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Morgan L. Vis and Robert G. Sheath: Distribution and systematics of *Chroodactylon* and *Kyliniella* (Porphyridiales, Rhodophyta) from North American streams

Key Index Words: Chroodactylon—*Cladophoraceae*—*epiphyte*—*freshwater streams*—Kyliniella—*North America.*

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The freshwater pseudofilamentous members of the rhodophyte order Porphyridiales, *Chroodactylon* and *Kyliniella*, have been reported from North American streams but there has been no detailed study of their geographic distribution or taxonomic status. Hence, this study was undertaken as part of a survey of 1,000 stream segments in North America (Sheath and Cole 1992).

a) *Chroodactylon*

Populations of Cladophoraceae (151) were collected from streams throughout North America from the Northwest Territories (68°N) to Costa Rica (10°N) (Sheath and Cole 1992). The samples were fixed in 2.5% gluteraldehyde and maximum depth and width, pH, specific conductance, temperature and mean current velocity were measured from each stream segment as described by Sheath *et al.* (1989).

From each cladophoracean population, branches were randomly sampled and at least 0.2 g fresh weight of material was thoroughly searched for *Chroodactylon*. The length and diameter of the middle cell from the main filament of *Chroodactylon* was measured using an ocular micrometer. The number of false branches was enumerated, total filament length was measured and number of *Chroodactylon* plants g^{-1} fresh weight of Cladophoraceae was calculated.

Only one type specimen of *Chroodactylon* species reported from freshwaters was available for examination.

Chroodactylon ornatum (C. Agardh) Basson 1979. *Bot. Mar.* **22:** 67. (Basionym: *Conferva ornata* C. Agardh 1824. *Systema Algarum*: 104) (holotype) PC herbarium G. Thuret No. 69. in Lacu Mälaren.

The type specimens of *Chroodactylon ramosum* (Thwaites) Hansg. and *Asterocytis smaragdina* (Reinsch) Forti could not be located and probably no longer exist (BM, IB, M, TCD). A portion of the type specimen was moistened and removed for examination. Each population and the type specimen was measured in replicates of ten with the exception of ON 65, from which only six plants were available. Sample size was determined and statistical tests were done according to Vis and Sheath (1992).

Seven populations of *Chroodactylon* were found, one from northern Manitoba, three from southern Ontario, two from western New York and one from southern Arizona (Table 1). The host was *Cladophora glomerata* (L.) Kütz. in each case, with the exception of *Rhizoclonium hookeri* Kütz. in Manitoba. The densities of *Chroodactylon* plants ranged from 60 to 570 filaments g^{-1} fresh weight host. The streams containing *Chroodactylon* tended to be large (maximum width 8–20 m, maximum depth 60–>100 cm), moderately flowing (0–62 cm s^{-1}), warm (12–23°C) and alkaline (pH 6.8–8.5, specific conductance 220–540 μS cm^{-1}). These trends are similar to those previously reported for the occurrence of *Chroodactylon* in North American freshwaters (Sheath and Hymes 1980; Sheath and Morison 1982).

Cell dimensions varied considerably within the populations and type specimen, such that there was overlap in the ranges of diameter

Table 1. Morphometric features of *Chroodactylon* types and populations in North America. Mean and standard deviation in parentheses.

Population[a] or type	Cell diameter (μm)	Cell length (μm)	Filament length (μm)	False branch number
a) *Populations measured*				
MAN11	5.8- 8.7 (6.4±1.0)	8.7-14.5 (11.3±2.1)	47- 372 (159±117)	0-1
ON23	5.8- 9.3 (7.7±1.1)	7.3-11.6 (9.5±1.6)	71- 560 (326±178)	0-1
ON50	6.1- 7.2 (7.1±0.9)	7.2-11.9 (10.2±1.5)	118-1,180 (294±320)	0-6
ON65	8.8-11.6 (10.2±0.9)	8.8-11.9 (10.7±1.2)	53- 442 (204±178)	0-4
NY113	6.5-11.6 (8.6±1.6)	7.1-10.2 (9.9±2.3)	24- 974 (188±324)	0-2
NY114	8.7-11.6 (10.8±1.0)	10.2-14.5 (11.9±1.9)	59- 295 (142± 77)	0-3
AZ5	7.4-10.2 (8.4±0.9)	10.3-16.0 (12.2±2.4)	88- 643 (362±199)	0-4
b) *Types*				
ornatum	4.9- 7.4 (6.4±0.9)	8.6-14.8 (10.9±1.7)	345-1,240 (817±332)	1-4
ramosum[b]	c. 17	c. 28	—	—
smaragdinum[c]	4.1-8.4	9.7-11.2	700-1,100	max. 5

[a] MAN=Manitoba, ON=Ontario, NY=New York, AZ=Arizona
[b] from Plate 213 in Harvey (1848) as *Hormospora ramosa*
[c] from protologue of Reinsch (1875) as *Callonema smaragdinum*

and length (Table 1). In addition, the type of *C. ornatum* did not statistically differ from three populations in cell diameter and all seven populations in cell length ($p<0.05$). The cell sizes from this study (5.8-11.6×7.1-16.6 μm, Table 1) are also similar to other freshwater studies (4.0-16.0×6.4-17.8 μm) (Daily 1943; Prescott 1962; Taft and Taft 1971; Sheath and Hymes 1980; Sheath and Morison 1982) and some marine accounts (3-8×8-20 μm) (Taylor 1957; Schneider and Searles 1991). However, cell sizes of marine populations from Jamaica and California are larger (13-28×9-19 μm) (Chapman 1961; Abbott and Hollenberg 1976).

Filament lengths of *Chroodactylon* also vary considerably and the number of false branches was significantly correlated to this feature ($p<0.05$, Table 2). The maximum filament length measured was an order of magnitude smaller than that reported for some marine populations (Taylor 1957; Schneider and Searles 1991).

Based on the similarity in morphometry among the North American populations of *Chroodactylon* and the type specimen of *C. ornatum* and the protologue of *C. smaragdinum* (Table 1, Reinsch 1875), we consider them to be synonymous. The oldest specific epithet is *C. ornatum* and the North American populations are referred to this taxon. The fact that the cell dimensions of *C. ramosum* determined

Table 2. Morphometric characteristics of *Kyliniella latvica* populations. Mean and standard in parentheses. Measurements from Skuja (1926) and Flint (1953) below. All measurements in μm.

Population[a] or type	Cell diameter	Cell length	Rhizoid diameter	Rhizoid length	Filament diameter
K. latvica type	9.9-14.8	9.9-17.3	7.4- 9.9	17.3-24.7	17.3-29.6
	(12.7±1.8)	(13.4±2.6)	(8.4±1.3)	(19.8±3.1)	(20.8±4.7)
	(10-19)	—	(10)	(150)	(16)
NH	7.4-14.8	4.9-11.1	7.4- 9.9	17.3-24.7	12.4-32.1
	(11.3±2.1)	(7.7±2.1)	(8.5±1.2)	(20.3±2.5)	(25.7±6.9)
	(c. 15)	—	—	(≤50)	—
RIA3	8 -11	5 -9	7 -10	18 -25	24
	(9.7±1.0)	(6.1±1.4)	(8.3±1.5)	(21.3±2.9)	

[a] NH=New Hampshire, RI=Rhode Island

from the original plate differ considerably from those of *C. ornatum* (Table 1, Harvey 1848) is in disagreement with previous studies which have synonymized these two taxa (John *et al.* 1979; Entwisle and Kraft 1984).

Description

Pseudofilaments with variable number of false branches (0-6) composed of rectangular to ellipsoidal cells loosely arranged in a linear fashion within a broad gelatinous matrix (Figs. 1-2). Cells with axial blue-colored chloroplast containing a prominent central pyrenoid (Fig. 3). Cell diameter 5.8-11.6 μm, cell length 7.1-16.6 μm and filament length 24-1,240 μm (Table 1). Occasional component of the epiphyton of *Cladophora* and *Rhizoclonium* in warm, alkaline streams of North America.

b) *Kyliniella*

Kyliniella was collected from the only two sites in North America known to contain this alga, Rhode Island (Sheath and Burkholder 1985) and New Hampshire (Flint 1953) (Table 2). The type specimen of *K. latvica* was obtained as follows:

> *Kyliniella latvica* Skuja 1926. *Acta Horti. Bot. Univ. Latv.* **1:** 4 (holotype) RIG. in Latvia in Lacu Usma (Sinus Brūždanga) epiphytic on *Phragmites*, Aug. 20, 1925.

The populations and type were measured for cell diameter and length, rhizoid diameter

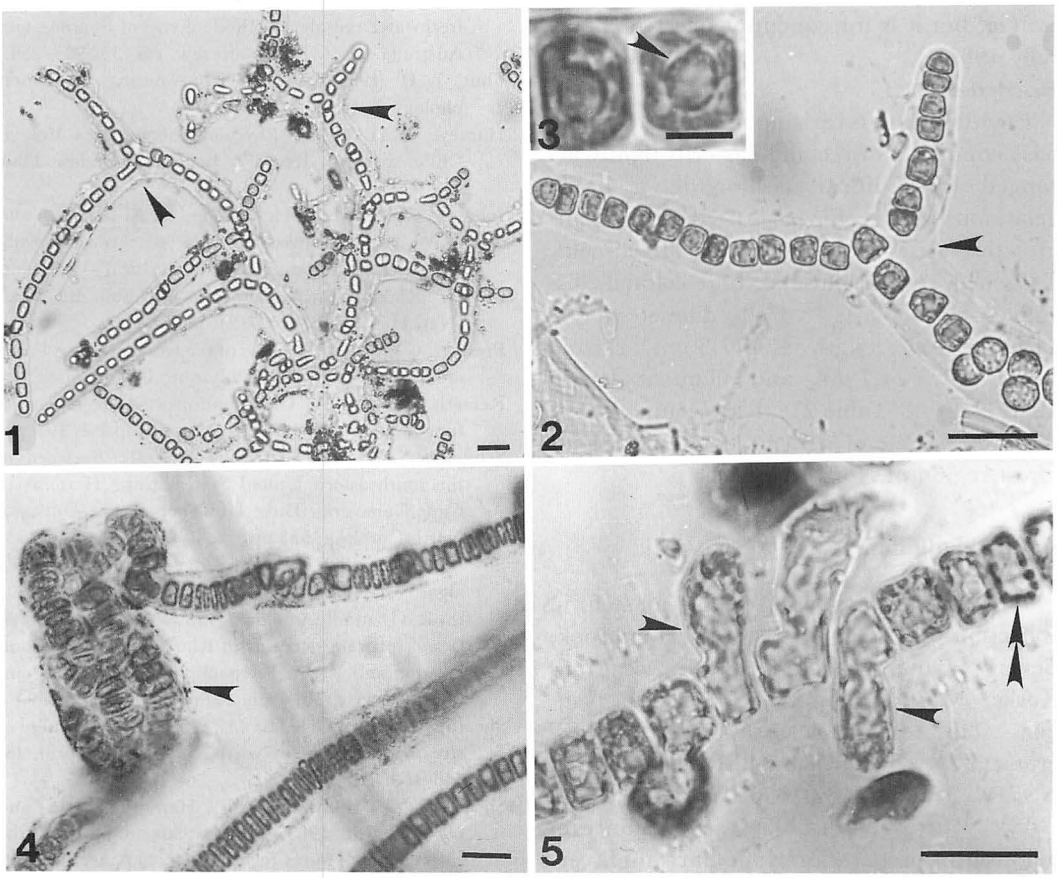

Fig. 1-3. *Chroodactylon ornatum* (NY114). Scale bar=20 μm except in Fig. 3 where it is 5 μm. 1, complex of pseudofilaments with false branches (arrowheads). 2, linear arrangement of cells in a broad gelatinous matrix with a false branch (arrowhead). 3, Two cells showing the axial, stellate chloroplast with prominent, central pyrenoid (arrowhead). Figs. 4-5. *Kyliniella latvica* (from Sheath 1984 with permission). Scale bar=20 μm. 4, Pseudofilament arising from discoidal base (arrowhead). 5, Densely packed cells with parietal, discoidal chloroplasts (double arrowhead); some cells produce rhizoidal outgrowths (arrowheads).

and length, and filament diameter. Each population was examined in replicates of ten with the exception of RI A3 from which only 4–8 measurements could be made.

The two populations and the type specimen had similar ranges of morphometric features except for a significantly larger cell length in the type ($p < 0.05$). However, this feature is quite variable and cannot be used alone to distinguish taxa. Therefore, we conclude that the North American populations are synonymous with *K. latvica*.

Kyliniella latvica appears to be quite rare in that it has been found in only two streams out of 1,000 surveyed from North America (Sheath and Cole 1992). Worldwide, it has also been reported from Austria, France and Latvia, but it is infrequently collected (Bourrelly 1985).

Description

Pseudofilaments arising from a discoidal base composed of rectangular cells tightly arranged in a linear fashion in a broad gelatinous matrix (Figs. 4–5). Rhizoidal outgrowths arise from cells for attachment. Cells with several parietal, blue-colored, discoidal chloroplasts. Cell diameter 7.4–14.8 μm, cell length 4.9–17.3 μm, rhizoid length 17.3–24.7 μm and filament length 12.4–32.1 μm (Table 2). Rare component of the littoral zone of streams in the deciduous forest region of North America.

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Morgan L. Vis・Robert G. Sheath：*Chroodactylon* と *Kyliniella*（紅藻；ヒナノリ目）の北アメリカの河川における分布と系統分類

北米の1000地点にわたる淡水藻の分布調査の結果に基づき，紅藻 *Chroodactylon* と *Kyliniella* の分布と形態学的観察の結果につき報告する。*Chroodactylon ornatum* はマニトバ北部，オンタリオ南部，ニューヨーク西部，アリゾナ南部から7つの個体群が採集された。北米の材料とタイプ標本の観察から *Chroodactylon ornatum* と *C. smaragdinum* は同種であると結論した。*Kyliniella* はロードアイランドとニューハンプシャーの2地点でのみ採集された。

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