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Lectotypification of *Porphyra elongata* Kylin (Bangiales, Rhodophyta) and proposed synonymy of *Porphyra rosengurttii* Coll *et* Cox

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Abstract – In 1905 Kylin collected a species of *Porphyra* from the west coast of Sweden, which he described as *P. elongata* (Aresch.) Kylin. However, *P. laciniata* var. *elongata* Aresch., the intended basionym, was never validly published so that the name *P. elongata* must be attributed directly to Kylin. Sequence data of the *rbc*L plastid gene obtained from Kylin's original material of *P. elongata* differed by only a single nucleotide transition from the *rbc*L sequences for the holotype and isotype of *P. rosengurttii* Coll *et* Cox. In this paper, we lectotypify *P. elongata* and propose *P. rosengurttii* as a synonym.

Lectotype / North Atlantic / Original material / *Porphyra rosengurttii* / *rbc*L

Résumé – **Lectotypification de *Porphyra elongata* (Aresch.) Kylin et proposition de *P. rosengurtii* Coll *et* Kox comme synonyme.** En 1950 Kylin a récolté une espèce de *Porphyra* de la côte occidentale de la Suède, espèce qu'il a décrite sous le nom de *P. elongata* (Aresch.) Kylin. Pourtant le nom *P. laciniata* var. *elongata* Aresch., cité par Kylin comme basionyme, n'a jamais été publié validement. Le nom *P. elongata* doit alors être attribué directement à Kylin. Les séquences du gène plastidien *rbc*L obtenues à partir du spécimen cité par Kylin comme *P. elongata* diffèrent d'une seule transition nucléotidique de l'holotype et de l'isotype de *P. rosengurttii* Coll *et* Cox. Dans cet article nous lectotypifions *P. elongata* et proposons *P. rosengurttii* comme synonyme.

Lectotype / Nord Atlantique / Matériel originel / *Porphyra rosengurttii* / *rbc*L

INTRODUCTION

The simple, but highly variable morphology of species in the red algal genus *Porphyra* makes them notoriously difficult to identify. Consequently, individuals of a single species may be known under several different names. In the

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North Atlantic, progress has been made in resolving the circumscription of species (see Brodie *et al.,* 2007, 2008), notably by obtaining comparative molecular data from type material or historically important specimens. In this paper we report on *Porphyra elongata* Kylin: we have been able to lectotypify the species and, based on molecular data from type material, to determine its relationship to other *Porphyra* species in the North Atlantic and Mediterranean.

MATERIALS AND METHODS

A sample (1 by 3 mm) of *P. elongata* was taken from the left hand specimen shown in Fig. 1a, which was collected on 21 July 1905 by Kylin from Koster, Bohuslän, Sweden. Similar samples were taken from the *P. rosengurttii* Coll *et* Cox holotype (US55293) (Fig. 2) and isotype specimens (US55294) collected by J. Coll on 3 April 1976 from Pivers Island, Beaufort, North Carolina, USA. Sequences of the *rbc*L gene and *rbc*L-*rbc*S intergenic spacer were obtained from these samples following the methods of Brodie *et al.* (2007). Sequences were assembled in SeqMan Pro, aligned in MegAlign (Lasergene v.7.2.1(1) DNASTAR, Inc.) and BLAST searched in GenBank.

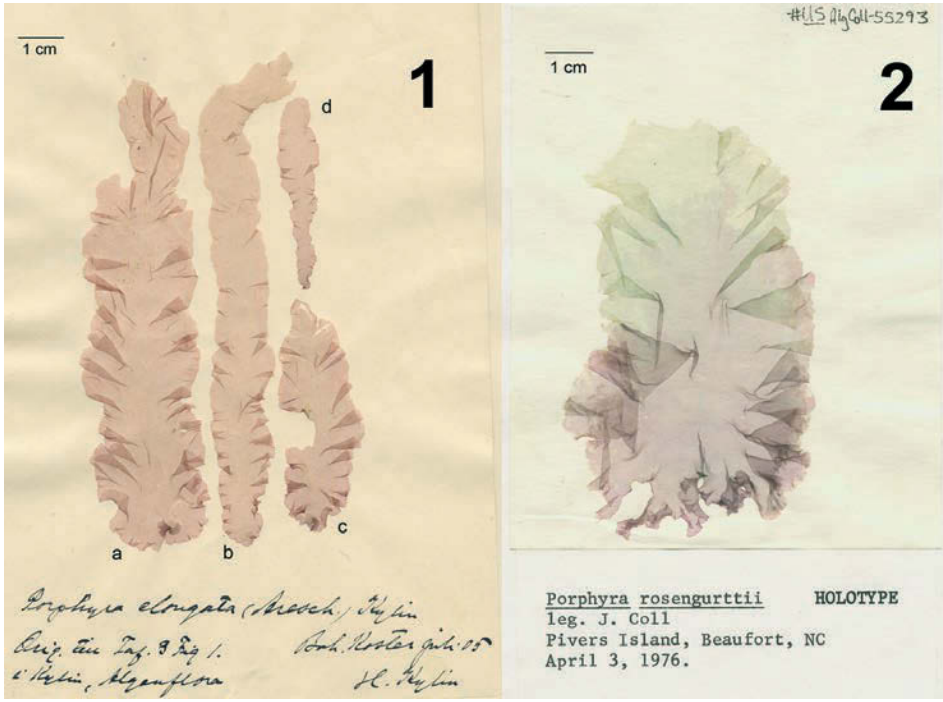
RESULTS AND DISCUSSION

Molecular results

From Kylin's *Porphyra elongata* specimen, a sequence was obtained for the entire *rbc*L gene (1467 bp) plus the *rbc*L-*rbc*S (76 bp) and a small segment (14 bp) of *rbc*S (GenBank accession number: FJ817088). A sequence was obtained from the *P. rosengurttii* holotype, for the whole of the *rbc*L gene, except for a small (19 bp) unresolved segment starting at position 1091, and for all but the last 4 bp of the spacer (FJ817090). A sequence was successfully obtained for nearly the entire *rbc*L gene (positions 1-1436) for the *P. rosengurttii* isotype (FJ817089). The sequences for the 3 specimens were nearly identical to each other except for a single nucleotide transition located at position 713 that was G in the *P. elongata* specimen and A in the two *P. rosengurttii* specimens. The A at position 713 also occurred in a more recently collected (2 February 2002) specimen of *P. rosengurttii* from Masonboro, North Carolina, USA (GenBank AY486349) as well as one from Cove Island, Stamford, Connecticut, USA (GenBank AF228754). A single nucleotide transition in the entire *rbc*L and spacer is not unusual within *Porphyra* species (Neefus & Brodie, pers. obs., Lindstrom and Fredericq 2003).

Proposed lectotype of *Porphyra elongata*

Kylin's (1907) description of *Porphyra elongata* cites two collections. One was made by Kylin himself at Koster, Bohuslän, Sweden; illustrations of several of the specimens from this collection accompanied his description (Kylin, 1907,



Figs 1-2. *Porphyra elongata* and *P. rosengurttii*. **1**. *Porphyra elongata* Kylin: original material collected by Kylin in 1905 from Koster, Bohuslän, Sweden; in UPS. The proposed lectotype is indicated with the letter a. **2**. *Porphyra rosengurttii* Coll *et* Cox (holotype specimen 55293 in US) collected by J. Coll in 1976 from Pivers Island, Beaufort, North Carolina, USA.

p. 110, pl. 3, figs 1a, b, c). The other collection which Kylin felt matched his specimens was that distributed by Areschoug (1862) as no. 117 of his *Alg. Scand. Exsicc.*, Series 2, with the printed label "*Porphyra laciniata* var. *elongata*" but with no accompanying description. Because the name *P. laciniata* var. *elongata* Aresch., Kylin's intended basionym for *P. elongata*, was never validly published, *P. elongata* must be directly attributed to Kylin (P. Silva, pers. comm.). Although a specimen from either collection could serve as the lectotype for *P. elongata* Kylin, it seems more appropriate to choose one of Kylin's. Therefore, we propose as lectotype, the left hand specimen of the sheet illustrated in Fig. 1, collected on July 21 1905 by Kylin from Koster, Bohuslän, Sweden (Kylin, 1907, p. 110, pl. 3, fig. 1a), which is housed at the Uppsala University Herbarium (UPS).
Synonym: *Porphyra rosengurttii* Coll *et* Cox 1977, p. 157, figs 9-17.

Relationship of *Porphyra elongata* to *P. leucosticta*

Two years after Kylin described *Porphyra elongata*, Rosenvinge (1909) wrote "It appears to me, however, rather doubtful if [*P. elongata*] can be regarded as a species distinct from *P. leucosticta*…". Yendo (1916) also felt *P. elongata* was insufficiently distinct from *P. leucosticta* to warrant species rank and proposed

Table 1. *Porphyra elongata* based on Kylin (1907); *P. rosengurttii* based on Brodie *et al.* (2007)

	P. elongata	*P. rosengurttii*
General morphology		
Shape	Elongate, uniformly broad or becoming slightly smaller above and below; occasionally divided into two tips.	Round, ovate, reniform, occasionally oblong, broad-ovate, or sublanceolate to lanceolate, elongate.
Dimensions (Length × Breadth) cm	4-12 × 1-2.5 (3)	1.5-16 × 1.5-10.5
Margins	More or less undulate, entire.	Undulate, moderately to deeply ruffled, entire to laciniate.
Base	Sessile.	Sessile, cordate to pseudoumbilicate.
Fertile area	Monoecious; spermatangial sori small, mainly along margin of thallus, often not visible to the naked eye, irregular round or more or less elongated. Larger sori slender, elongate, about 2 mm long, more or less parallel with thallus margin. Zygotosporangial sori irregularly scattered, sometimes between spermatangial sori, sometimes outside them when not extended to thallus margin, interspersed with vegetative cells.	Monoecious; spermatangial sori near margin of blade, irregular patches, narrow streaks or sometimes block-like, elongating in direction of blade. Zygotosporangial sori small clusters interspersed with vegetative cells near spermatangial sori.
Vegetative morphology		
Thallus thickness (μm)	25-33	25-62.5
Cell layers	Monostromatic.	Monostromatic.
Cell dimensions (surface view, length × breadth)	14 × 17	5-32 × 5-17.5
Ecology		
Seasonality	July.	Nov-May (possibly July).
Shore level	Littoral.	Upper littoral to shallow sublittoral.
Substrata	Epiphytic on larger algae.	On rocks, wooden sea defences, epiphytic on other algae and epizooic on e.g. barnacles.
Exposure	Sheltered.	Sheltered-exposed.
Distribution	Sweden, west coast.	North Atlantic (Connecticut-North Carolina, USA, Gran Canaria and Sussex, UK) and the Mediterranean (Spain, Italy and Greece).

P. leucosticta f. *elongata* (Kylin) Yendo. Algaebase (Guiry & Guiry, 2009) indicates that *P. elongata* is currently regarded as a synonym of *P. leucosticta*. Brodie *et al.* (2007), using molecular and morphological evidence, clearly distinguished *P. rosengurttii* from *P. leucosticta*. Since it is now evident that *P. elongata* and *P. rosengurttii* are conspecific, *P. elongata* is also obviously distinct from *P. leucosticta*.

Relationship of *Porphyra elongata* to *P. rosengurtii*

A morphological and ecological comparison of Kylin's (1907) description of *P. elongata* with that for *P. rosengurttii* in Brodie *et al.* (2007) (Table 1) showed the similarity of the two. Particularly of note is Kylin's description of the spermatangial sori of *P. elongata*, as irregularly round or more or less elongated and parallel to the thallus margin, which matches closely that for *P. rosengurttii*.

Porphyra rosengurttii was originally described from North Carolina, USA (Coll & Cox, 1977). It was later (Brodie *et al.* 2007) reported for elsewhere along the northwestern Atlantic coast, Canary Isles, south coast of England and the Mediterranean (Table 1). Kylin's collection from Sweden of *P. elongata* represents a more northerly locality for this species. Reports of the occurrence of *P. rosengurttii* are typically from winter to spring whereas Kylin's material of *P. elongata* was collected in July. This difference probably is a consequence of the more northerly, cooler location of the Swedish site. These results provide additional data on the geographical range and seasonal occurrence of *P. elongata* (including *P. rosengurttii*) in the North Atlantic and Mediterranean.

Concluding remarks

Brodie *et al.* (2008) commented that "While there is evidence that different regions have distinct floras, it is important to consider that species may be much more widely distributed than recognised and may be going under different names in different regions." The discovery that *P. elongata* includes *P. rosengurttii* is a case in point, showing the continuing need to compare type material using molecular techniques if we are to resolve the identity of *Porphyra* species in different parts of the world.

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