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***Cystoseira montagnei* J. Agardh and *C. spinosa*
Sauvageau (Phaeophyceae, Sargassaceae):
a taxonomic reappraisal of misused names,
with the proposal of *Cystoseira michaelae*
Verlaque *et al.* nom. et stat. nov.**

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Abstract – *Cystoseira granulata* C. Agardh var. *turneri* Montagne was described by Montagne (1838) from Algeria (southern Mediterranean Sea). Subsequently, Agardh (1842) renamed the taxon as *C. montagnei* J. Agardh, on the basis of specimens from France and the northern Adriatic (northern Mediterranean Sea) which he believed to be identical to Montagne's taxon. Finally, Sauvageau (1912) described *C. spinosa* Sauvageau and *C. adriatica* Sauvageau as nomina nova, to partly accommodate Agardh's and some other authors' concept of *C. montagnei*. These taxonomic treatments caused confusion regarding the delineation of these taxa and doubts have been raised regarding the taxonomic value of Montagne's taxon, which today is often listed as *taxon inquirendum* in updated checklists and floras. Since 2014, we have collected near Algiers (Algeria) a species of *Cystoseira* that formed sparse forests between 10 and 25 m depth. Our specimens perfectly match the original description as well as the syntype material of Montagne's taxon. They are well characterized and distinct from *C. montagnei* J. Agardh and from all the *Cystoseira* taxa hitherto described in having: a single axis with young tophules spinose becoming smooth-tuberculate when older; primary branches either slightly compressed with an inconspicuous rib and irregularly alternate in one plane, or cylindrical and branched in all directions, with spaced short spine-like appendages; and conceptacles both intercalary basal, just above the tophule, and terminal on branchlets. Here, we propose *Cystoseira michaelae* Verlaque *et al.* nom. et stat. nov. to accommodate Montagne's taxon (*Cystoseira granulata* C. Agardh var. *turneri* Montagne) and the lectotypification of the species on the basis of both Montagne's protologue and of an original specimen of Montagne (out of the syntype housed at the Muséum National d'Histoire Naturelle de Paris, PC). *Cystoseira michaelae* seems to be an endemic species restricted to Algeria and northern Tunisia. In addition, *C. montagnei* J. Agardh is lectotypified on the basis of an original specimen of J.G. Agardh (out of the syntype housed at the Botanical Museum of Lund University, LD). The study of lectotypes of *C. spinosa* Sauvageau and of its synonym *C. adriatica* Sauvageau confirmed that they are junior synonyms of *C. montagnei* J. Agardh.

Algeria / *Cystoseira michaelae* / *Cystoseira montagnei* / *Cystoseira spinosa* / Mediterranean Sea / nomenclature / Phaeophyceae / lectotypification

Résumé – *Cystoseira granulata* C. Agardh var. *turneri* Montagne a été décrit par Montagne (1838) d’Algérie (Sud de la Méditerranée). Par la suite, Agardh (1842) a renommé ce taxon *C. montagnei* J. Agardh, sur la base de spécimens de France et du Nord de l’Adriatique (Nord de la Méditerranée) qu’il croyait identiques au taxon de Montagne. Enfin, Sauvageau (1912) a décrit *C. spinosa* Sauvageau et *C. adriatica* Sauvageau comme des nomina nova, y incluant en partie le concept de *C. montagnei* de J.G. Agardh et de divers auteurs ultérieurs. Ces traitements taxonomiques ont créé la confusion quant à la délimitation de ces taxons et des doutes sont apparus sur la valeur taxonomique du taxon de Montagne, aujourd’hui souvent placé parmi les *taxa inquirenda* dans les inventaires et les flores. Depuis 2014, nous avons récolté près d’Alger (Algérie) une espèce de *Cystoseira* qui constitue des forêts clairsemées entre 10 et 25 m de profondeur. Nos spécimens correspondent tout à fait à la description originale ainsi qu’au syntype du taxon de Montagne. Ils sont bien caractérisés et se distinguent de *C. montagnei* J. Agardh et de tous les autres taxons de *Cystoseira* décrits à ce jour par : la présence d’un tronc portant des tophules épineux quand ils sont jeunes, devenant lisses-tuberculés quand ils sont plus vieux ; les rameaux primaires qui sont soit légèrement comprimés avec une nervure peu marquée et des ramifications irrégulièrement alternes dans un plan, soit cylindriques et ramifiés dans toutes les directions, avec des épines courtes et espacées ; des réceptacles à la fois basaux-intercalaires, juste au-dessus du tophule, et terminaux sur des ramules. Ici, nous proposons le nom de *Cystoseira michaelae* Verlaque *et al.* nom. et stat. nov. pour le taxon de Montagne (*Cystoseira granulata* C. Agardh var. *turneri* Montagne) et la lectotypification de l’espèce sur la base du protologue et d’un spécimen appartenant au syntype de Montagne, conservé au Muséum National d’Histoire Naturelle de Paris (PC). *Cystoseira michaelae* semble être une espèce endémique de l’Algérie et du Nord de la Tunisie. Par ailleurs, nous proposons la lectotypification de *C. montagnei* J. Agardh, sur la base d’un spécimen original de J.G. Agardh, appartenant au syntype conservé au Botanical Museum de Lund University (LD). L’étude des lectotypes de *Cystoseira spinosa* Sauvageau et de son synonyme *C. adriatica* Sauvageau confirme que ce sont des synonymes de *C. montagnei* J. Agardh.

Algérie / *Cystoseira michaelae* / *Cystoseira montagnei* / *Cystoseira spinosa* / Méditerranée / nomenclature / Phaeophyceae / lectotypification

INTRODUCTION

In the Mediterranean Sea, the species of the genus *Cystoseira* C. Agardh, 1820, *nom. cons.*, are the main forest-forming species of the photophilous rocky substrates from the littoral fringe down to the lower euphotic zone (down to 70-80 m depth in the clearest waters) (Giaccone & Bruni, 1973; Giaccone *et al.*, 1994; Thibaut *et al.*, 2015; Blanfuné *et al.*, 2016a,b; Boudouresque *et al.*, 2016). Out of 289 taxa of *Cystoseira* listed worldwide (including homotypic and heterotypic synonyms and names of uncertain taxonomic status), 32 species and more than fifteen infra-specific taxa are currently accepted taxonomically in the Mediterranean Sea (Guiry & Guiry, 2017). However, in spite of their importance as habitat formers, the delimitation and distribution of a number of species are still not well known (Roberts, 1978; Ribera *et al.* 1992, Draisma *et al.*, 2010; Cormaci *et al.*, 2012; Berov *et al.*, 2015; Bouafif *et al.*, 2014, 2016). The reason for this is that the species of *Cystoseira* offer few unambiguous diagnostic characters and that some of these characters are more or less overlapping. Genetic tools will probably help to disentangle their taxonomic value.

Montagne (1838) described from Algeria (Cherchell, west of Algiers, Mediterranean Sea) a taxon he regarded as a new variety of the Atlantic species *Cystoseira granulata* C. Agardh, as *C. granulata* var. *turneri* Montagne. This taxon represents one of the least well known *Cystoseira* taxa; in addition, it became subsequently a source of confusion. Agardh (1842: 47-48), on the basis of distinct specimens from the north-western Mediterranean and the Adriatic Sea, raised Montagne's taxon to species level, under the name of *C. montagnei* J. Agardh, actually a new species. *Cystoseira montagnei* was widely recorded in the Mediterranean Sea until several authors expressed doubts regarding its taxonomic value, considering it as a mixture of distinct taxa (e.g.: Sauvageau, 1912, 1920; Papenfuss, 1967; Roberts, 1978). Following Sauvageau (1912), Mediterranean authors replaced the name '*C. montagnei*' by those of *C. spinosa* Sauvageau and *C. adriatica* Sauvageau. *Cystoseira montagnei* is now often treated as a *taxon inquirendum* in the updated Mediterranean checklists and floras (Ribera *et al.*, 1992; Cormaci *et al.*, 2012; but see Perret-Boudouresque & Seridi, 1989).

In 2014 and 2015, we collected specimens corresponding to Montagne's taxon, *C. granulata* var. *turneri*, from the regions of Tipaza and Algiers (Algeria) (Sellam *et al.*, 2016). The morphological study of these specimens showed that they belonged to a taxon quite distinct from *C. spinosa*. The aim of this study was (i) to reassess the status of *C. granulata* var. *turneri*, *C. montagnei* and *C. spinosa*, made obscure by taxonomic ambiguities and misuses (ii) to propose the lectotypification of *C. granulata* var. *turneri* and of *C. montagnei*, (iii) to propose a new name for Montagne's *C. granulata* var. *turneri* (*C. michaelae* nom. et stat. nov.) and (iv) to provide information concerning the ecology and distribution range of the latter species.

MATERIAL AND METHODS

Sampling and observations were undertaken using SCUBA diving, between the sea surface and 25 m depth, at different localities in the regions of Tipaza and Algiers (Algeria), from La Corne d'Or to Bounetah Island, between August 2014 and November 2015 (Fig. 1). The populations were studied all year round, at two-week intervals.

Samples were transferred to the laboratory (in Algiers), then rinsed with seawater and cleaned of epiphytes. The samples were either preserved in 4% buffered formalin/seawater or pressed and prepared as herbarium specimens. A subsample of some specimens was preserved in silica gel for further DNA analyses. The material studied has been deposited in HCOM, the Herbarium of the Mediterranean Institute of Oceanography, Aix-Marseille University (Herbarium abbreviation follows Thiers, 2016).

Specimens were compared with the almost exhaustive collection of Mediterranean *Cystoseira* species deposited in the HCOM and with the syntype of *C. granulata* C. Agardh var. *turneri* Montagne (deposited in the herbaria of the Muséum National d'Histoire Naturelle, Paris, PC), the syntype of *C. montagnei* J. Agardh (deposited in the J.G. Agardh herbarium, Botanical Museum, Lund University, LD) and the lectotypes of *C. spinosa* Sauvageau and *C. adriatica* Sauvageau (herbaria of the Muséum National d'Histoire Naturelle, Paris, PC). They were also compared with other specimens housed in the herbaria of the Université Montpellier 2 (MPU) and of PC (Table 1).

Table 1. Major herbarium specimens of *Cystoseira* examined. The syntypes of *C. michaelae* Verlaque *et al.* nom. et stat. nov. and of *C. montagnei* J. Agardh are indicated with an asterisk. (coll.: collection); m.d.: missing data. Correct names according to the authors of the present study

Collection date	Country	Location	Code of specimens	Herbarium	Institution	Name(s) on the sheet	Correct name
August 1836	Algeria	Cherchell (Montagne, 1838), as Algiers on the sheet	PC0535490* (coll. Roussel, n° 659)	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. granulata</i> var. <i>turneri</i> Montagne, <i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
August 1836	Algeria	Idem	PC0535491* (coll. Roussel, n° 659)	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. granulata</i> var. <i>turneri</i> Montagne, <i>C. montagnei</i> J. Agardh, <i>Phyllacantha montagnei</i> Kützting	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
April 1837	Algeria	Idem	PC0043664* PC0043665* (coll. Roussel, n° 659)	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. sp. nov.</i> ? <i>C. granulata</i> var. <i>turneri</i> Montagne, <i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
March 1838	Algeria	Idem	PC0043657* (coll. C. & P. Monnard, n° 397)	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. sp. nov.</i> , <i>C. montagnei</i> J. Agardh, <i>C. platyclada</i> Sauvageau	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
March 1838	Algeria	Idem	PC0043663* (coll. C. & P. Monnard, n° 397), lectotype designated here (Fig. 22)	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. granulata</i> var. <i>turneri</i> Montagne	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
March 1838 (erroneously noted 1835)	Algeria	Idem	PC0602244* (coll. C. & P. Monnard, n° 397)	Bory de St Vincent	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
26 December 1890	Algeria	Saint Eugène (now Bologhine)	PC0478104 (coll. F. Debray)	J. Feldmann	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> , nom. et stat. nov.
18 April 1910	Algeria	Cap Matifou – Jean Bart Island	PC0525538 to PC0525543, PC0525546	C. Sauvageau	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
18 April 1910	Algeria	Cap Matifou – Jean Bart Island	MPU-binder 33	C. Sauvageau	Université Montpellier 2 (MPU)	<i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.

18 April 1910	Algeria	Cap Matifou – Jean Bart Island	PC0602245, PC0602246	Thuret	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
17 May 1939	Algeria	Matifou Bank	PC0457240, PC0457245	J. Feldmann	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. michaelae</i> Verlaque <i>et al.</i> nom. et stat. nov.
m.d. (≅ 1842)	France	Cette (now Sète)	LD00526*, LD00527*	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
May 1837	France	Cette (now Sète)	LD00528*, lectotype designated here (Figs 23-26)	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
May 1837	France	Cette (now Sète)	LD00529, LD00529a*	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (≅ 1842)	France	Marseille	LD00529b* (coll. Solier)	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
May 1837	France	Cap Croisette, Marseille	LD00529c*	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m d. (≅ 1842)	France	Cap Croisette, Marseille	LD00530*	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. abies</i> , <i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (≅ 1842)	Italy	Adriatic Sea, Trieste	LD00534* (coll. Biasoletto)	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. selaginoides</i> , <i>C. corniculata</i> Wulfen, <i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (≅ 1842)	Italy	Adriatic Sea, Trieste	LD00535* (coll. Biasoletto)	J.G. Agardh	Botanical Museum, Lund University (LD)	<i>C. selaginoides</i> , <i>C. corniculata</i> Wulfen, <i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
September 1855	France	Marseille	PC0043651	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
August 1856	Italy	Genova	PC0477835 (coll. Lebel)	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (19 th century)	m. d.	m. d.	PC0477838 (coll. Lebel)	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
20 October 1878	Spain	Menorca, Cabo Negro	PC0535494 (coll. J.J. Rodriguez)	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh, <i>Phyllacantha montagnei</i> Kützing	<i>C. montagnei</i> var. <i>compressa</i> (Ercegović) Verlaque <i>et al.</i> comb. nov.

Table 1. Major herbarium specimens of *Cystoseira* examined. The syntypes of *C. michaelsae* Verlaque *et al.* nom. et stat. nov. and of *C. montagnei* J. Agardh are indicated with an asterisk. (coll.: collection); m.d.: missing data. Correct names according to the authors of the present study (*continued*)

Collection date	Country	Location	Code of specimens	Herbarium	Institution	Name(s) on the sheet	Correct name
m.d. (19 th century)	France	Marseille	PC0043650	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. concatenata</i> (L.) C. Agardh, <i>C. montagnei</i> J. Agardh,	<i>C. montagnei</i> J. Agardh
m.d. (19 th century)	France	Marseille	PC0043654 (coll. Herpin)	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (19 th century)	Italy	Trieste	PC0535493 (coll. Le Sourd)	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (19 th century)	France	Toulon (as Tolone)	PC0043658 (coll. Ricasoli)	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. granulata</i> var. <i>turneri</i> Montagne, <i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (19 th century)	Italy	Venice	PC0043659 (coll. G.G.A. Meneghini)	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. granulata</i> var. <i>turneri</i> Montagne, <i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
m.d. (19 th century)	Italy	Naples	PC0043660	Montagne	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. corniculata</i> Zanardini, <i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> J. Agardh
1 February 1926	France,	Ajaccio, Corsica	PC0527486	Général	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh, <i>C. spinosa</i> Sauvageau	<i>C. montagnei</i> J. Agardh
27 August 1958	Italy	Ischia, Naples	PC0478105, PC0478106 (Coll. Moncharmont)	J. Feldmann	Muséum National d'Histoire Naturelle, Paris (PC)	<i>Sargassum montagnei</i>	<i>C. montagnei</i> var. <i>compressa</i> (Ercegović) Verlaque <i>et al.</i> comb. nov.
July 1962	France,	Calvi, Corsica	PC0478097, PC0478099 to PC0478103	J. Feldmann	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> var. <i>compressa</i> (Ercegović) Verlaque <i>et al.</i> comb. nov.
6 May 1907	France	Ile Grosse, Banyuls-sur- Mer	PC0525446 (coll. Sauvageau), SA4767, lectotype of <i>C. spinosa</i> (Figs 27-29)	C. Sauvageau	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. erica-marina</i> Valiante, <i>C. spinosa</i> Sauvageau	<i>C. montagnei</i> J. Agardh
May 1909	Italy	Trieste	PC0525482 (coll. J. Schiller), SA4729, lectotype of <i>C. adriatica</i> (Figs 30-32)	C. Sauvageau	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. adriatica</i> Sauvageau, <i>C. montagnei</i> Hauck, <i>C. erica-marina</i>	<i>C. montagnei</i> J. Agardh
1815	Morocco	Tangier?	PC0602243 (coll. Schousboe, n° TA7658)	Thuret	Muséum National d'Histoire Naturelle, Paris (PC)	<i>C. granulata</i> Ag., <i>C. montagnei</i> ('plante <i>douteuse</i> ', C. Lamy)	<i>C. nodicaulis</i> (Withering), M. Roberts

Identification criteria, in the genus *Cystoseira*, are based on the mode of attachment to the substratum, the number and the form of axes, the aspect of apices and tophules (when present), the phyllotaxy and the morphology of branches, the occurrence and the arrangement of cryptostomata and aerocysts, and the location and the morphology of reproductive structures (see Sauvageau, 1912, 1920; Hamel, 1939; Ercegović, 1952; Gómez Garreta *et al.*, 2001; Mannino & Mancuso, 2009; Cormaci *et al.*, 2012; Taşkın *et al.*, 2012). The initial nomenclature (before the changes resulting from the present investigation) followed that adopted by Guiry & Guiry (2017).

Literature dealing with *C. granulata* var. *turneri*, *C. montagnei*, *C. spinosa* and *C. adriatica* was exhaustively searched and analyzed.

RESULTS

Hereafter, we describe the morphology, phenology and habitat of the specimens we collected in Algeria.

Specimens studied: **H8287-8288** – Cap Caxine (36° 49' 4" N & 2° 57' 19" E), September 2014, 17 m depth, rocky substrates; **H8289-8290** – Aïn Benian, close to the harbor (36° 48' 45" N & 2° 53' 29" E), August 2014, 19 m depth, rocky substrates; **H8291-8294** and **H8300-8301** – Tipaza, La Corne d'Or (36° 35' 45" N & 2° 26' 44" E), September 2014, 16 m depth, rocky substrates; **H8295** – Aïn Benian, close to the harbour, September 2014, 18 m depth, rocky substrates; **H8296-8297** – Aïn Benian, close to the harbour, April 2015, 14 m depth, rocky substrates; **H8298** – Cap Caxine, April 2015, 16 m depth, rocky substrates; **H8299** – Islets of Tipaza (36° 35' 52" N & 2° 27' 40" E), March 2015, 11 m depth, rocky substrates; **H8302** – Islets of Tipaza, August 2015, 10 m depth, rocky substrates; **H8303** – Bounetah Island (36° 47' 46" N & 3° 21' 19" E), August 2015, 14 m depth, rocky substrates; **H8304** – Cap Caxine, August 2015, 13 m depth, rocky substrates; **H8305** – Islets of Tipaza, October 2015, 12 m depth, rocky substrates; **H8306** – Cap Caxine, November 2015, 13 m depth, rocky substrates (Fig. 1).

Morphological description. Plants stiff, up to 30 cm high, not caespitose, yellow-brown in colour when alive and darker when dried, attached to the substrate by a robust discoid holdfast (Figs 2-4); main axis up to 20 cm high, branched, with apices not protruding, surrounded by spinose tophules (Figs 5, 7); spinose tophules ovoid, 5-13 mm × 5-7 mm, becoming smooth-tuberculate when older (Figs 5-7); primary branches, up to 18-19 cm long, of two different types: either slightly complanate, up to 2.5 mm wide, with an inconspicuous rib and irregularly alternately branched in one plane, or cylindrical and branched in all directions, with spaced short simple to bifid spine-like appendages (Figs 2-3 & 8-10). The habit varies with depth: shallow specimens have cylindrical branches while the deeper ones have complanate branches. Cryptostomata scattered along branches; specimens monoecious; receptacles both intercalary basal, compact to more or less loosely arranged, attached just above the tophule (Figs 11-13), and terminal, cylindrical and more or less diffuse on branchlets (Figs 18-19); conceptacles male, female or hermaphroditic, differentiated in the branch and at the base of spine-like appendages (Figs 14-17 & 20). No obvious relationship was found between the location of the conceptacles, their type (male, female, hermaphroditic) and the receptacles.

Phenology. The annual growth cycle is similar to that of other lower infralittoral species of *Cystoseira*. The plant grows from the early spring to the summer. While terminal receptacles were observed in late summer and autumn, basal receptacles

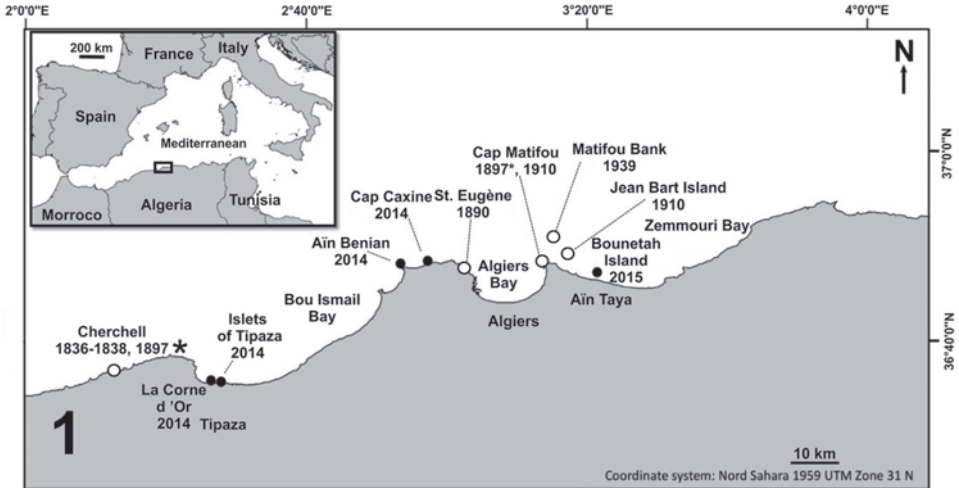


Fig. 1. Locations with collection dates of *Cystoseira michaelae* Verlaque *et al.*, nom. et stat. nov. (*C. granulata* C. Agardh var. *turneri* Montagne) in Algeria (Tipaza and Algiers regions) – Historical data: Herbarium specimens and references (light circles) and newly collected specimens (this work) (dark circles). *: Debray (1897): specimens not found.

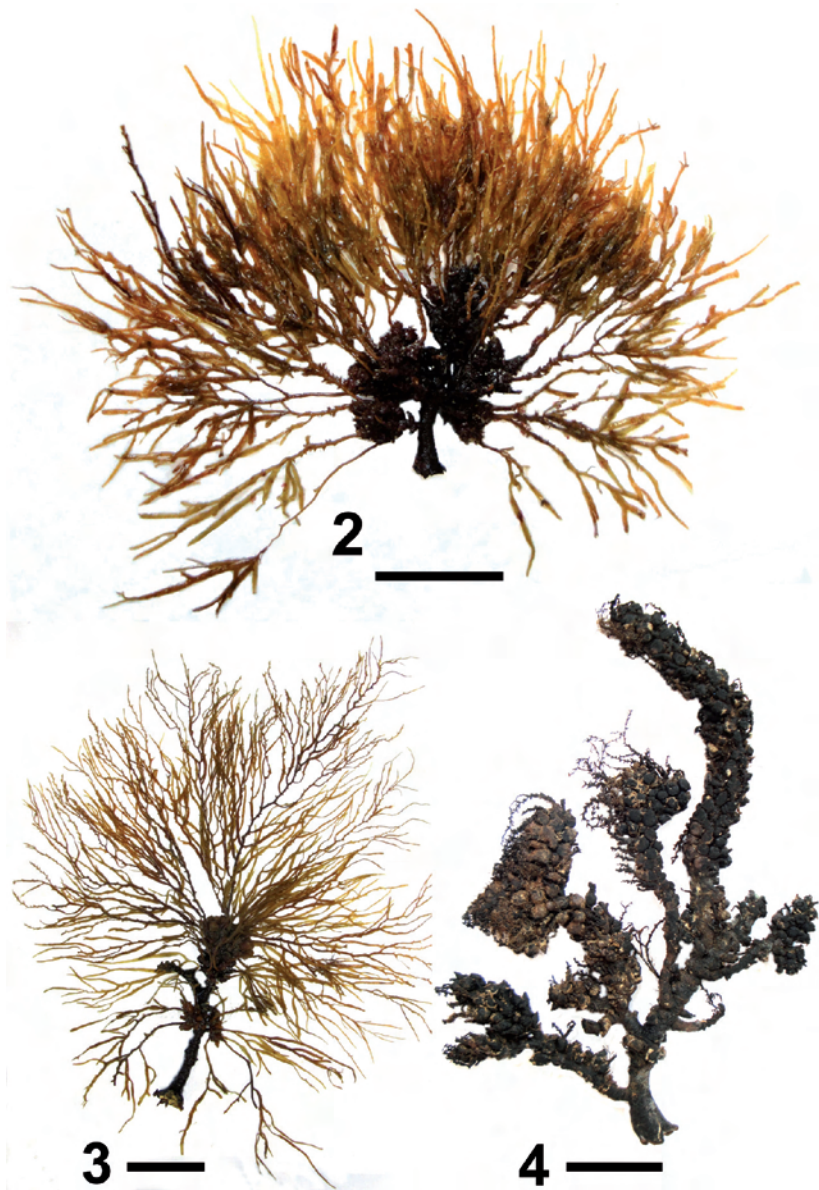
were present all year round. Plants shed their primary branches in late autumn and they are almost devoid of primary branches in winter (Fig. 4).

Habitat. The species thrives in the lower infralittoral zone (*sensu* Pérès, 1982), between 10 m and 25 m depth (limit of our investigations), and on sub-horizontal to gently sloping photophilous rocky substrates (0 to 45°). It is always heavily covered with epiphytes such as other macroalgae, bryozoans, hydroids and sponges. The species forms sparse algal forests (< 5 individuals.m⁻²), in association with other large macroalgae such as *Cystoseira zosteroides* (Turner) C. Agardh, *Dictyopteris lucida* M.A. Ribera Siguán *et al.*, *Dictyota cyanoloma* Tronholm *et al.*, *Dictyota* spp., *Flabellia petiolata* (Turra) Nizamuddin, *Phyllariopsis* sp., *Sargassum* sp., *Zonaria tournefortii* (J.V. Lamouroux) Montagne, and a rich sessile fauna dominated by *Eunicella singularis* (Esper, 1791) and large species of sponges, bryozoans and hydroids.

DISCUSSION AND CONCLUSIONS

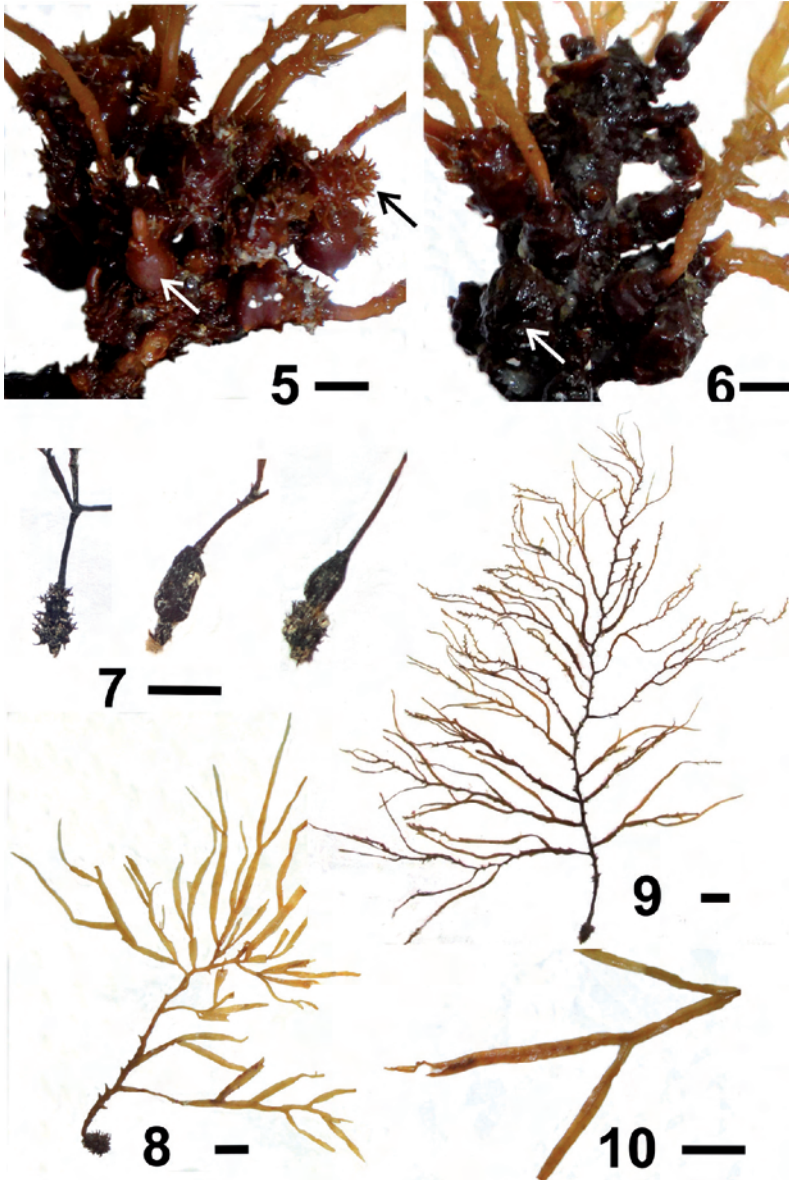
A good fit between *Cystoseira granulata* C. Agardh var. *turneri* Montagne and the specimens collected in the Algiers region

Montagne (1838: 340-342) described from Algeria, ‘*prope Juliam Caesaream*’ (now Cherchell, ~ 80 km west of Algiers) a taxon he regarded as a variety of the Atlantic species *Cystoseira granulata* C. Agardh, as *C. granulata* var. *turneri* Montagne. Montagne (1846: 13-14, plate 4) re-described and nicely illustrated

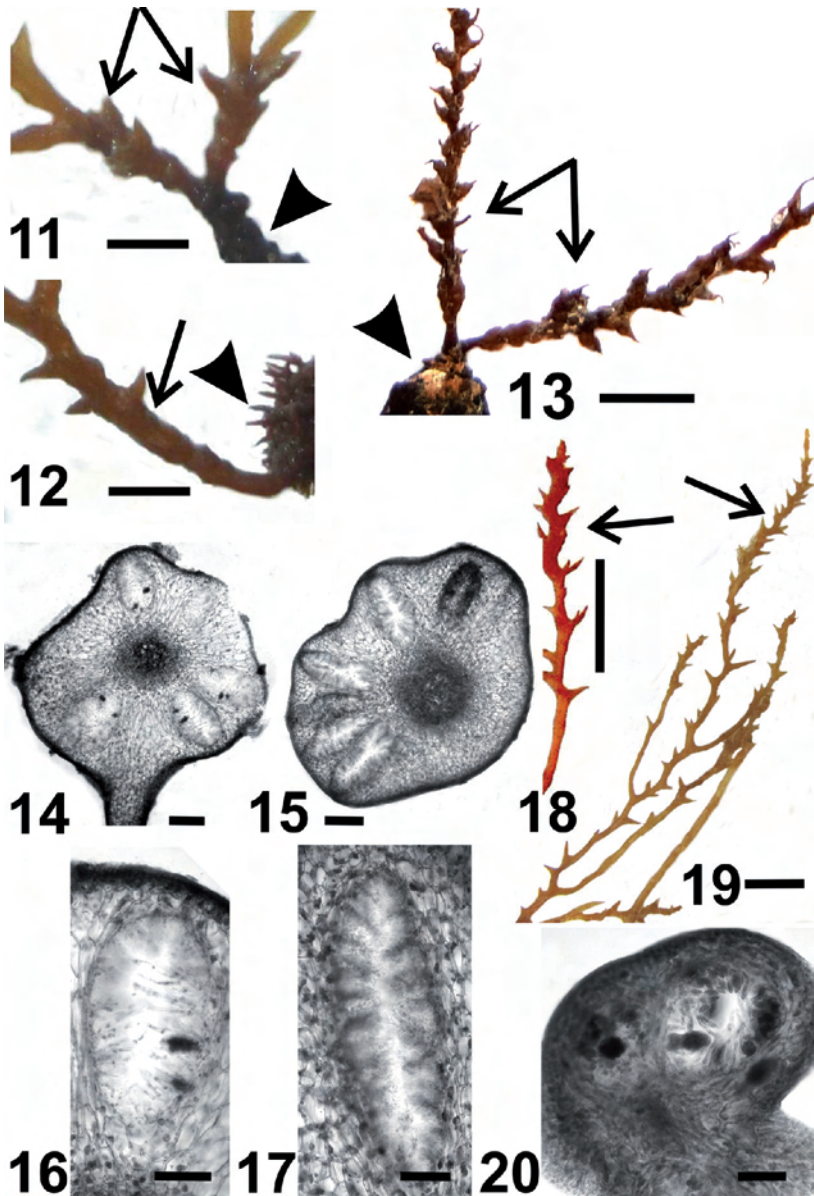


Figs 2-4. *Cystoseira michaelae* Verlaque *et al.*, nom. et stat. nov. from Algeria (newly collected specimens, this work). 2-3. Habit of specimens H8300 and H8291, respectively, from Tipaza, La Corne d'Or, September 2014. 4. Habit of an old individual, specimen H8299 from Islets of Tipaza, March 2015. Bars = 5 cm.

(figures reproduced here as Fig. 21) the taxon under the name of *C. montagnei* J. Agardh [here: *C. michaelae* nom. et stat. nov. Verlaque *et al.*], proposed by J.G. Agardh (1842: 47-48) who erroneously applied it to Montagne's taxon (see below).



Figs 5-10. *Cystoseira michaelae* Verlaque *et al.*, nom. et stat. nov. from Algeria (newly collected specimens, this work). **5-6.** Apical views of axes showing spinose (black arrows) and smooth-tuberculate (white arrows) tophules (specimen H8300); bars = 5 mm. **7.** Spinose and smooth-tuberculate tophules, specimen H8288 from Cap Caxine, September 2014; bar = 1 cm. **8.** Complanate branch with inconspicuous midrib, specimen H8300; bar = 1 cm. **9.** Complanate to cylindrical branch with short spine-like appendages, specimen H8291; bar = 1 cm. **10.** Detail of a complanate branch with inconspicuous midrib, specimen H8300; bar = 1 cm.



Figs 11-20. *Cystoseira michaelae* Verlaque *et al.*, nom. et stat. nov. from Algeria (newly collected specimens, this work). **11-12.** Compact tuberculate-spinose basal intercalary receptacles (arrows) close to the tophule (arrow heads), specimen H8300; bars = 5 mm. **13.** Diffuse spinose basal intercalary receptacles (arrows) close to the tophule (arrow head), specimen H8290 from Aïn Benian, August 2014; bar = 5 mm. **14.** Transverse section of a female basal receptacle, specimen H8291; bar = 200 μ m. **15.** Transverse section of a male basal receptacle, specimen H8300; bar = 200 μ m. **16.** Transverse section of a female basal conceptacle, specimen H8291; bar = 100 μ m. **17.** Transverse section of a male basal conceptacle, specimen H8300; bar = 100 μ m. **18-19.** Diffuse spinose terminal receptacles, specimen H8291; bars = 5 mm. **20.** Transverse section of a hermaphroditic terminal conceptacle, specimen H8291; bar = 100 μ m.

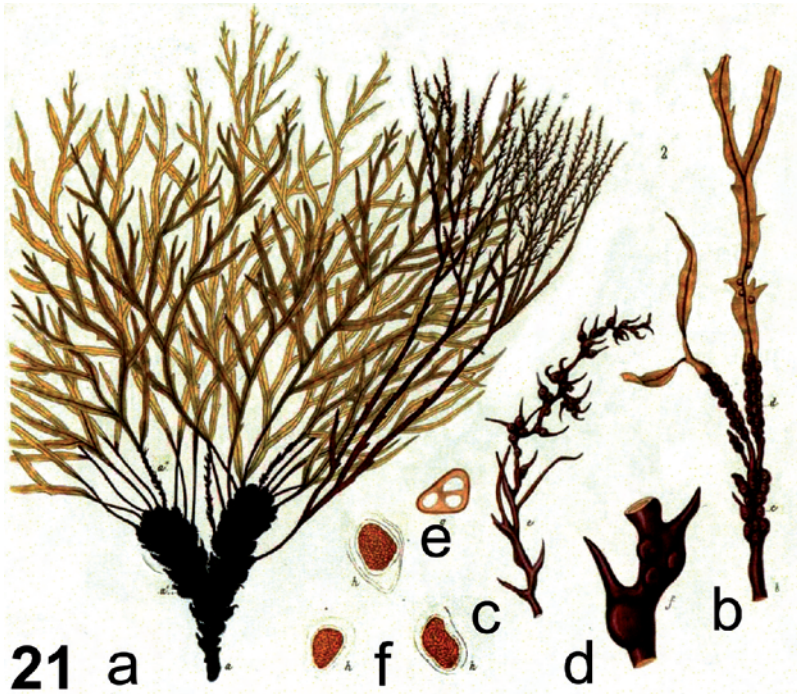


Fig. 21. Illustration of *Cystoseira michaelae* Verlaque *et al.*, nom. et stat. nov., as *C. montagnei* J. Agardh (*sensu* Montagne), in Montagne (1846, plate 4, figs 2a-h). a: Habit. b: Lower part of a branch with intercalary receptacles. c: Terminal receptacle. d: Detail of a terminal receptacle. e: Transverse section of a terminal receptacle showing the conceptacles. f: Oogonia. The original numbering of figures within the plate has been changed, but the original numbers have not been erased and can be seen in very small print.

The specimens we collected from the region of Algiers correspond well with Montagne's description and to his herbarium specimens (syntype) housed in the Muséum National d'Histoire Naturelle (Paris: PC) (Table 1). The taxon is very easily distinguishable from all other *Cystoseira* species through a panel of characters: (i) a single axis with spinose (when young) to smooth-tuberculate (when old) tophules, (ii) primary branches either slightly compressed, with an inconspicuous rib, and irregularly alternately branched in one plane, or cylindrical and branched in all directions, with spaced short spine-like appendages (iii) receptacles either intercalary basal, just above the tophule, or terminal, cylindrical and diffuse on branchlets.

The fate of *Cystoseira granulata* var. *turneri* and the confusing story of *C. montagnei* and *C. spinosa*

Meneghini (1842) reported *C. granulata* var. *turneri* from Naples, Toulon, the northern Adriatic Sea and Dalmatia. J.G. Agardh (1842), receiving several specimens of *Cystoseira* with spinose tophules from France (Cette, now Sète, and Marseille) and the northern Adriatic Sea (Trieste, Italy), concluded that they all belonged to Montagne's taxon. Considering *C. granulata* var. *turneri* to be quite

distinct from *C. granulata* C. Agardh [currently *C. usneoides* (Linnaeus) M. Roberts (Roberts, 1968; Spencer *et al.*, 2009)] and from all the other species known at that time (*'Species distinctissima, a Montagne primum bene descripta, sed cum C. granulata male confusa'*: 'very distinct species..., well described for the first time by Montagne, but with *C. granulata* badly confused'), J.G. Agardh raised the var. *turneri* to species rank under the name *C. montagnei* J. Agardh. However, it is worth noting that, in his description, J.G. Agardh mentioned the spinose tophules and the compressed branches but omitted the major diagnostic character of Montagne's taxon, i.e. the basal intercalary receptacles. Montagne (1846) followed J.G. Agardh and re-described his alga from Algeria under the name *C. montagnei* J. Agardh [here: *C. michaelae*]. At the same time, he excluded all the records of Meneghini (1842). J.G. Agardh (1848) considered Montagne's illustrations of *C. montagnei* [here: *C. michaelae*] as excellent (*'Montagne (1846) p.43. tab. IV.2 (eximie !)'*), and completed the distribution of the species (*'Hab. In mari mediterraneo ad littora Occitaniae et galloprovinciae (ipse! = J.G. Agardh), ad Algeriam (Montagne!); in Adriatico ad Trieste (Biasoletto! et C. Agardh!) et Venetiam (Martens!); e Gadibus = Cadix (Cabrera!)'*), but always without any mention of basal intercalary receptacles. This shows that (i) J.G. Agardh probably never saw any genuine specimen of Montagne's taxon, (ii) the J.G. Agardh concept of *C. montagnei* is much broader than that of Montagne and (iii) *C. montagnei* cannot be treated as a replacement name for *C. granulata* var. *turneri* (according to Art. 6.11 of ICN; McNeill *et al.*, 2012), but as a new species based upon the Sète, Marseille and Trieste specimens (syntype housed in the Lund herbarium, LD).

Kützing (1849) transferred *C. montagnei* to the genus *Phyllacantha* Kützing (currently a junior synonym of *Cystoseira*). Later on, he published the illustrations of *P. montagnei* and *P. montagnei* var. *cirrosa* Kützing on the basis of Algerian specimens sent by Montagne (Kützing, 1860) [here: *C. michaelae*]. Hauck (1885) recorded *C. montagnei* (with *Phyllacantha gracilis* Kützing, *P. pinnata* Kützing and *P. affinis* Kützing as synonyms), from the Adriatic Sea, with no mention of basal intercalary receptacles; the illustrations of these species of *Phyllacantha* in Kützing (1860) agree more with the Sauvageau (1912) *C. spinosa* [here: *C. montagnei*] than with Montagne's taxon [here: *C. michaelae*]. In his *'Catalogue des algues du Maroc, de l'Algérie & de la Tunisie'*, Debray (1897) recorded *C. montagnei* [here: *C. michaelae*] only from Algeria, close to Algiers [Cherchell, Matifou and Saint Eugène (now Bologhine)]. When Sauvageau (1912) published his impressive revision of the genus *Cystoseira*, with descriptions of new species with spinose tophules (*C. adriatica* Sauvageau and *C. spinosa* Sauvageau), the first taxonomic questions about the real identity of *C. montagnei* J. Agardh were raised. Considering all the previous records of *C. montagnei* with, when possible, re-examination of samples, Sauvageau (1912, 1920) concluded that *C. montagnei* J. Agardh differed from *C. montagnei sensu* Montagne and was a mixture of species. Except for specimens from Algeria that possessed all the characteristics of *C. montagnei* Montagne *non* J. Agardh (sic) [here: *C. michaelae*], all the other records from France, Corsica, Sardinia, Italy and Adriatic Sea were doubtful because devoid of basal intercalary receptacles: *C. montagnei sensu* Valiante from Naples would probably be *C. spinosa* and *C. montagnei sensu* Hauck from the Adriatic sea would probably be *C. adriatica* (subsequently synonymised with *C. spinosa*; see Cormaci *et al.*, 1992). In the Adriatic Sea, Ercegović (1952) followed the conclusions of Sauvageau (1912, 1920) and treated (i) *C. montagnei* J. Agardh *sensu* Hauck as a synonym of *C. adriatica*, (ii) '*C. montagnei* J. Agardh (ex parte)' (sic) as a synonym of *C. platyramosa* Ercegović [currently *C. spinosa* var. *compressa* (Ercegović)

Cormaci *et al.*], and (iii) ‘*C. montagnei* J. Agardh (pro parte)’ (sic) and *C. montagnei* J. Agardh *sensu* Valiante as synonyms of *C. spinosa*. At Naples, Funk (1955) did the opposite and recorded *C. montagnei* J. Agardh, with *C. spinosa* Sauvageau as synonym. According to Papenfuss (1967), ‘until J. G. Agardh’s material has been examined and *C. montagnei* lectotypified, it will not be possible to settle the status of the species’. Our re-examination of the syntype of *C. montagnei* J. Agardh dating before 1842 and deposited in the J.G. Agardh Herbarium (LD) showed that no specimen originates from Algeria and confirmed the conclusions of Sauvageau and Ercegović: all the specimens of J.G. Agardh do not differ from *C. spinosa* Sauvageau (synonyms: *C. adriatica* Sauvageau and *C. platyramosa* Ercegović) [here: *C. montagnei*]. In Spain, *C. montagnei* was recorded from the Balearic Islands before being excluded from the flora (Gallardo *et al.*, 1985; Ribera Siguan & Gómez Garreta, 1985; Gómez Garreta *et al.*, 2001). The species was never recorded from Morocco (see Benhissoune *et al.*, 2002), Libya, in spite of extensive research on the genus *Cystoseira* (Nizamuddin, 1978, 1985 and 1995), and from Egypt (Aleem, 1993). Subsequently, *C. montagnei* was definitely considered as *taxon inquirendum* (Ribera *et al.*, 1992; Furnari *et al.* 1999, 2003; Giaccone *et al.*, 1999; Cormaci *et al.*, 2012; Taşkin *et al.*, 2012; Tsiamis *et al.*, 2013), including in Algeria (Ould-Ahmed *et al.*, 2013). See Table 2 for further records of *C. montagnei*, *C. spinosa* and *C. adriatica*.

Table 2. Records of *Cystoseira* species with spinose tophules, referred to as *C. spinosa*, *C. adriatica* and *C. montagnei*, in the Mediterranean Sea (in addition to the records mentioned within the text), and probable correspondence with the taxonomic treatment in the present study (*Cystoseira montagnei* J. Agardh and *C. michaelae* Verlaque *et al.* nom. et stat. nov.)

Reference	Location	Name(s) and authority used by the author(s)	Correct name(s) according to the present treatment	Comments
Ardissonne & Strafforello (1877)	Liguria (Italy)	<i>C. montagnei</i> J. Ag.	<i>C. montagnei</i> ?	No description or illustration
Piccone (1879)	La Galite (Tunisia)	<i>C. montagnei</i> J. Agardh	<i>C. montagnei</i> or <i>C. michaelae</i> ?	No description or illustration
Valiante (1883)	Gulf of Naples (Italy)	<i>C. montagnei</i> J. Ag.	<i>C. montagnei</i>	Description and illustrations corresponding well to <i>C. spinosa</i> Sauvageau [here <i>C. montagnei</i>]
Piccone (1884)	Sardinia (Italy)	<i>C. montagnei</i> J. Ag.	<i>C. montagnei</i> ?	No description or illustration
Rodríguez y Femenías (1889)	Balearic Islands (Spain)	<i>C. montagnei</i> J. Ag.	<i>C. montagnei</i> ?	No description or illustration
Petersen (1918)	La Galite (Tunisia)	<i>C. montagnei</i> Montagne and <i>C. spinosa</i> Sauvageau	<i>C. michaelae</i> and <i>C. montagnei</i> , respectively?	As the 2 taxa are cited, the possibility that they could actually refer to <i>C. michaelae</i> and <i>C. montagnei</i> must be considered

<i>Reference</i>	<i>Location</i>	<i>Name(s) and authority used by the author(s)</i>	<i>Correct name(s) according to the present treatment</i>	<i>Comments</i>
Hamel (1939)	Algeria, Corsica (?)	<i>C. montagnei</i> J. Agardh, <i>emend.</i> Montagne	<i>C. michaelae</i>	
Feldmann & Feldmann (1939), Feldmann (1943)	Matifou Bank (near Algiers, Algeria). Between 8 and 15 m depth	<i>C. montagnei</i> (J. Ag.) Mont.	<i>C. michaelae</i>	According to the authors, species restricted to Algeria and possibly to Corsica
Feldmann (1961)	La Galite (Tunisia)	<i>C. montagnei</i> J. Agardh <i>emend.</i> Montagne (sic)	<i>C. montagnei</i>	All specimens were all lacking basal intercalary receptacles (Feldmann, 1961)
Giaccone (1969)	Eolian Islands, Ustica I., Sicily (Palermo, Scopello, Trapani) (Italy)	<i>C. montagnei</i> (J. Agardh) Montagne (sic) and <i>C. spinosa</i> Sauvageau	<i>C. michaelae</i> and <i>C. montagnei</i> , respectively?	As the 2 taxa are cited, the possibility that they could actually refer to <i>C. michaelae</i> and <i>C. montagnei</i> must be considered
Cinelli (1971)	Ischia I. (Gulf of Naples, Italy)	<i>C. spinosa</i> Sauv.	<i>C. montagnei</i> ?	
Gerloff & Geissler (1974)	Greece	<i>C. montagnei</i> J. Agardh <i>em.</i> Montagne (sic) and <i>C. spinosa</i> Sauvageau	?	
Tsekos & Haritonidis (1974)	Rhodos Island (Greece)	<i>C. montagnei</i> (J. Ag.) Mont. and <i>C. spinosa</i> Sauv.	?	Both species mentioned from the midlittoral zone. Species never recorded from this habitat
Haritonidis & Tsekos (1975)	Northern Greece	<i>C. montagnei</i> (J. Ag.) Mont. and <i>C. spinosa</i> Sauv.	?	Both species mentioned from the midlittoral zone. Species never recorded from this habitat
Giaccone <i>et al.</i> (1985)	Sicily and affiliated islands (Italy)	<i>C. spinosa</i> Sauvageau <i>var.</i> <i>spinosa</i>	<i>C. montagnei</i> <i>var. montagnei</i>	<i>Cystoseira montagnei sensu</i> Montagne (here <i>C. michaelae</i>) no longer cited: a correction of Giaccone (1969) citation?
Giaccone <i>et al.</i> (1985)	Ustica I., Sicily (Palermo, Messina), Pantelleria I. and Linosa I. (Italy)	<i>C. spinosa</i> Sauvageau <i>var. squarrosa</i> (De Notaris) Giaccone	<i>Cystoseira squarrosa</i> De Notaris	
Giaccone <i>et al.</i> (1985)	Catania, Siracusa (Sicily, Italy)	<i>C. adriatica</i> Sauvageau	<i>C. montagnei</i>	<i>C. adriatica</i> is a synonym of <i>C. spinosa</i> Sauvageau [here <i>C. montagnei</i>] (Cormaci <i>et al.</i> , 1992)
Hamza (1987)	Kerkennah Islands (Tunisia)	<i>C. montagnei</i> J. Agardh	?	The description does not fit with the species

***Cystoseira michaelae* Verlaque *et al.* nom. et stat. nov. and *Cystoseira montagnei* J. Agardh: two similar but distinct species**

Our study shows that Montagne's alga, from Algeria, described as *Cystoseira granulata* C. Agardh var. *turneri* Montagne (Fig. 22), constitutes a well delineated



Fig. 22. Lectotype of *Cystoseira granulata* C. Agardh var. *turneri* Montagne (here: *C. michaelae* Verlaque *et al.*, nom. et stat. nov.), Algiers [Algeria], PC (Herbarium Montagne), barcode PC0043663, by courtesy of the MNHN-Paris ©; Collection C. and P. Monnard; labelled '*Cystoseira granulata* L. Turner var. *turneri* Montagne – Alger n° 397 – Com. Class. Monnard'. The lectotype is the top left specimen. Isolated branches (top right and bottom) possibly belong to the same individual.

taxon, distinct from *C. montagnei* J. Agardh, currently known as *C. spinosa* Sauvageau, an illegitimate name coined by Sauvageau (1912). The most unambiguous diagnostic characters which distinguish the two taxa are (i) the spinose tophules, when young, becoming smooth-tuberculate when older (in the former), versus remaining spinose (in the latter) and (ii) the receptacles both basal and intercalary, just above the tophule, and terminal on branchlets, in the former, versus only terminal on the branchlets, in the latter.

Montagne's taxon therefore deserves the status of species. As pointed out by J.G. Agardh (1842), it cannot be maintained within *C. granulata* C. Agardh [currently *C. usneoides* (Linnaeus) M. Roberts; see Roberts (1968) and Spencer *et al.* (2009)]. We cannot use the epithet '*turneri*', as '*Cystoseira turneri*', because the binomial combination *Cystoseira turneri* (Yendo) Roberts (Roberts, 1978) already exists [basionym: *Cystophyllum turneri* Yendo; currently synonym of the accepted taxon *Myagropsis myagroides* (Mertens ex Turner) Fensholt (Fensholt, 1955; Yoshida & Kawai, 1987; Horiguchi & Yoshida, 1998)]. We therefore propose a new name, *C. michaelae* Verlaque *et al.* nom. et stat. nov., having as replaced synonym: *C. granulata* C. Agardh var. *turneri* Montagne.

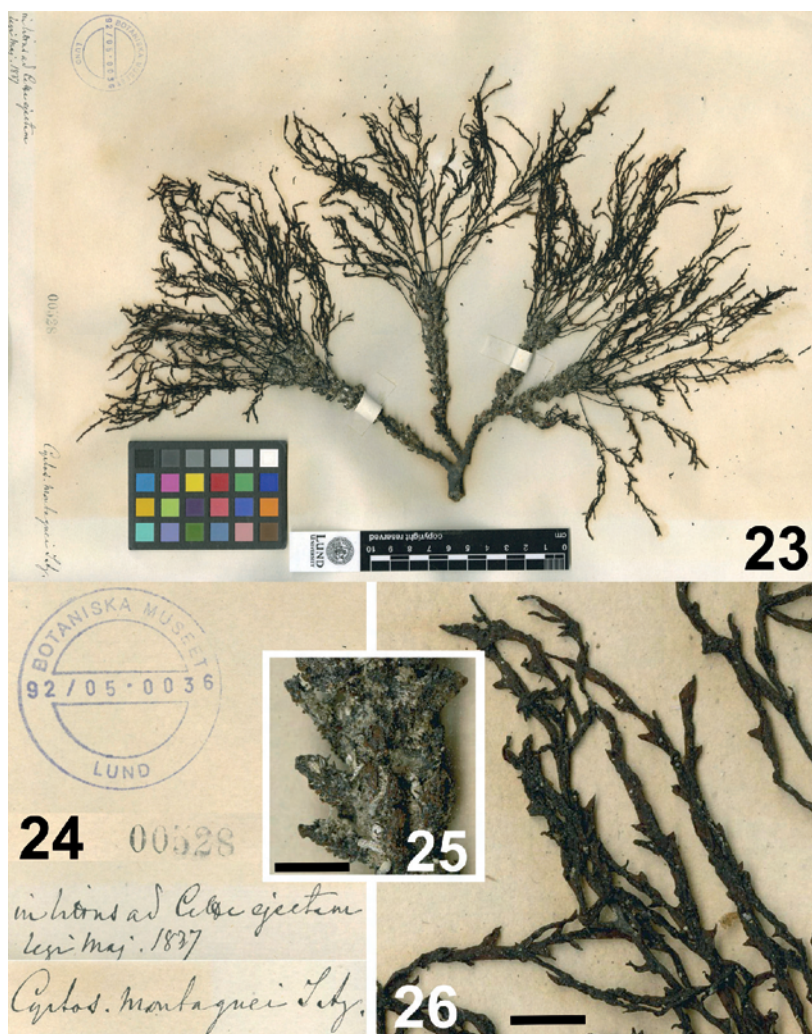
The placing of Montagne's taxon (as *C. montagnei*) among *taxa inquirenda* resulted from the early confusion of J.G. Agardh (1842) who thought he had found Montagne's taxon when he was only in possession of specimens of a distinct species. If J.G. Agardh (1842) had actually dealt with Montagne's taxon, he should have used the epithet '*turneri*' as *Cystoseira turneri* (Montagne) J. Agardh for the change of taxonomic rank (a combination no longer available; see above). In fact, J.G. Agardh validly described a new species, as *C. montagnei*, based upon specimens from the north-western Mediterranean Sea and the northern Adriatic Sea. Later, Sauvageau (1912) re-named the J.G. Agardh taxon (*C. montagnei* J. Agardh) as *C. spinosa* Sauvageau (for the north-western Mediterranean specimens) and as *C. adriatica* Sauvageau for the Adriatic specimens. Cormaci *et al.* (1992) synonymized *C. adriatica* with *C. spinosa*, as *C. spinosa*. The comparison of the lectotypes of *C. montagnei* (LD00528, J.G. Agardh herbarium, LD) (Figs 23-26), of *C. spinosa* (SA4767, PC0525446, Sauvageau herbarium, PC; Gómez Garreta & Ribera, 2002) (Figs 27-29) and of *C. adriatica* Sauvageau (SA4729, PC0525482, Sauvageau herbarium, PC; Gómez Garreta & Ribera, 2005) (Figs 30-32) shows that they all belong to the same taxon, with *C. spinosa* and *C. adriatica* as junior synonyms of *C. montagnei*.

All in all, two taxa are present: (i) *C. granulata* C. Agardh var. *turneri* Montagne, often named *C. montagnei* auct. non J. Agardh (a misused name), in need of a new name, for which we propose here *C. michaelae* Verlaque *et al.* nom. et stat. nov., and (ii) *C. montagnei* J. Agardh, currently incorrectly named *C. spinosa* Sauvageau.

Biogeographical, ecological and conservation considerations

It is worth noting that we never found *C. montagnei* during our field study, although the species was repeatedly recorded from the Algiers region (see Perret-Boudouresque & Seridi, 1989). There is a high probability that all these records are misidentifications of *C. michaelae* due to morphological, phenological and ecological similarities between the two species, especially between *C. michaelae* and *C. montagnei* var. *compressa* (Ercegović) Verlaque *et al.* comb. nov. We consider *C. michaelae* as the possible vicariant species of *C. montagnei* in Algeria.

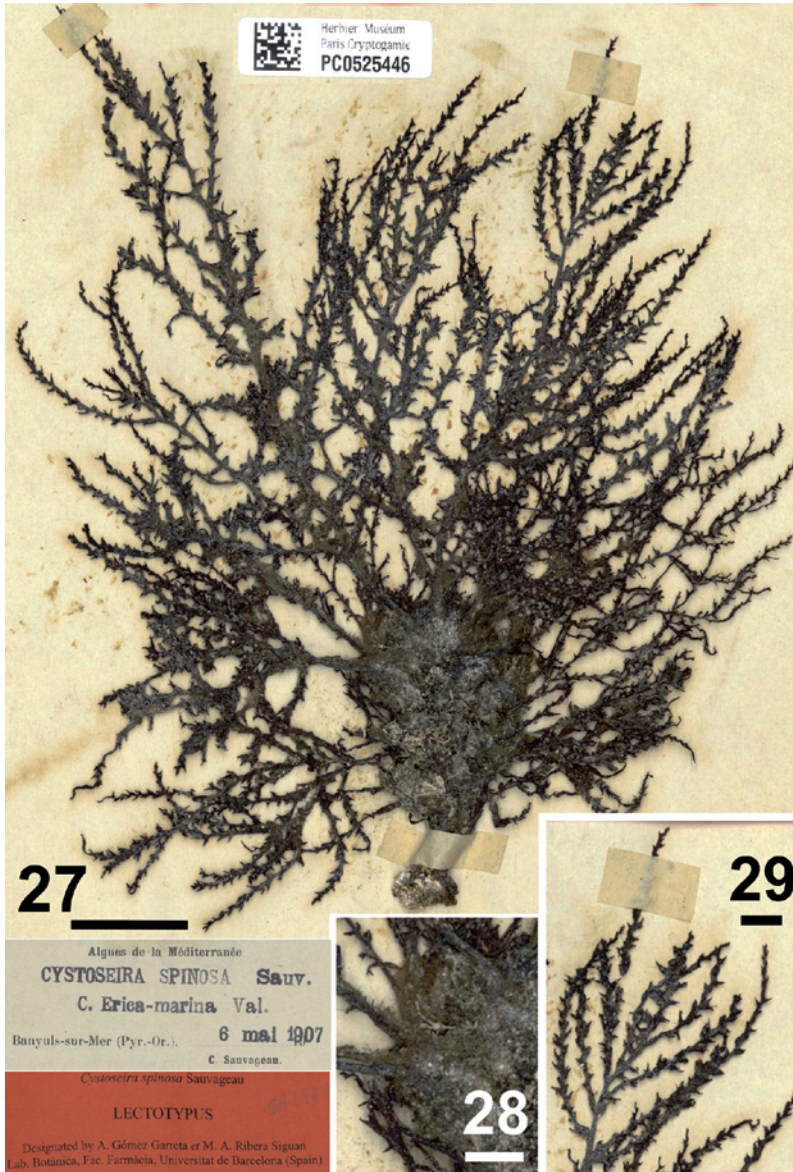
In the study area, *C. michaelae* is distributed from Cherchell to the Matifou Bank and Bounetah Island. The species must be searched for in the other parts of



Figs 23-26. Lectotype of *Cystoseira montagnei* J. Agardh, Cette (now Sète), France, May 1837, Botanical Museum, Lund University (Herbarium J. Agardh), barcode LD528, by courtesy of Lund University ©. **23.** Habit; bar = 10 cm. **24.** Detail of the label. **25.** Detail of spinose tophules; bar = 5 mm. **26.** Detail of the upper part of branchlets with receptacles; bar = 5 mm.

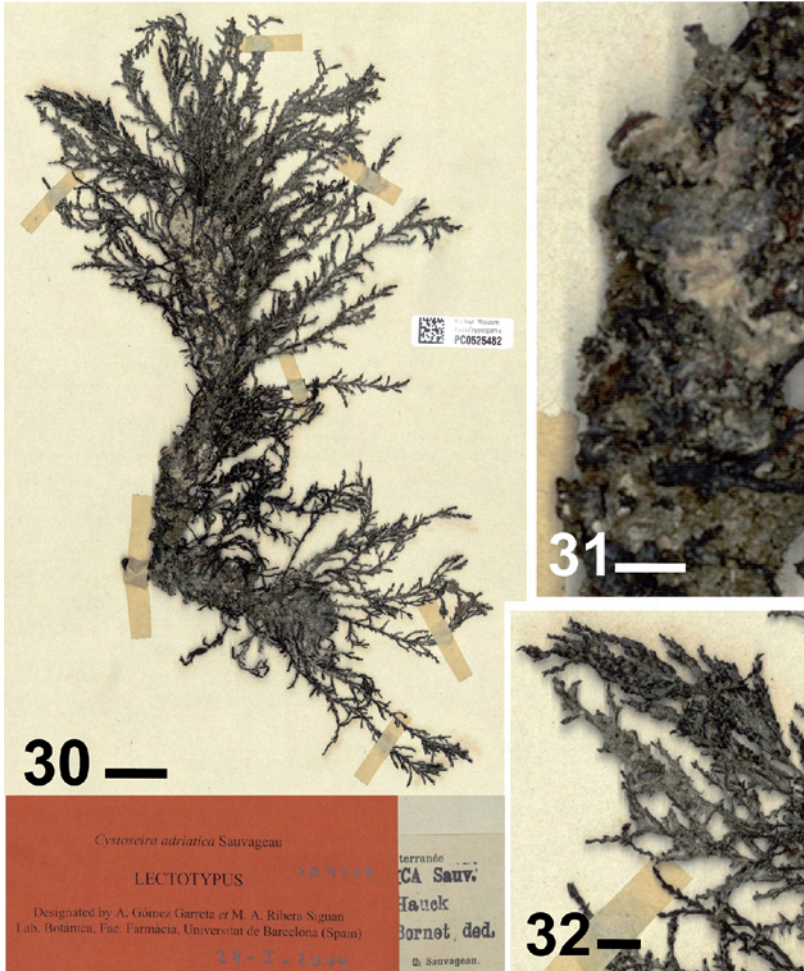
the Algerian coast. Currently, *C. michaelae* seems to be an endemic species restricted to Algeria and northern Tunisia (Cyrine Bouafif, pers. com.).

Cystoseira forests are highly impacted due to the cumulative effects of increasing human pressure (e.g. destruction of habitats, pollution, non-indigenous species, overfishing, coastal aquaculture and global warming). Losses have been reported throughout the Mediterranean Sea caused by habitat destruction, eutrophication and overgrazing by herbivores (fish, sea urchins), leading to a shift to lesser structural complexity, such as turf-forming seaweed assemblages or barren



Figs 27-29. Lectotype of *Cystoseira spinosa* Sauvageau, Banyuls-sur-Mer, Pyrénées-Orientales, France, 6 May 1907, PC (Herbarium Général, collection C. Sauvageau), barcode PC0525446, by courtesy of the MNHN-Paris ©. **27.** Habit; bar = 2 cm. **28.** Detail of spinose tophules; bar = 5 mm. **29.** Detail of the upper part of branchlets with receptacles; bar = 5 mm.

grounds where sea urchins are the drivers of habitat homogenization (Thibaut *et al.*, 2005, 2015; Blanfuné *et al.*, 2016a,b). Protective measures should be taken so that the *C. michaelae* forests do not suffer the same decline as many *Cystoseira* forests of the Mediterranean Sea.



Figs 30-32. Lectotype of *Cystoseira adriatica* Sauvageau, Trieste, Italy, May 1909, SA4729, PC (Herbarium Général, collection C. Sauvageau), barcode PC0525482, by courtesy of the MNHN-Paris ©. **30.** Habit; bar = 2 cm. **31.** Detail of spinose tophules; bar = 5 mm. **32.** Detail of the upper part of branchlets with receptacles; bar = 5 mm

Nomenclature

***Cystoseira michaelae* M. Verlaque, A. Blanfuné, C.F. Boudouresque, T. Thibaut & L.N. Sellam nom. et stat. nov.**

Replacement name for *C. granulata* C. Agardh var. *turneri* Montagne. Montagne (1838) – Cryptogames algériennes, ou plantes cellulaires recueillies par M. Roussel aux environs d'Alger, et publiées par le Docteur Camille Montagne. *Annales des Sciences Naturelles, Botanique* série 2, 10, p. 278 + Suppl. pp. 340-342. **Lectotype** (designated here): PC/Montagne Herbarium, barcode PC0043663, labelled '*Cystoseira granulata* L. Turner var. *turneri* Montagne – Alger n° 397 – Com. Class. Monnard' (Fig. 22). The lectotype was chosen, among the syntype

(7 specimens that predate the protologue) (Table 1), because it is the most similar to the fertile specimen illustrated by Montagne (1846: Plate 4, Fig. 2a-h) (reproduced here as Fig. 21).

Type locality: On the sheet of the lectotype: Algiers (Algeria). However, in the protologue, Montagne (1838) mentions ‘*propè Juliam Caesaream*’ (near Cherchell, ~80 km West of Algiers). We therefore consider that the type locality is Cherchell.

Illustrations: Montagne (1846, Algiers, Plate 4, Fig. 2a-h, misnamed as *Cystoseira montagnei* J. Agardh) (reproduced here as Fig. 21); Kützing (1860, leg. C. Montagne, Algeria, Plate 31, Fig. II, misnamed as *Phyllacantha montagnei* Kg. and Plate 32, Fig. I, as *Phyllacantha montagnei* Kg. var. *cirrosa*).

Etymology: The epithet ‘*michaelae*’ honors Michèle Perret-Boudouresque, a French phycologist, curator of the library and HCOM macroalgae herbarium of the Mediterranean Institute of Oceanography (MIO), Marseille, France.

***Cystoseira montagnei* J. Agardh**

Reference: J.G. Agardh (1842). *Algae maris Mediterranei et Adriatici, observationes in diagnosing specierum et dispositionem generum*. pp. [i-x], 1-164. Apud Fortin, Masson & Cie, Parisiis [Paris]: pp. 47-48.

Lectotype (designated here): LD J.G. Agardh herbarium, code LD00528, labelled ‘*Cystos. montagnei* J. Ag. – 00528 – *In littus ad Cette ejectum, maj 1837*’ (Figs 23-26). The lectotype was chosen, among the syntype (9 specimens that predate the protologue) found in J.G. Agardh collections by Patrick Froden, Assistant curator of the Botanical Museum (LD) of Lund University (Table 1), because it is a representative fertile specimen agreeing with the protologue.

Heterotypic synonyms: *Cystoseira spinosa* Sauvageau (Sauvageau, 1912: 201-220). *C. adriatica* Sauvageau (Sauvageau, 1912: 249-251). Some other possible synonyms are evoked by e.g. Sauvageau (1912), Cormaci *et al.* (1992, 2012) and Guiry & Guiry (2017): their discussion is beyond the scope of the present study.

***Cystoseira montagnei* J. Agardh var. *compressa* (Ercegović) M. Verlaque, A. Blanfuné, C.F. Boudouresque, T. Thibaut & L.N. Sellam comb. nov.**

Basionym: *Cystoseira adriatica* Sauvageau ssp. *compressa* Ercegović (Ercegović, 1952: 107; icon.: Plate IX).

Synonyms: *Cystoseira adriatica* Sauvageau var. *compressa* (Ercegović) Giaccone in Amico *et al.* (Amico *et al.*, 1985: 906). *Cystoseira platyramosa* Ercegović (Ercegović, 1952: 108; icon.: Plate XIII and Fig. 15). *Cystoseira adriatica* Sauvageau ssp. *intermedia* Ercegović (Ercegović, 1952: 108; icon.: Plate XIb). *Cystoseira adriatica* Sauvageau var. *intermedia* (Ercegović) Giaccone in Amico *et al.* (Amico *et al.*, 1985: 906). *Cystoseira spinosa* Sauvageau var. *compressa* (Ercegović) Cormaci *et al.* (Cormaci *et al.*, 1992: 30).

***Cystoseira montagnei* J. Agardh var. *tenuior* (Ercegović) M. Verlaque, A. Blanfuné, C.F. Boudouresque, T. Thibaut & L.N. Sellam comb. nov.**

Basionym: *Cystoseira adriatica* Sauvageau ssp. *tenuior* Ercegović (Ercegović, 1952: 107; icon.: Plate XII and Figs 13-14).

Synonyms: *Cystoseira adriatica* Sauvageau f. *tenuior* (Ercegović) Giaccone in Amico *et al.* (Amico *et al.*, 1985: 906). *Cystoseira adriatica* Sauvageau ssp. *reducta* Ercegović (Ercegović, 1952: 108; icon.: Plate X and XIa). *Cystoseira adriatica* Sauvageau f. *reducta* (Ercegović) Giaccone in Amico *et al.* (Amico *et al.*, 1985: 906). *Cystoseira adriatica* Sauvageau var. *intermedia* (Ercegović) Giaccone in Amico *et al.* (Amico *et al.*, 1985: 906). *Cystoseira spinosa* Sauvageau var. *tenuior*

(Ercegović) Cormaci *et al.* (Cormaci *et al.*, 1992: 30). Some other possible synonyms are evoked by Cormaci *et al.* (1992, 2012) and Guiry & Guiry (2017): their discussion is beyond the scope of the present study.

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