	r
Juncus gerardii Loisl.	–	–	–	–	4	2a	–	2b	3	–	2b	2a	2a	–
Festuca rubra L.	–	–	–	–	2a	–	–	2b	2a	–	–	–	–	–
Scirpus rufus (Huds.) Schrad.	–	–	–	–	–	–	–	–	–	–	2b	–	–	–
Aster tripolium L.	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Sagina maritima G. Don	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Total covering Mosses in %	–	–	–	–	–	–	–	5	–	–	–	–	–	–
Amblystegium serpens (Hedw.) B.S.G.	–	–	–	–	–	–	–	2a	–	–	–	–	–	–
Total covering Algae in %	100	100	100	100	100	100	100	95	100	90	100	100	100	80
Vaucheria canalicularis (L.) Christ.	–	–	–	–	sp	–	–	–	–	–	–	–	–	–
V. synandra Woron.	4	–	–	–	–	–	–	–	4(50)	–	sp	4	–	–
V. erythrospora Christ.	–	–	–	–	–	–	–	–	–	–	4	–	–	–
V. coronata Nordst.	4 (100)	–	4	4	2	1	4(100)	4(5)	–	–	4 (50)	4 (50)	4	4
V. sesculicaria Christ.	–	1	sp (100)	– (90)	–	1	–	–	–	–	–	–	– (50)	– (60)
V. arcassonensis P. Dang.	4	–	4	4	–	sp	–	–	–	–	–	4	4	4

	T144	T801V	T165	T167	T181	T183	K26	K19	K20	A3	K50	K51	K52	K53
Pilayella littoralis (L.) Kjellm.	–	–	–	–	–	–	–	–	–	–	–	–	0	–
Apistonema pyrenigerum Pasch.	0	2	0	0	1	4(50)	2	0	1	–	1	0	1	1
Chrysomeris ramosa N. Carter	0	2	0	0	0	0	2	0	0	0	0	0	0	0
Rhizoclonium riparium (Roth) Harv.	2	4(50)	1	4(10)	4(100)	2	1	4(35)	4(50)	4(90)	4(25)	4(25)	4(50)	2
Ulothrix subflaccida Wille	0	1	0	0	0	0	0	1	0	2	0	1	1	2
U. pseudoflacca Wille	–	–	–	–	–	1	0	0	0	2	–	–	–	–
U. flacca (Dillw.) Thur. in Le Jol.	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Percusaria percursa (C. Ag.) Rosenv.	0	4(50)	0	1	1	0	–	–	–	0	4(25)	4(25)	2	1
Capsosiphon fulvescens (C. Ag.) Setch. & Gardn.	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Enteromorpha torta (Mert. in Jürg.) Reinb.	0	–	–	–	0	2	–	–	–	1	0	1	2	1
E. prolifera (O. F. Müll.) J. Ag.	–	–	2	–	–	–	–	0	–	–	–	–	–	–
Blidinga marginata (J. Ag.) P. Dang.	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Coccoid Chlorophyceae	–	2	–	–	–	–	0	–	–	–	–	–	–	–
Cladophora sericea (Huds.) Kütz.	–	–	–	–	–	–	–	–	–	–	–	–	–	4(20)

Table 1. (continued).

	T144	T80IV	T165	T167	T181	T183	K26	K19	K20	A3	K50	K51	K52	K53
Coccochloris stagnina Spreng.	–	–	–	–	0	–	–	4(25)	0	–	–	–	–	–
Anacystis montana (Lightf.) Dr. & Daily	–	–	–	–	0	–	–	1	2	–	1	1	–	–
A. dimidiata (Kütz.) Dr. & Daily	–	0	0	1	1	0	1	1	2	1	0	2	2	2
A. thermalis (Menegh.) Dr. & Daily	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Gomphosphaeria aponina Kütz.	–	–	–	–	–	–	–	–	–	–	0	–	0	1
Spirulina subsalsa Gom.	–	–	0	–	–	0	2	2	0	–	–	1	1	1
Schizothrix calcicola Gom.	0	1	–	0	1	1	0	4(5)	1	2	1	0	1	0
Oscillatoria brevis Gom.	–	–	0	0	2	–	0	2	1	2	0	2	0	0
O. nigroviridis Gom.	–	1	–	–	–	0	1	2	1	3	0	1	0	2
Microcoleus chthonoplastes Gom.	–	0	–	–	–	–	–	–	–	–	–	–	–	–
M. lyngbyaceus Gom.	1	2	0	0	0	2	2	2	2	0	1	2	3	2
Symploca atlantica Gom.	–	–	–	–	–	–	–	1	0	–	–	–	–	–
Anabaena variabilis Born. & Flah.	–	2	–	–	–	4(50)	–	–	1	–	3	1	1	–
A. torulosa Born. & Flah.	–	–	–	–	–	–	–	–	–	–	3	1	2	–
Nodularia harveyana Born. & Flah.	0	0	–	0	–	1	1	1	0	–	1	0	2	–
N. spumigena Born. & Flah.	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Nostoc spec.	0	2	–	–	0	2	–	1	1	–	2	1	0	–
Calothrix aeruginea Born. & Flah.	–	–	–	–	–	0	–	2	–	–	–	–	–	–
C. scopulorum Born. & Flah.	–	–	–	–	–	–	–	4(25)	–	–	–	–	–	–

5. DISCUSSION OF RESULTS

In The Netherlands and in Denmark *Chrysomeris ramosa* was found in brackish localities with a very moist, well-developed algal layer. In The Netherlands these brackish localities are situated on the landward side of the dike. In Denmark they border directly on the sea. The latter localities are irregularly flooded, especially in winter. The water in Aarhus Bay (Kattegat) has a salinity that rarely rises above $20^{0}/_{00}$ NaCl. Salinities in the *Puccinellietum* of the polder "Het Noorden" measured during autumn and winter varied between 8 and $17^{0}/_{00}$ NaCl. Seepage of fresh water into and through this area is indicated by locally well-developed populations of *Juncus maritimus* Lamk.

Chrysomeris ramosa was found in the *Puccinellietum maritimae* and in the *Juncetum gerardii* (WESTHOFF & DEN HELD 1969), but more frequently and abundantly in the former than in the latter. Both associations occur in mesohaline, polyhaline, and euhaline situations (sensu DEN HARTOG 1971), and in localities where salinity varies very much (poikilohaline habitats). The alga was found in samples taken in January, March, April and May, (see *table 1*). The January record concerns one specimen detected at final micro-analysis in July. No *Chrysomeris ramosa* could be detected in samples from the polder "Het Noorden" taken at other times of the year.

In spring thick *Vaucheria* cushions are to be found in these marshes. In nine out of fourteen samples in which *Chrysomeris* was found a major part of the sample-plot was covered by *Vaucheria* spp. Only one sample-plot was totally devoid of *Vaucheria*. In these *Vaucheria* cushions varying combinations of the following six species could be found: *V. coronata*, *V. arcassonensis*, *V. synandra*, *V. sescuplicaria*, *V. erythrospora* and *V. canalicularis*. A combination of the first three species was particularly common. *V. coronata* and *V. arcassonensis* are widely distributed in saline areas. They are not only found in the brackish areas described above, but also commonly occur in the *Puccinellietum maritimae* and the *Juncetum gerardii* of salt-marshes subject only to the influence of euhaline water. *V. synandra* is a euryhaline species which occurs in the whole range of salinities from freshwater habitats to the *Puccinellietum maritimae* of brackish localities. In a salt-marsh on the isle of Terschelling (The Netherlands) *V. synandra* was found in a population of *Scirpus maritimus* L. subject to the influence of the discharge of a brackish ditch. *V. sescuplicaria* is often found in the same localities as *V. coronata* and *V. arcassonensis*. *V. erythrospora* is a typical inhabitant of brackish habitats and *V. canalicularis* is a salttolerant freshwater species.

Other major components of samples in which *Chrysomeris ramosa* was found were the green algae *Rhizoclonium riparium* and *Percursaria percursa*. In several cases these species covered a large part of the sample-plots. The green alga *Ulothrix subflaccida*, the Chrysophyte *Apistonema pyrenigerum*, and the blue-green algae *Anacystis dimidiata*, *Schizothrix calcicola*, *Oscillatoria brevis*, *Microcoleus lyngbyaceus*, and *Nodularia harveyana* were found almost constantly, but in minor amounts.

Few detailed ecological data are available from earlier work. CARTER (1937) detected *Chrysomeris ramosa* epiphytic on *Spartina sp.* in artificial brackish pools.

MAGNE published several papers on saltmarsh Chrysophyceae (MAGNE 1957, 1959). In a later paper (FELDMANN & MAGNE 1964) the habitat of *Chrysomeris ramosa* was given in some detail. The species was said to be epiphytic on "*Fucus muscoides*", *Juncus maritimus*, etc.: schorre de Térénez' (Finistère, France). This is a salt-marsh regularly flooded by euhaline water, but a few years ago the second author observed that a small brook discharges into the sea there, especially through the vegetation of *Scirpus maritimus*, where "*Fucus muscoides*" was also established. Thus at least local to this fresh-water outfall *Chrysomeris ramosa* is subject to the varying salinities of a poikilohaline habitat.

LEPAILLEUR found the alga (according to GAYRAL & HAAS 1969) on or between *Bostrychia scorpioides* (Huds.) Mont. in a saltmarsh in the estuary of the river Orne (Calvados, France). This is a purely marine salt-marsh, but with occasional flooding by fresh water in winter and early spring (DEN HARTOG, personal communication). Consequently the habitat there may also be poikilohaline.

It is obvious from the present, somewhat sparse data that *Chrysomeris ramosa* can occur in habitats with marked differences in characteristics of the physical and biotic environment; the sole requirements seem to be that the areas concerned are consistently moist and subject to fluctuating salinities.

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