

M. Emilia Croce and Elisa R. Parodi*

The turf-forming alga *Gelidium crinale* (Florideophyceae, Rhodophyta) on Atlantic Patagonian coasts

Abstract: We describe for the first time the morphology of *Gelidium crinale* from its natural habitat in Atlantic Patagonia with special consideration of diagnostic characters. Observations and morphometric measurements were done on fresh specimens using scanning electron and inverted light microscopy. This report is a new record for Atlantic Patagonian coasts. The thalli comprise prostrate and erect axes; they are subterete at the base and compressed to flattened at the apices. The basal parts are scarcely and irregularly branched, while the apical parts are highly ramified and subdichotomously branched. The lengths of thalli and the ramification patterns differ from previous descriptions, and were variable between seasons and life history phases. “Brush-like” haptera confirmed the identity of the algae as members of the Gelidiaceae. Internal rhizoidal filaments are abundant and distributed in groups throughout the medulla. The life history was of the “*Polysiphonia*-type”; occurrences of carposporophytes and tetrasporophytes were variable.

Keywords: cystocarp; haptera; internal rhizoidal filaments; tetrasporangia.

***Corresponding author: Elisa R. Parodi**, CONICET-Bahía Blanca, Laboratorio de Ficología Aplicada, Instituto Argentino de Oceanografía (IADO), Camino Carrindanga 7.5 km, B8000FTN Bahía Blanca, Argentina; and Laboratorio de Ecología Acuática, Departamento de Biología, Bioquímica y Farmacia, Universidad Nacional del Sur, San Juan 670, B8000ICN, Bahía Blanca, Argentina, e-mail: elipapers@criba.edu.ar

M. Emilia Croce: CONICET-Bahía Blanca, Laboratorio de Ficología Aplicada, Instituto Argentino de Oceanografía (IADO), Camino Carrindanga 7.5 km, B8000FTN Bahía Blanca, Argentina

Introduction

The genus *Gelidium* Lamour. comprises several species among which many are of economic importance (Akatsuka 1986, Lembi and Waaland 1988). *Gelidium*

populations are components of intertidal assemblages where they propagate vegetatively and form large turf populations. These extensive turf matrices provide habitats for benthic organisms (Buschmann 1990, Schneider and Mann 1991, Huang et al. 2007) and have an important role in sedimentation processes (Airoldi and Cinelli 1997, Airoldi and Virgilio 1998, Birrel et al. 2005). Turf populations can be dominant and persistent throughout the year depending on vegetative growth patterns (Hay 1981, Scrosati 2006, Copertino et al. 2009, Prathep et al. 2009).

The reliability of diagnostic characters in this group of marine algae has been questioned (Dixon 1961, Maggs and Guiry 1987, Rodriguez and Santelices 1988, Guiry and Womersley 1992, Millar and Freshwater 2005). However, several revisions based on morphology have recognized significant phylogenetic relationships between species, and some of the traditional morphological characters are still considered useful for diagnosis (Fan 1961, Hommersand and Fredericq 1988, Santelices 1990a, Norris 1992, Perrone et al. 2006, Santelices 2007).

Gelidium crinale (Hare ex Turner) Gaillon has been previously recorded on Atlantic Patagonian coasts; however, the only information available includes non-descriptive lists and surveys (Pujals 1963, Sar et al. 1984, Croce and Parodi 2012). The morphology of *Gelidium* species in natural populations has never been examined in this region of the world. In addition, Kim and Boo (2012) have recently indicated the need for morphological and phenological studies of *G. crinale* populations.

In the present study, we exhaustively describe for the first time the vegetative and reproductive morphology of *G. crinale* from its natural habitat on the Atlantic Patagonian coast. We focused on relevant diagnostic characters and the seasonality of external morphology. The aim of this study was to provide reliable data for identifying individuals of *G. crinale* from a particular habitat in Atlantic Patagonia, therefore increasing the available information about the distribution of this species worldwide and contributing to the understanding of the distribution of Gelidiales on Atlantic coasts.

Materials and methods

Collection of specimens was carried out in spring (2009) and summer (2010) in intertidal pools located in *Crassostrea gigas* Thunberg oyster beds in Anegada Bay (40°25'S; 62°25'W) on the north Patagonian Atlantic coast of Argentina. The coast comprises coastal meadows of *Spartina* and tidal flats where *C. gigas* has established large populations (Spalleti 1980, Borges 2006).

Specimens were rinsed with filtered seawater and drained on blotting paper. Observations of external appearance and morphology were made on fresh specimens under a dissecting microscope (Wild Heerbrugg, Gais, Switzerland). Longitudinal and cross sections of erect axes, stolons, tetrasporangial branches, and cystocarps were cut by hand, mounted on microscope slides, and examined with a Nikon Eclipse TE (Nikon, Tokyo, Japan) inverted microscope. Photographs were taken with a Nikon FDX 35 digital camera. For subsequent observations by scanning electronic microscopy (SEM), selected vegetative and reproductive portions and sections of specimens were preserved at 5°C for 2 h in 2.5% glutaraldehyde in seawater with cacodylate buffer. The preserved material was mounted on slides covered with 0.5% poly-D-lysine and dehydrated in a graded acetone series (up to 80%). Samples were critical point dried for 1 h, coated with gold, and observed with a Leo Evo 40 SEM (Cambridge, UK) equipped with a photographic system.

Morphometric measurements were done on algae specimens using a micrometric ocular and/or obtained from photographs using the UTHSCSA Image tool version 3.00 software (developed by University of Texas Health Science Center of San Antonio, San Antonio, TX, USA; ftp://maxrad6.uthscsa.edu, 2011).

The material identified was deposited in the Herbarium of Universidad Nacional del Sur, Argentina: BBB (Croce 63 and 64, LP11-2009), BBB (Croce 65 and 66, LP3-2010).

Results

External appearance

The specimens formed dense assemblages or “turfs”, which were strongly attached to the shells of the native mussel *Brachidontes rodriguezii* d'Orbigny and the exotic oyster *Crassostrea gigas* inside intertidal pools.

The thalli were small, ranging from 1 to 3 cm high (Figures 1–4), and formed by a ramified system of prostrate axes (stolons) from which erect axes arose (Figure 5). Erect axes were dark red to black and had a wiry consistency.

The apices of erect axes were acute and usually truncated with up to seven branches regenerating from each of them (Figure 6). Apical growth was indicated by a single prominent dome-shaped cell (Figure 7). Erect axes were terete to subterete in basal parts and compressed to flattened in apical parts (Figures 8–10), while stolons were terete (Figure 11). The branching pattern was irregular at the bases of axes, and alternate, opposite, or subdichotomous in the apical portions. The apical parts of the erect axes were more ramified than the basal parts (Figure 12). Branching occurred up to the fourth order.

Algae collected in summer were more developed than in spring, with longer erect axis and more branching at the apices. In spring, the algae were shorter, poorly branched, and had many truncated branches from which regeneration occurred.

The prostrate axes (stolons) were light red to pinkish and attached to the substratum by several haptera located at intervals and usually opposite erect axes (Figures 13–15). Haptera consisted of internal rhizoidal filaments of different lengths protruding from the cortex and formed together a distinct “brush-like” organ (Figures 15 and 16). The mean width of haptera was 0.48 mm (0.18–1.00 mm).

Internal structure

Axes comprised a cortex of small pigmented cells; the cortex was from one to three cells in thickness. There was a medulla of larger cells; the medulla was up to six cells in thickness (Figure 17).

Cortical cells were ovoid to oval with parietal chloroplasts; cortical cells were irregularly distributed in surface view (Figure 18). The mean diameter was 11.6 µm (7.7–16.45 µm) in surface view. Medullary cells were elongate (Figure 19). The arrangement of medullary cells in terete axes was axial, with one small axial cell surrounded by several pericentral cells (Figure 20). Flattened axes had a different distribution of medullary cells; in these shoots, central and pericentral cells were arranged in a row (Figure 21). The mean length of medullary cells was 90.5 µm (48.3–185 µm), and the mean diameter was 17.5 µm (11.1–28.5 µm).

Internal rhizoidal filaments (also known as “rhizines” or “hyphae”) were unicellular, unbranched, and with a thick cell wall. In cross sections, they were observed as bright small cells (Figure 22); they were readily viewed by manual longitudinal tearing of the erect axes, where they appeared protruding from the medulla (Figures 23 and 24). They were abundant, arranged in groups distributed throughout the medulla, and observed as long, narrow filaments (Figures 25 and 26).

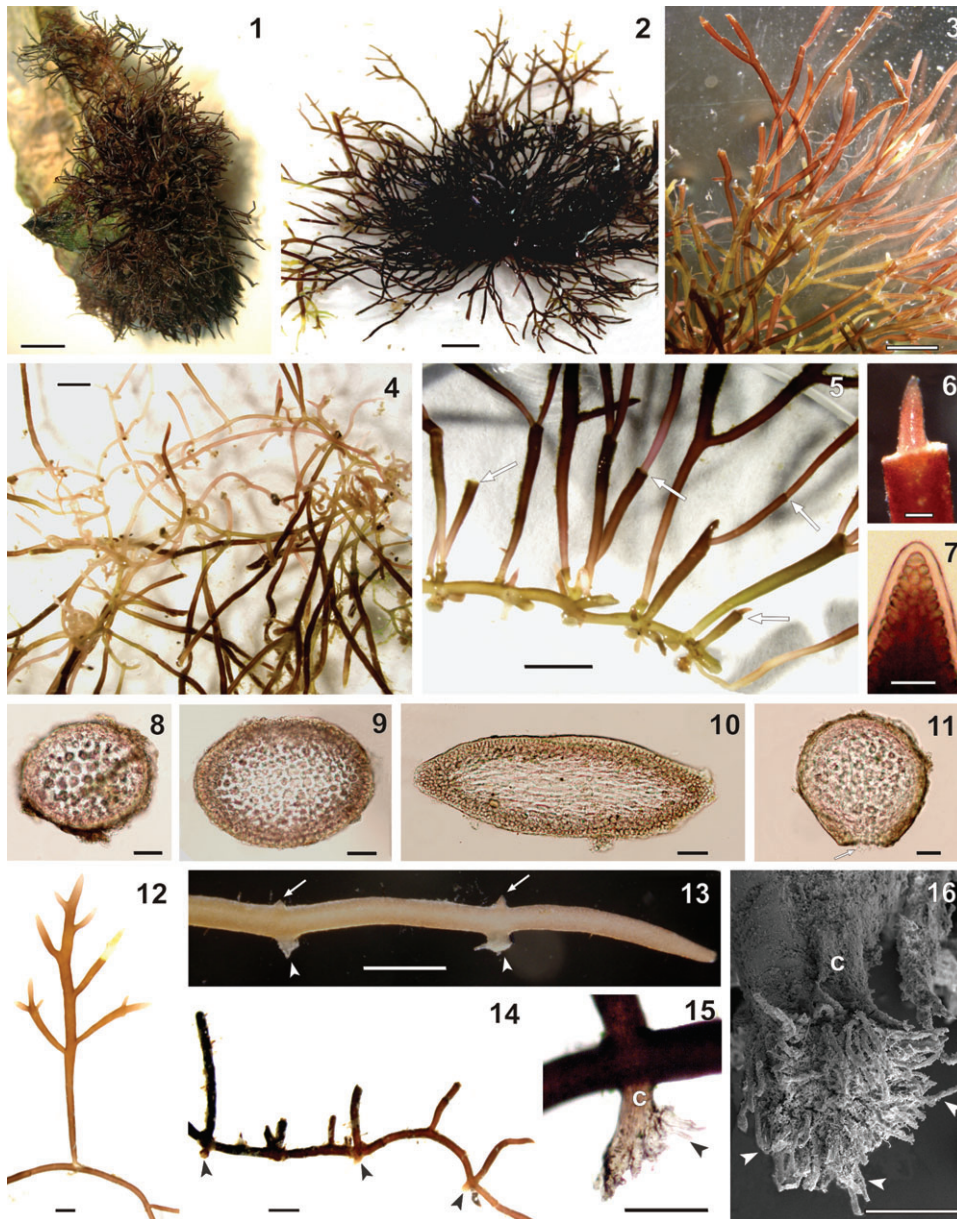
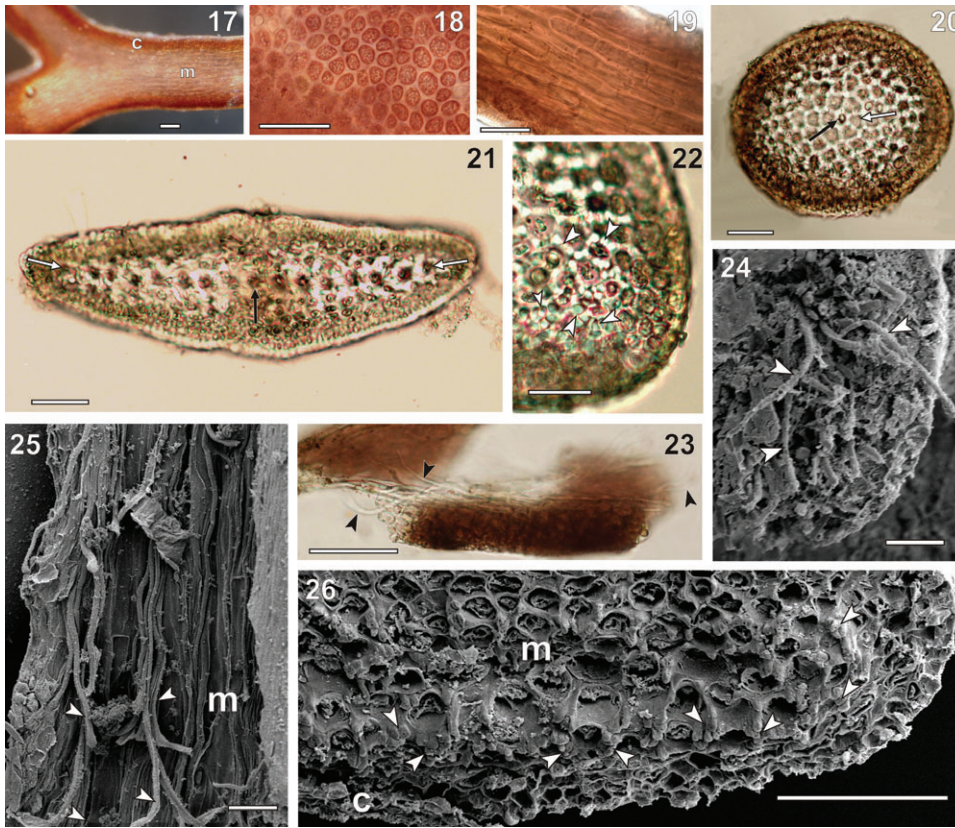


Figure 1–16 *Gelidium crinale*: external appearance. (1) Habit of specimen growing on a *Crassostrea gigas* shell. (2–4) General aspect of the thallus. (5) Detail of erect and prostrate axes (stolons); arrows show truncated axes and regenerated branches. (6) Detail of a regenerated branch. (7) Apice of erect axes showing prominent apical cell with a dome shape. (8–11) Cross sections of (8) terete erect axes, (9) compressed erect axes, (10) flattened erect axes, and (11) stolon. (12) Branching pattern. (13–14) Detail of stolon showing attachment structures (arrowheads) and erect axis initials (arrows). (15–16) “Brush-like” haptera showing internal rhizoidal filaments (arrowheads) protruding from the cortical cells. (16) Detail of haptera (SEM). c, cortical cells. Scale bars: Figures 1–5, 2 mm; Figures 6 and 7, 100 μ m; Figures 8–11 and 16, 50 μ m; Figures 12–15, 1 mm. Herbarium voucher: BBB (Croce 63 and 64, LP11-2009).

Reproductive morphology

Tetrasporangia were located terminally on erect axes of tetrasporophytes or in short flattened, spatula-shaped branches, usually with three lobes, which were located laterally on erect axes (Figure 27). There was high variability in the shape of tetrasporangial branches. They ranged

from long, narrow, spatulate branches with acute apices, to shorter, wider, multilobulate structures (Figures 28–33). The mean length of the tetrasporangial branches was 5.8 mm (1.9–12.5 mm), and the mean width was 2.2 mm (1.3–3.3 mm). The distribution of tetrasporangia on these branches was irregular; they covered the entire surface up to the margins of the branches. Thus, no sterile margin



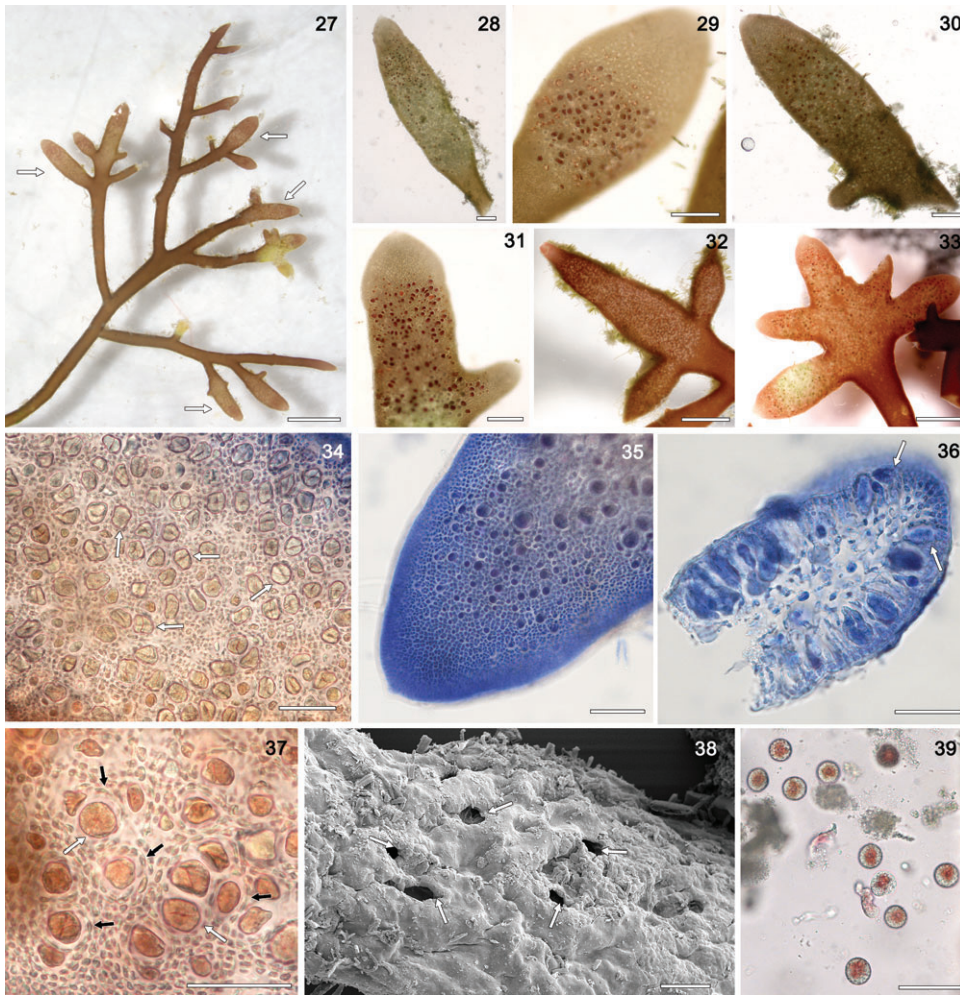
Figures 17–26 *Gelidium crinale*: internal structure. (17) Longitudinal section of erect axes. (18) Cortical cells (surface view). (19) Medullary cells (longitudinal section). (20) Arrangement of medullary cells in terete axes (cross section); black arrow points to the axial cell and white arrows point to a pericentral cell. (21) Arrangement of medullary cells in flattened axes; note the distribution of axial (black arrow) and pericentral cells (white arrows) in a row. (22 and 23) Cross sections of erect axes showing the distribution of internal rhizoidal filaments (arrowheads). (24 and 25) Longitudinal sections of erect axes showing the distribution of internal rhizoidal filaments (arrowheads). (26) Detail of internal rhizoidal filaments in groups located throughout the medulla (arrowheads) (SEM). c, cortical cells; m, medullary cells. Scale bars, 50 μm . Herbarium voucher: BBB (Croce 63 and 64, LP11-2009).

was observable in either surface view or in cross section (Figures 34 and 35). Tetrasporangia developed in the apical direction (Figure 36). Tetrasporangia were solitary or grouped in sori, which were surrounded by cortical cells (Figure 37). The mean diameter of tetrasporangia was 33.1 μm (9.5–77.7 μm). The arrangement of tetrasporangia was cruciate (Figure 37). Tetraspores were released through pores on the tetrasporangial branches (Figure 38) and were spherical with a mean diameter of 38.5 μm (32–42.8 μm) (Figure 39). The pattern of tetraspore release was variable; in some branches, it started in the basal parts and spread up to the apical parts of the branches (Figures 28, 30, and 32), while in others it was uniform without a specific pattern (Figures 29, 31, and 33).

Fertile zones of multifurcate branches of female gametophytes were identifiable by the white branch tips (Figures 40 and 41). Cystocarps were located on flattened branches of female gametophytes, which were alternate to

opposite or on multifurcated branches located terminally on erect axes (Figures 42–44). Cystocarps were globose and bilocular, with locules protruding from both surfaces of the branch (Figures 45–47). The mean thickness of cystocarps (measured between ostioles) was 445.1 μm (356–545.4 μm) in cross section. Each cystocarp had one or two ostioles on each surface (Figure 47). The locules were separated by a septum with placentae paired along both sides of the septum; they developed carpospores on both sides of the placenta surrounded by colorless nutritive filaments (Figure 48). Carpospores were clavate and highly pigmented (Figure 49). The mean length of carpospores was 47.6 μm (31.2–80.7 μm), and the mean diameter was 22.4 μm (11.2–31.3 μm). Male gametophytes were not found.

Female specimens bearing cystocarps and tetrasporophytes were more branched than vegetative thalli, and were more abundant in summer. Tetrasporophytes were more frequent than carposporophytes.



Figures 27–39 *Gelidium crinale*: tetrasporophytes. (27) External aspect; arrows point to tetrasporangial branches. (28–33) Variability of the morphology of tetrasporangial branches. (34) Surface view of tetrasporangial branch showing the irregular distribution of tetrasporangia (arrows) (carmine-acetic and aniline blue staining). (35) Apical part of a tetrasporangial branch showing the progression of tetrasporangia development (carmine-acetic and aniline blue staining). (36) Cross section of tetrasporangial branch. Note the presence of tetrasporangia up to the margins (arrows) (carmine-acetic and aniline blue staining). (37) Detail of cruciately arranged tetraspores in surface view (white arrows); note the cortical cells surrounding the sori (black arrows) (carmine-acetic and aniline blue staining). (38) Surface view of tetrasporangial branch (SEM); arrowheads indicate empty tetrasporangia. (39) Released tetraspores. Scale bars: Figure 27, 2 mm; Figure 28, 1 mm; Figures 29–33 and 39, 100 μ m; Figures 34–37, 10 μ m; Figure 38, 30 μ m. Herbarium voucher: BBB (Croce 65, LP3-2010).

Discussion

The order Gelidiales is poorly represented on Atlantic Patagonian coasts; only two species have been recorded: *Gelidium crinale* off the Malvinas Islands, the Magellanic region, Tierra del Fuego, and Mar del Plata (Harriot 1889, Cotton 1915, Skottsberg 1923, Pujals 1963, Sar et al. 1984), and a species of *Gelidium* in Anegada Bay, which was identified as *G. maggsiae* J.M. Rico et Guiry (Croce and Parodi 2012). In the present study, detailed observations on the vegetative and especially reproductive morphology

of new specimens from the same population revealed that the species we observed was *G. crinale*.

This species is actually considered cosmopolitan and found along the shores of all continents other than the Americas, where it has been recorded only for tropical and subtropical coasts (Kim and Boo 2012). As noted by these authors, the morphology of *G. crinale* has been less studied than that of other *Gelidium* species, and further investigations are required; thus, the present study represents an important contribution for filling knowledge gaps on its distribution in the Americas.



Figures 40–49 *Gelidium crinale*: fertile female gametophytes and carposporophytes. (40) Female gametophyte showing fertile branches (arrows); note the sequence of cystocarp development (a–c). (41) Detail of fertile zone on branches (arrows). (42) Cystocarpic thallus; note the mature cystocarps (arrows). (43–44) Multifurcate lobes on terminal axes bearing cystocarps (arrows). (45) Surface view of cystocarp bearing carpospores (arrows). (46) Cross section of mature cystocarp; the arrows indicate the location of ostioles. (47) Cross section of cystocarp showing three ostioles (arrows). (48) Internal structure of cystocarp showing carpospores developed on both sides of the placenta (arrow); note the longitudinal septum (white arrowheads) and nutritive filaments (black arrowheads). (49) Detail of clavate carpospores. Scale bars: Figures 35 and 37, 2 mm; Figure 36, 100 μm ; Figures 38 and 39, 1 mm; Figures 40–43, 100 μm ; Figure 44, 10 μm . Herbarium voucher: BBB (Croce 66, LP3-2010).

The characters that were traditionally used to distinguish gelidioid taxa included thallus size, axis shape, presence of internal rhizoidal filaments, arrangement of surface cells, and configuration of apical cells (Bailey and Freshwater 1997). At the species level, several authors have used both vegetative and reproductive features for distinguishing *Gelidium* species: thallus size, predominance of erect vs. prostrate systems, branching pattern, shape of erect axes, shape of erect apices, shape of tetrasporangial branches, and arrangement of tetrasporangia (Chapman 1969, Santelices 1977, Santelices and

Stewart 1985, Etcheverry 1986, Millar and Freshwater 2005, Baldock 2010, Huisman and Parker 2011). The reliability of these features has been extensively discussed (Santelices 1990a, Guiry and Womersley 1992, Norris 1992, Perrone et al. 2006). However, some characters are useful for diagnostic purposes, especially those related to reproductive morphology, and were easily observable in our specimens.

The morphology of the specimens we collected fitted the descriptions of *G. crinale* from New Zealand (Chapman 1969), Chile (Etcheverry 1986), the Pacific coast of the

Americas (Santelices and Stewart 1985), Hawaii (Santelices 1977), and Australia (Millar and Freshwater 2005, Baldock 2010, Huisman and Parker 2011). A comparison of the relevant features of *G. crinale* observed in the present study with other descriptions from the Southern Hemisphere is presented in Tables 1 and 2.

The lengths of thalli and the ramification patterns we observed differed to some extent from other descriptions of *G. crinale* (see Table 1). The thallus length of turf algae is a variable feature because it depends on grazing pressure, regeneration capacity, and may be related to life history phases, as seen in our specimens. Variability in morphology in relation to life history phases has also been recorded in other species of Gelidiales; shorter and less ramified thalli appear after tetraspore shedding and apical decay (Santelices 1978).

Some authors have remarked on the differences in the degree of branching and the pattern between the basal and apical portions of *G. crinale* (Santelices 1977, Etcheverry 1986, Millar and Freshwater 2005), with specimens being highly ramified in the apical parts of the thallus. We observed the same morphology in specimens from Anegada Bay. On the contrary, Chapman (1969) described dense branching at the base and sparse branching at the apices of New Zealand specimens. Given the cosmopolitan distribution of this species, high phenotypic plasticity in the branching pattern should be expected in relation to diverse factors such as light, temperature, wave exposure, and grazing (D'Antonio and Gibor 1985, Santelices 1987, Rueness and Fredriksen 1989).

Recent studies have demonstrated that the morphology of the attachment structures on prostrate axes and internal rhizoidal filaments are related characters and have taxonomic value for distinguishing families and genera using traits of vegetative specimens (Perrone et al. 2006, Santelices 2007). The characteristics of the haptera found in our specimens confirmed their affinity with the Gelidiaceae according to the classification proposed by Perrone et al. (2006). “Brush-like” haptera, which are characteristic of Gelidiaceae, were found in all the specimens we analyzed and the typical rhizoidal filaments were visible protruding from the cortex. A very common feature observed in our specimens was the localization of haptera opposite erect axes. Although this character is typical of the Pterocladaceae, it is also common in the Gelidiaceae (Perrone et al. 2006). Internal rhizoidal filaments were similar to those described by Norris (1992) who suggested that may have a structural function in strengthening the thalli. These structures were distributed throughout the medulla but not in the inner cortex, as observed by Millar and Freshwater (2005) in Australian specimens of *G. crinale*.

The organization of medullary cells was similar to other descriptions for this species except in compressed and flattened axes, in which the medullary cells formed a distinct row. This characteristic has been observed in other species of Gelidiales (Fredriksen and Rueness 1990, Guiry and Womersley 1992, Rico and Guiry 1997, Kim et al. 2012) but has not been mentioned before for *G. crinale*; thus, it must be considered in taxonomical studies.

The order Gelidiales is characterized by a “*Polysiphonia*-type” life history, with alternation of isomorphic generations and variable sex ratios, with tetrasporophytes usually predominating over carposporophytes and male gametophytes (Hommersand and Fredericq 1988). As a consequence, reproductive specimens are rarely found in the natural populations, and many of the descriptions of reproductive phases have been based on cultured specimens (Rueness and Fredriksen 1989, Rico and Guiry 1997, Rico et al. 2002). In the present study, only carposporophytes and tetrasporophytes of *G. crinale* were found and their morphology resembled previous descriptions, except for the absence of paired cystocarps (Chapman 1969, Santelices 1977, Santelices and Stewart 1985, Etcheverry 1986, Baldock 2010, Huisman and Parker 2011).

Other studies have demonstrated that the features associated with the development of nutritive systems and carposporophyte are the basis for a natural classification of gelidioid genera (Bailey and Freshwater 1997). The characteristics of the placenta and septum and the distribution of carpospores we observed in *G. crinale* agreed with descriptions of *Gelidium* by Santelices (1991), allowing us to distinguish it from *Pterocladia*. In the present study, nutritive filaments were observed in developed carposporangia; however, the observations were not suitable for diagnosis purposes. Culturing studies might be necessary to determine the development of cystocarpic structures.

Male gametophytes were not found in the present study, and no descriptions of this phase are available in the literature. The presence of developed cystocarps and carpospores was evidence that fertilization had occurred; thus, the fact that males were not found may indicate that they are very rare.

A detailed examination of vegetative and reproductive structures revealed that previously collected thalli of *Gelidium* in Anegada Bay (Croce and Parodi 2012) are in fact *G. crinale*. *Gelidium maggsiae* differs from our specimens of *G. crinale* in size of thalli, flattening of erect branches, frequency of branching, presence of peg-like holdfast, location of rhizoidal filaments in margins of flattened branches, pairing of cystocarps, location of tetrasporangial branches, presence of sterile margins on

Table 1 *Gelidium crinale*: diagnostic vegetative characters from the populations observed in the present study compared with those of other populations from the Southern Hemisphere.

Locality	Maximum size (cm)	Axis shape	Branching	Attachment structures	Cortical cells (μm)	Medullary cells (μm)	Internal rhizoidal filaments	Described in
Atlantic Patagonia	3	Prostrate: terete Erect: terete, compressed and flattened	Irregular at base Alternate and opposite at apices Dichotomous	“Brush-like” (internal rhizoids)	Rounded 7–11	Elongate 48–185×11–28	Narrow, long Thick-walled Abundant in groups throughout medulla	This study
Pacific coasts of South America and Pacific coasts of New Zealand	7	Cylindrical, compressed	Sparse Dichotomous	–	4–6×6–8	6–15	Few in medulla	Santelices and Stewart (1985)
Chile	5	–	Alternate, pinnate	Disc	Cube shaped	–	–	Etcheverry (1986)
New Zealand	5	Erect: subcylindrical	Irregularly alternate, dense at base Irregularly pinnate, sparse at apices	Holdfast	5–16×6–16	–	–	Chapman (1969)
Western Australia	3	Prostrate: cylindrical Erect: cylindrical, compressed	Irregular Intervals 3–10 mm	Holdfast (clumped rhizoids)	Rounded Thin-walled 4–8 μm	–	Throughout medulla (young branches) In outer medulla (old branches)	Huisman and Parker (2011)
Australia	2	Erect: cylindrical, compressed	Irregular	–	Rounded Thin-walled	–	Thick-walled Thread-like	Baldock (2010)
Australia	1.8	Prostrate: cylindrical Erect: cylindrical, compressed, flattened	Distichous Multifurcate tips	Cylindrical “peg” or “brush”	Globose to elliptical	Elongate Thick-walled	Abundant throughout medulla and inner cortex	Millar and Freshwater (2005), “large form”
Australia	0.5	As above, “large form”	Simple	As above, “large form”	As above, “large form”	As above, “large form”	As above, “large form”	Millar and Freshwater (2005), “short form”

Table 2 *Gelidium crinale*: diagnostic reproductive characters from the populations observed in the present study compared with those of other populations of the Southern Hemisphere.

Locality	Tetrasporangial branches	Arrangement of tetrasporangia	Size (μm) and shape of tetrasporangia	Position of cystocarps	Cystocarps	Spermatangia	Described in
Atlantic Patagonia	Flattened Spatulate Occasionally with three lobes	Irregular	9–77 Cruciate	Solitary Subterminal	Globose Bilobular 0.3–0.5 mm 1–2 ostioles each surface	–	This study
Pacific coasts of South America and Pacific coasts of New Zealand	Expanded ends of axes and branches	–	–	–	Ovoid 0.5×0.6 mm 0.5 mm thick	–	Santelices and Stewart (1985)
Chile	Spatulate	–	–	Solitary Occasionally paired	–	–	Etcheverry (1986)
New Zealand	Pinnately disposed Spatulate	–	10–22×13–25	Solitary Occasionally paired Terminal	–	On surface of branchlets	Chapman (1969)
West Australia	Slightly to distinctly compressed Occasionally furcate Occasionally with lobes	Mixed	20–30 Ovoid Decussate cruciate	Subterminal	0.5–0.6 μm	–	Huisman and Parker (2011)
Australia	Flattened ends of small branches	Scattered	Decussate	–	–	–	Baldock (2010)

tetrasporangial branches, and acropetal development of tetrasporangia (Rico and Guiry 1997).

The external morphology of *G. crinale* was seasonally variable. The lengths of the thalli and branching were both higher in the specimens collected in summer. The variability in shape and branching degree of erect axes was presumably related to size of the thalli. Shorter thalli were terete and less branched in the apices, while longer ones were flattened and highly branched in the apices. Santelices (1977) found a similar variation in Hawaiian specimens of *G. crinale*. He showed that longer specimens are more flattened and branched in the apical half than shorter ones. Variation in morphology related to seasons and environmental conditions has also been observed in other species of Gelidiales (Macler and West 1987, Santelices 1988, Rueness and Fredriksen 1989, Prathep et al. 2009). For example, Santelices (1991) demonstrated that the size of the thalli was related to light intensity and water movement.

Vegetative propagation is common in many species of *Gelidium* (Santelices 1991). Prostrate axes grow and colonize new substratum; from these, erect axes develop, producing new mats. Erect axes are usually truncated and regeneration occurs. This growth pattern allows *Gelidium* populations to have a perennial habit, decaying during unfavorable seasons but regrowing from prostrate axes when conditions become favorable (Santelices 1990b). The fact that *G. crinale* was only observed during the warm seasons could be related to burial by sediment, as has been suggested for other species of red algae in shallow coasts (Airoidi et al. 1996).

The occurrence of fertile specimens was also related to seasons, as the largest number of fertile specimens was found in summer. Although the ratio of reproductive phases was not evaluated, tetrasporophytes were more frequent and males were not found. The dominance of tetrasporophytes over carposporophytes and the scarcity of males have been frequently recorded for the Gelidiales and well documented in the Rhodophyta (Akatsuka 1986, Santelices 1988, Guiry and Womersley 1992, Prathep et al. 2009).

Morphological studies greatly contribute to the understanding of the phylogeny and distribution of algal species and reinforce molecular studies. Recent studies have shown that *G. crinale* specimens from Asian and Australian coasts form a monophyletic clade together with specimens having distributions in Europe and North America (Kim and Boo 2012). The present study provides previously unpublished information on the vegetative and reproductive characters of *G. crinale* collected from a natural population on the Atlantic Patagonian coast.

Further evaluation of the phylogenetic relationship between these specimens and those from other coasts worldwide would be of great relevance.

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