

First record of *Osmundea oederi* (Gunnerus) G. Furnari comb. nov. (Rhodomelaceae, Rhodophyta) from the Mediterranean Sea

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Abstract – The first documented occurrence of *Osmundea oederi* (Gunnerus) G. Furnari comb. nov. in the Mediterranean Sea is reported from the Gulf of Taranto (Italy). A comparison with the morphologically similar species *O. truncata* and other species of *Osmundea* with compressed thalli and secondary pit-connections between epidermal cells occurring in the Mediterranean Sea, is presented. The conspecificity of the Caribbean *Laurencia bolivarii* with *O. oederi* is also proposed.

Mediterranean Sea / *Osmundea oederi* / Rhodomelaceae / Rhodophyta / Taranto

Résumé – Premier report d'*Osmundea oederi* (Gunnerus) G. Furnari comb. nov. en mer Méditerranée. La présence d'*Osmundea oederi* (Gunnerus) G. Furnari comb. nov. est signalée pour la première fois en Méditerranée dans le Golfe de Tarante (Italie). *O. oederi* est comparé avec *O. truncata*, espèce morphologiquement voisine, et avec d'autres espèces d'*Osmundea* présentes en Méditerranée et pourvues de thalles comprimés et de synapses secondaires entre les cellules de l'épiderme. *Laurencia bolivarii* des Caraïbes est conspécifique d'*O. oederi*.

Mer Méditerranée / *Osmundea oederi* / Rhodomelaceae / Rhodophyta / Golf de Tarante

INTRODUCTION

In the Mediterranean Sea, the *Laurencia* complex is represented by 20 taxa at specific and infraspecific levels (Table 1), belonging to the genera *Laurencia* (Hudson) J.V. Lamouroux, *Osmundea* Stackhouse, *Chondrophyucus* (Tokida & Saito) Garbary & J. Harper and *Palisada* (Yamada) K.W. Nam.

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Table 1. Taxa of the *Laurencia* complex recorded to date from the Mediterranean Sea.

Taxon	References
<i>Chondrophycus patentirameus</i> (Montagne) K.W. Nam	Furnari <i>et al.</i> (2001)
<i>Chondrophycus tenerrimus</i> (Cremades) G. Furnari, Boisset	Furnari <i>et al.</i> (2002)
<i>Chondrophycus thuyoides</i> (Kützing) G. Furnari	Furnari <i>et al.</i> (2001)
<i>Laurencia caduciramulosa</i> Masuda & Kawaguchi	Furnari <i>et al.</i> (2001)
<i>Laurencia chondrioides</i> Børgesen	Furnari <i>et al.</i> (2001)
<i>Laurencia epiphylla</i> Boisset & Lino	Furnari <i>et al.</i> (2001)
<i>Laurencia glandulifera</i> (Kützing) Kützing	Furnari <i>et al.</i> (2001)
<i>Laurencia intricata</i> J.V. Lamouroux	Furnari <i>et al.</i> (2001)
<i>Laurencia majuscula</i> (Harvey) Lucas	Furnari <i>et al.</i> (2001)
<i>Laurencia microcladia</i> Kützing	Furnari <i>et al.</i> (2001)
<i>Laurencia minuta</i> Vandermeulen, Garbary & Guiry subsp. <i>scammaccae</i> G. Furnari & Cormaci	Furnari <i>et al.</i> (2001)
<i>Laurencia obtusa</i> (Hudson) J.V. Lamouroux	Furnari <i>et al.</i> (2001)
<i>Laurencia pyramidalis</i> Bory <i>ex</i> Kützing	Serio <i>et al.</i> (2004)
<i>Osmundea maggsiana</i> Serio, Cormaci <i>et</i> G. Furnari	Furnari <i>et al.</i> (2001)
<i>Osmundea pelagiensis</i> G. Furnari	Furnari <i>et al.</i> (2001)
<i>Osmundea pelagosae</i> (Schiffner) K.W. Nam	Furnari <i>et al.</i> (2001)
<i>Osmundea pinnatifida</i> (Hudson) Stackhouse	Furnari <i>et al.</i> (2001)
<i>Osmundea truncata</i> (Kützing) K.W. Nam & Maggs	Furnari <i>et al.</i> (2001)
<i>Osmundea verlaquei</i> G. Furnari	Furnari <i>et al.</i> (2001)
<i>Palisada papillosa</i> (C. Agardh) K.W. Nam	Furnari <i>et al.</i> [2001 as <i>Chondrophycus papillosus</i> (C. Agardh) Garbary & J. Harper]

Phylogenetic relationships within the *Laurencia* complex were studied by Nam (2006). The only Mediterranean species in the 2006 study, *Chondrophycus papillosus*, subsequently was ascribed to the newly validated genus *Palisada* (Nam, 2007).

In the course of a floristic study of the Mar Piccolo of Taranto (southern Italy, Ionian Sea), tetrasporic, male and female specimens of *Osmundea oederi* (Gunnerus) G. Furnari comb. nov. were found. This species was considered by Athanasiadis (1996, as *O. ramosissima* Athanasiadis *nom. illeg.*; see below) to be conspecific with *O. truncata*, a species widely distributed throughout the Mediterranean Sea. Nam *et al.* (2000) demonstrated, however, that *O. truncata* is distinct from *O. ramosissima* (= *O. oederi*). According to Nam *et al.* (2000), *O. ramosissima* (= *O. oederi*) occurred only in the NE Atlantic (France, Britain, Ireland, Helgoland and West Norway), and hence all the Mediterranean records of *O. ramosissima* (= *O. oederi*) were considered to represent *O. truncata* (Furnari *et al.*, 2001; Furnari *et al.*, 2003). Our present finding represents the first documented record of *Osmundea oederi* in the Mediterranean Sea.

MATERIAL AND METHODS

Investigations were carried out on tetrasporic, male and cystocarpic specimens collected at 0.5 m depth in January and February 2007 in the Mar Piccolo of Taranto (Fig. 1) by Cecere and Petrocelli. Observations were made on specimens-preserved in a 4% formaldehyde-seawater solution. Herbarium specimens are held at the Department of Botany of the University of Catania (CAT 2064 and 2690) and at the Herbarium of the Istituto Sperimentale Talassografico of Taranto (TAR 219 and 221). The following additional herbarium specimens were also examined: male and tetrasporic thalli (CAT 1151 and 1153, respectively) collected on 14/x/1987 in the Mar Piccolo of Taranto by Cecere and labelled as *O. truncata*.

Herbarium abbreviations follow Holmgren *et al.* (1990). For microscopic observations, some specimens were stained with 1% aqueous aniline blue acidified with dilute HCl, which enhances pit connections. Photographs were made by a Nikon D1 digital camera and mounted using Adobe Photoshop 6.0.

RESULTS

Thalli are epilithic, brown to reddish brown, up to 10 cm high, soft in texture, compressed throughout, except near the base of axes and in ultimate

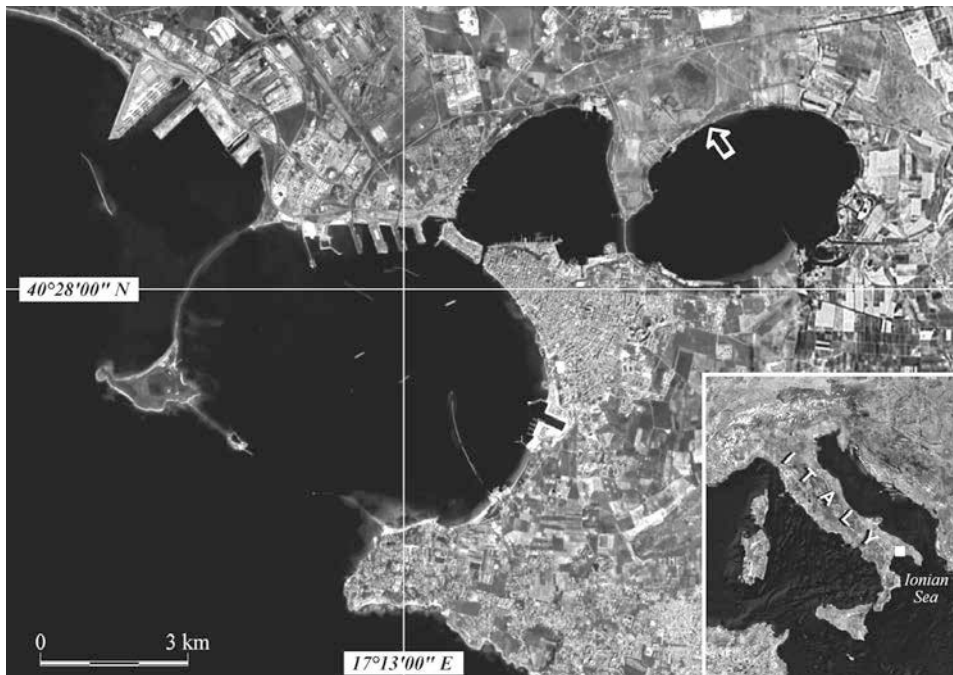


Fig. 1. Location of the collection site (arrow).

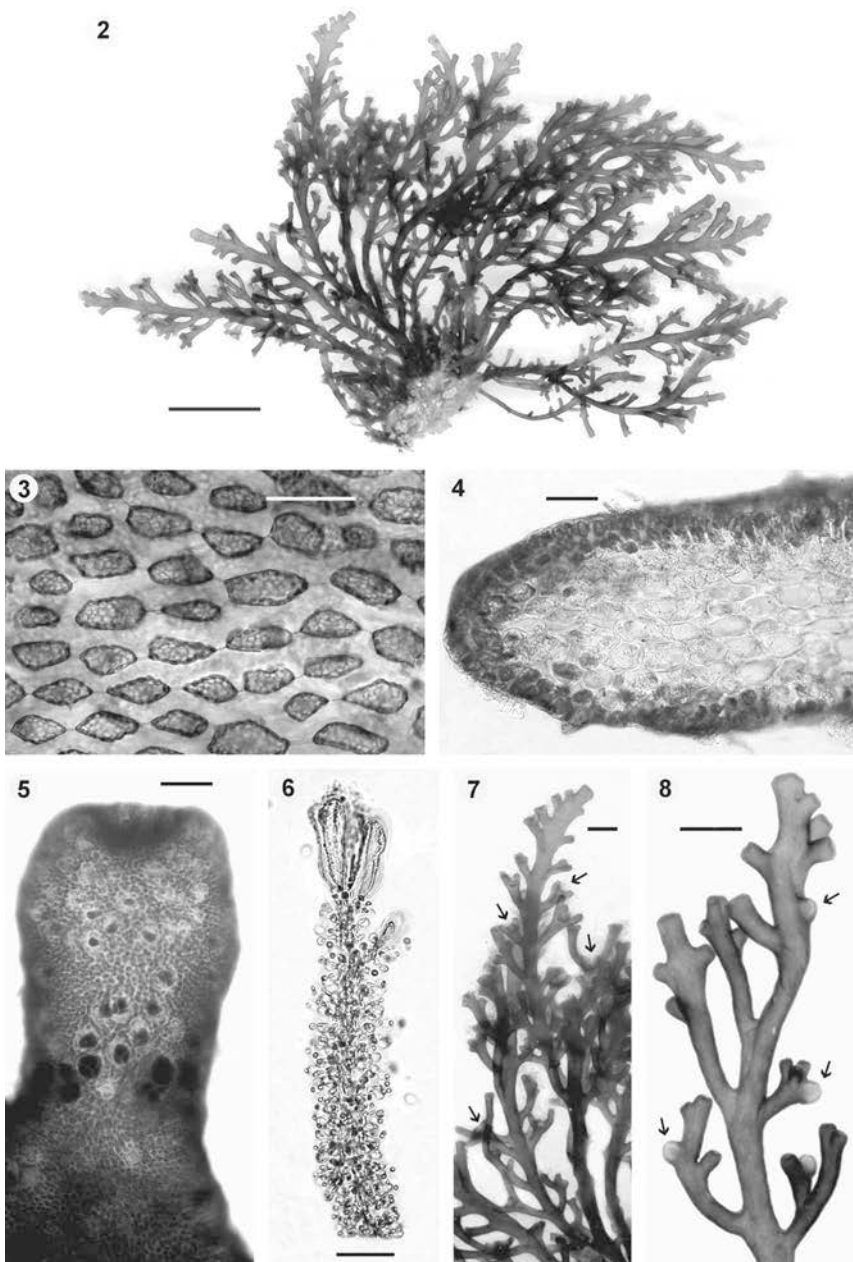
branchlets which are terete (Fig. 2). Axes, up to 1.5 mm in diameter, arise from a discoid holdfast, are irregularly ramified and bear distichous, alternately or suboppositely arranged branches. In surface view, epidermal cells, with secondary pit-connections (Fig. 3), are elongate in basal to median parts of the thallus (50-60 μm long \times 10-13 μm wide) and more or less isodiametric (25-30 μm long \times 15-25 μm wide) near the apex. In transverse section, they are isodiametric and palisade-like (Fig. 4). Medullary cells do not show lenticular thickenings (Fig. 4). Two pericentral cells are produced from each axial cell. Tetrasporangia are produced randomly (Fig. 5) from epidermal cells and are cut off from the mother cells laterally. The two presporangial cover cells are aligned parallel to the stichidial axis in surface view. Male reproductive structures are of the filament-type, with spermatangial branches unramified or 1-2 alternately ramified. They usually terminate in a cluster of large vesicular sterile cells, 60-80 (100) μm high \times 25-35 μm wide (Fig. 6), and are inserted in cup-like depressions, slightly sunken, and located at the bifurcation of branchlets (Fig. 7). Cystocarps, distributed in the middle to subapical parts of branches, are ovoid, 600-650 μm high \times 620-700 μm wide, with non protuberant ostioles (Fig. 8).

Nomenclature

Athanasiadis (1996: 119) proposed the new combination *Osmundea ramosissima* (Oeder) Athanasiadis (basonym *Fucus ramosissimus* Oeder, 1766: pl. 276), on the erroneous premise that Oeder's "*Fucus, ramosissimus, ramis vagis approximatis teretibus, vesicis solidis, sparsis, caulinis*" is a validly published name. Lyngbye (1819) and C. Agardh (1822) also made such an incorrect interpretation, transforming Oeder's polynomial to the binomial *Fucus ramosissimus*. Lyngbye (1819: 213) treated *Fucus ramosissimus* as a synonym of *Gelidium pinnatifidum* β *angustum* listing the disposition of taxa in Oeder's (1766) *Flora Danica*; and on p. 40 he only mentioned Oeder's pl. 276 but not a name. C. Agardh (1822: 239) treated *Fucus ramosissimus* as a synonym of *Chondria pinnatifida*. Therefore, according to Art. 34.1 of ICBN-Vienna Code (McNeill *et al.*, 2006), neither the Lyngbye nor the Agardh transformed binomials are validly published, because they are merely cited as synonyms.

By contrast, Gunnerus (1772), Hornemann (1827), Lange (1887) as well as Nam *et al.* (2000), McIvor *et al.*, (2002) and P.C. Silva (personal communication) have correctly interpreted Oeder's "*Fucus, ramosissimus, ramis vagis approximatis teretibus, vesicis solidis, sparsis, caulinis*" as a polynomial and consequently not validly published according to Art. 23.1 of ICBN-Vienna Code (McNeill *et al.*, 2006). On this basis, Nam *et al.* (2000) stated that *O. ramosissima* should be considered a new species described by Athanasiadis. Nam *et al.* (2000) were unaware, however, that *O. ramosissima* Athanasiadis is a superfluous name according to Arts 52.1 and 52.2 of ICBN-Vienna Code (McNeill *et al.*, 2006) because the names of earlier validly described species are cited as synonyms by Athanasiadis (1996).

Later, McIvor *et al.* (2002) stated that *Fucus oederi* Gunnerus (1772) is the earliest available name for "*O. ramosissima*". However, the combination in *Osmundea* could not be made in that paper, which appeared in the online journal *Costancea*. In fact, Art. 29 of ICBN (Greuter *et al.*, 2000; McNeill *et al.*, 2006) specifically states that online publication is not effective for nomenclatural purposes. Therefore, the following new combination is proposed here:



Figs 2-8. *Osmundea oederi*. **2.** Habit. Scale bar = 2 cm. **3.** Epidermal cells in surface view showing secondary pit connections. Scale bar = 50 μm . **4.** Transverse section of an axis showing medullary cells without lenticular thickenings. Scale bar = 100 μm . **5.** Detail of a stichidial branchlet showing randomly disposed tetrasporangia. Scale bar = 2 mm. **6.** Spermatangial branch terminating in a cluster of elongate vesicular sterile cells. Scale bar = 50 μm . **7.** Male gametophyte with cup-like spermatangial depressions (arrows). Scale bar = 2 mm. **8.** Female gametophyte with cystocarps (arrows). Scale bar = 2 mm.

***Osmundea oederi* (Gunnerus) G. Furnari, comb. nov.**

Basionym: *Fucus oederi* Gunnerus, *Flora norvegica*...2: 100 (1772).

Lectotype: "*Fucus ramosissimus*" Oeder, *Flora Danica*: plate 276 (1776).

Epitype: "*Fucus ramosissimus*" collected by M. N. Blytt, 1833 at Stavanger (Norway), designated by Nam *et al.* (2000: 767 and fig. 30); epitype deposited in O (the Botanical Museum of Oslo).

Synonym: *Osmundea ramosissima* Athanasiadis, *Taxonomisk litt*...119 (1996) *nom. illeg.*

DISCUSSION

Most of the characters of the Italian thalli are in agreement with the description of *Osmundea oederi* as provided by Nam *et al.* (2000, as *O. ramosissima*) for NE Atlantic specimens as well as with the epitype, except for minor features such as the size of vesicular cells in male structures [60-80 (100) μm high \times 25-35 μm wide in Mediterranean specimens vs. 40-50 μm \times 30-40 μm in NE Atlantic specimens] and of cystocarps (600-650 μm high \times 620-700 μm wide in Mediterranean thalli vs 800-1300 μm \times 800-1300 μm in NE Atlantic specimens). This species is morphologically very similar to *O. truncata*, from which it is almost indistinguishable when sterile. *O. oederi* differs from *O. truncata* by: i. the absence of lenticular thickenings in the medullary cells (abundantly present in *O. truncata*); ii. the absence of refractive needle-like inclusions in medullary cells (present in *O. truncata*); iii. cystocarps ovoid without protuberant ostioles (urceolate with protuberant ostioles in *O. truncata*); iv. spermatangial branches unramified or 1-2 alternately ramified and usually terminating in a cluster of vesicular sterile cells (spermatangial branches always unramified and terminating in a single large vesicular sterile cell in *O. truncata*).

As mentioned above, to date *Osmundea oederi* was only recorded from Atlantic France (Roscoff), Britain, Ireland, Helgoland and western Norway (Stavanger) (Nam *et al.*, 2000: 761, as *O. ramosissima*), so our finding represents the first documented record of the species from the Mediterranean Sea. However, it should be noted that since the above mentioned re-examined herbarium specimens labelled as *O. truncata* actually belong to *O. oederi*, the species has been present in the Mar Piccolo of Taranto since 1987. Moreover, in agreement with Nam *et al.* (2000), it cannot be excluded that the species recorded from the Gulf of Naples by Falkenberg (1901) as *Laurencia pinnatifida* (Hudson) J.V. Lamouroux, could be referred to as *O. oederi* on the basis of Falkenberg's illustrations (pl. 23: figs 21, 22, 33).

To date, only two other species of *Osmundea* with secondary pit connections between cortical cells are known from the Mediterranean Sea: *O. pelagosae* and *O. verlaquei*. *O. pelagosae* differs from *O. oederi* in having: medullary cells with lenticular thickenings (absent in *O. oederi*), deep and urn-shaped spermatangial receptacles with spermatangial branches only unramified and terminating with a single vesicular sterile cell (cup-like and slightly sunken spermatangial receptacles with spermatangial branches unramified and/or ramified terminating with a cluster of several vesicular sterile cell in *O. oederi*) (Table 2). Moreover, *O. pelagosae* occurs throughout the sublittoral zone (Furnari *et al.*, 2001) while *O. oederi* grows in the midlittoral zone (rarely in the subtidal

Table 2. Comparison of Mediterranean species of *Osmundea* with compressed thallus and secondary pit-connections between epidermal cells.

Species	Vegetative structures				Male structures			Female structure	Habitat	Geographical distribution	References
	Basal system	Lenticular thickenings	Spermatangial branch	Ending of spermatangial branch	Shape of spermatangial depression	Shape of cystocarp	Shape of protuberant ostiole				
<i>Osmundea pelagosae</i>	discoid holdfast	present	unramified	one elongate cell	urn-shaped	ovoid without protuberant ostiole	epiphytic, throughout the sublittoral zone.	Mediterranean		Furnari & Serio, 1993a [as <i>L. pelagosae</i> (Schiffner) Ercegovic]	
<i>Osmundea oederi</i>	discoid holdfast	absent	unramified or ramified	one or a cluster of sphaerical to elongate apical cells	cup-like slightly sunken	ovoid without protuberant ostiole	epilithic or epiphytic in the midlittoral zone (rarely to 7 m depth)	NE Atlantic; Caribbean Sea (as <i>L. bolivarii</i>); Mediterranean		Nam <i>et al.</i> , 2000; this study	
<i>Osmundea truncata</i>	discoid holdfast	present	unramified	one sphaerical cell	cup-like, shallow and broad	urceolate with protuberant ostiole	epiphytic or epilithic in mid- to upper sublittoral zones	NE Atlantic; Mediterranean		Furnari & Serio, 1993b (as <i>L. truncata</i> Kützing); Nam <i>et al.</i> , 1994; Nam <i>et al.</i> , 2000	
<i>Osmundea verlaqueti</i>	spreading crust	absent	unramified or ramified	one or a cluster of elongate apical cells	cup-like slightly sunken	urceolate with more or less protuberant ostiole	epilithic in the lower midlittoral zone	Mediterranean		Cormaci <i>et al.</i> , 1994 (as <i>L. verlaqueti</i> Cormaci <i>et al.</i>); this study	

zone to 7 m depth) (Nam *et al.*, 2000). *O. verlaquei* differs from *O. oederi* in having crustose spreading basal system (discoid holdfast in *O. oederi*) and in urceolate cystocarps with protuberant ostiole (ovoid without protuberant ostiole in *O. oederi*) (Table 2).

Recently, García (2006) examined specimens of *Laurencia bolivarii* N. Rodríguez de Ríos (1981: 4-7, figs 6-9), including the type material from the coast of Venezuela. She demonstrated that they belonged to the genus *Osmundea*, and proposed the new combination *Osmundea bolivarii* (Rodríguez) M. García-Ortiz. However, this new combination is invalid, since the author gave neither the basionym nor its full and direct reference as required by Art. 33.4 of ICBN (McNeill *et al.*, 2006). Moreover, from both the description and iconography, the species seems to correspond to *O. oederi*. In particular, the following characters are shared by the two species: habit; branching pattern; presence of secondary pit-connections between epidermal cell; absence of lenticular thickenings in the wall of medullary cells; spermatangial branches unramified and usually terminating in a cluster of sterile cells, inserted in cup-like depressions, slightly sunken, located at the bifurcation of branchlets; cystocarps ovoid with not protuberant ostiole. Therefore, we conclude that ***Laurencia bolivarii* is a heterotypic synonym of *Osmundea oederi*.**

Finally, the previous known distribution of *Osmundea oederi* suggested a restricted cold water affinity even though the southernmost and northernmost distribution of the species is uncertain due to taxonomic confusion. However, its occurrence in both Venezuela (Caribbean Sea) and the Mar Piccolo of Taranto, a basin with a relatively high sea water temperature, indicates that the species shows a wide range of tolerance to this environmental factor. Moreover, even though due to its occurrence in the Mar Piccolo of Taranto, a basin subject to aquaculture and commercial fishing, *O. oederi* could be considered as an alien species in the Mediterranean Sea, past confusion with *O. truncata* also supports the hypothesis that *O. oederi* could have a wider distribution in the Mediterranean Sea into which it came by natural way.

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