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First report of *Cystoseira squarrosa* De Notaris (Fucophyceae, Fucales) from Spanish coastal waters

Thierry THIBAUT [a] and Enric BALLESTEROS [b]*

[a] Laboratoire Environnement Marin Littoral, EA 3156 « Gestion de la Biodiversité », Université de Nice-Sophia Antipolis. 06108 Nice cedex 2, France

[b] Centre d'Estudis Avançats de Blanes (CSIC), Acc. Cala Sant Francesc 14, 17300 Blanes, Girona, Spain

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Abstract – *Cystoseira squarrosa* (Fucophyceae, Fucales), a rare Mediterranean endemic, is reported for the first time from Spanish coastal waters (Fenals, Lloret de Mar, Girona), where it was growing on a rocky substratum at 8 m depth. This is now the only known locality of *C. squarrosa* in the North-Western Mediterranean, after its almost sure extinction at the sites from where it was described in the 1840's (Nice, Genova).

***Cystoseira* / Fucophyceae / Fucales / distribution / Mediterranean / Spain / new record**

Résumé – Première récolte de *Cystoseira squarrosa* De Notaris (Fucophyceae, Fucales) dans les eaux côtières espagnoles. *Cystoseira squarrosa* (Phaeophyceae, Fucales), espèce très rare, endémique de Méditerranée, a été récoltée pour la première fois dans les eaux côtières espagnoles (Fenals, Lloret de Mar, Girona). L'espèce se développe sur substrat rocheux à 8 mètres de profondeur. À l'heure actuelle, cette localité est la seule connue de Méditerranée Nord-Occidentale, après la disparition de l'espèce dans les localités où elle fut décrite dans les années 1840 (Nice, Gênes).

***Cystoseira* / Fucophyceae / Fucales / distribution / Méditerranée / Espagne / nouvelle signalisation**

INTRODUCTION

The genus *Cystoseira* is widespread in the Mediterranean Sea, where it is often a major component of the underwater landscape in shallow to moderately deep coastal waters all over the basin. Nevertheless, most of the populations of *Cystoseira* spp. are undergoing a general decline due to pollution, habitat destruc-

* Correspondence and reprints: thibautt@unice.fr
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tion, or overgrazing by sea-urchins (Verlaque, 1987; Boudouresque *et al.,* 1990; Rodríguez-Prieto & Polo, 1996; Cormaci & Furnari, 1999; Benedetti-Cecchi *et al.*, 2001; Soltan *et al.,* 2001; Ballesteros *et al*., 2002). Also, most species of *Cystoseira* are Mediterranean endemics and some of them have been infrequently reported. Amongst these species, *Cystoseira squarrosa* De Notaris (Fucophyceae, Fucales) has been rarely observed in the Western Mediterranean. The first observations date back to the original description by De Notaris (1841: 200) from Nice (France) and also by De Notaris (1842) from Genova (Italy). However, a recent study by Alongi *et al*. (2002) stated that the alga had disappeared from both sites. According to these authors, the alga was now only known to occur with certainty on the shores of Palermo (Sicily, Italy) (Giaccone *et al.,* 1986), and some localities from the Adriatic Sea (Ercegovic, 1952; Alongi *et al.,* 2002). Here, we report on a small population of *Cystoseira squarrosa* found on the northern coast of Spain.

MATERIAL EXAMINED

Thirty four dispersed individuals of *Cystoseira squarrosa* were found thriving in a photophilic algal community over rocks emerging from the predominantly sandy bottom two hundred metres offshore from the southern part of the beach of Fenals (41° 41' 22" N – 2° 49' 42" E, Lloret de Mar, Girona, Spain), at 8 metres depth. Dominant species in August were the encrusting coralline alga *Lithophyllum incrustans* Philippi and the erect algae *Halopteris scoparia* (Linnaeus) Sauvageau, *Dictyota dichotoma* (Hudson) Lamouroux var. *intricata* (C. Agardh) Greville, *Corallina elongata* Ellis & Solander, *Padina pavonica* (Linnaeus) Thivy, *Codium vermilara* (Olivi) Delle Chiaje and *Flabellia petiolata* (Turra) Nizamuddin. *Cystoseira squarrosa* was highly epiphytized by *Haliptilon virgatum* (Zanardini) Garbary & Johansen, *Jania corniculata* (Linnaeus) Lamouroux and *Rhodymenia ardissonei* J. Feldmann. The upper part of the branches were heavily grazed by the fish *Sarpa salpa* (Linnaeus). Patches of the seagrass *Posidonia oceanica* (Linnaeus) Delile developed in the vicinity of the rocks.

As only a small number of individuals of *C. squarrosa* were found, we limited our collection to 3 specimens (15th May, 8th July, 22th August 2003), which were fixed in 5% formalin:seawater and deposited in the herbarium E. Ballesteros, hosted at the Centre d'Estudis Avançats de Blanes (CEAB)-CSIC, Blanes, Girona, Spain.

Description of herbarium-deposited material

The thalli are rigid, coriaceous, bushy, 6-7.5 cm high, attached to the rock by a distinctive large basal disc (2 cm diameter) provided with a single short primary axis, from which several (up to 4) secondary axes arise almost at right angles (Fig. 1A). The appendages located on the basal part of the branches are always sterile and the apical parts are bifid. The appendages situated in the terminal part of the branches are more crowded, overlapping, becoming tri- or multifid and bearing the conceptacles, which are always grouped at the base of the spinose appendages (Fig. 1B). Primary branches are abundant, simple or divided into secondary and tertiary branches. All branches are terete or flattened when young and

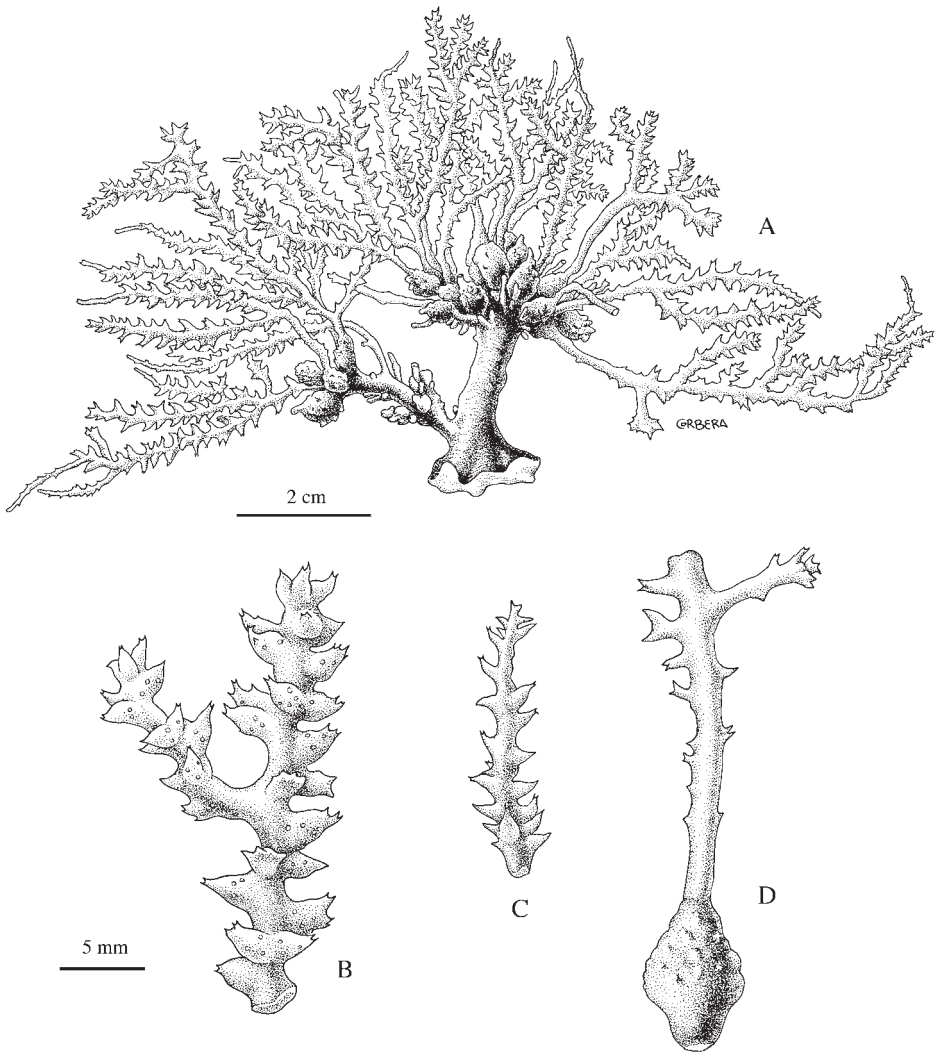

Fig. 1. *Cystoseira squarrosa*: **A,** habit of a specimen collected in August 2003 (Fenals, Lloret de Mar, Girona, Spain); **B**, apex of a branch with receptacles; **C**, apex of a sterile branch; **D**, detail of tophule and basal part of a primary branch (drawings by Jordi Corbera).

in the basal part of the thallus, up to 2 mm wide. Some of these flattened branches, abundant in July, range from a single flat branch to a more complex branch with a basal cylindrical part followed by a divided flat spiny part with a central midrib. Branches of all orders are provided with triangular, robust spinose appendages (Fig. 1C). The longest axis bears scars of old, detached, secondary axes. The apices of the axes are smooth and slightly prominent, bearing in summer a crown of tophules. Tophules are 5-8 mm long, oblong, spiny when young, warty when old (Fig. 1D).

DISCUSSION

There has been some controversy about the validity of *Cystoseira squarrosa* as a distinct species (Amico *et al.,* 1986). Nevertheless, recent chemical (Amico *et al.,* 1988) and morphological data (Alongi *et al.,* 2002) seem to support its maintenance at species level. The morphology of our specimens is in agreement with morphological observations made by Sauvageau (1912), Ercegovic (1952) and Alongi *et al*. (2002) and, in the absence of molecular data to the contrary, we also consider it specifically distinct from other related species (e.g. *Cystoseira spinosa* Sauvageau, *Cystoseira algeriensis* J. Feldmann). The specimens observed in Fenals occur at greater depths than those described by Ercegovic (1952) (1 m depth) and Alongi *et al.* (2002) (from 1 to 3 m depth). As *Cystoseira squarrosa* was unknown from Catalonia (Ballesteros, 1990), the Côte des Albères (French Catalonia) (Sauvageau, 1912; Feldmann, 1937; Gros, 1978; Boudouresque *et al.,* 1984) and Spain (Gómez-Garreta *et al.,* 2001), and since it has disappeared from Nice and Genova (Alongi *et al.,* 2002), Fenals is now the only known locality for the species in the North-western Mediterranean.

The population of *Cystoseira squarrosa* from Fenals is relatively protected from the main anthropogenic disturbances that are apparently causing the decline of *Cystoseira* in the Mediterranean. Although the Fenals area is close to several important tourist destinations, residual waters are treated, and water clarity and dissolved nutrient concentration in seawater are normal for Mediterranean coastal waters (Ballesteros *et al.,* 1999). Also, there are no projects for harbour or marina developments in the proximity of the population site (R. Sardá, pers. com.). Finally, overgrazing by sea urchins (*Paracentrotus lividus* Lamarck.) is limited, since the rocks are surrounded by sandy areas that prevent migration of sea urchins from the neighbouring seagrass beds. Intense grazing of *Cystoseira squarrosa* and other erect algae by *Sarpa salpa* has been observed during our dives; however, complete detachment of *Cystoseira squarrosa* by these fish is unlikely.

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