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***Asparagopsis taxiformis* (Bonnemaisoniales, Rhodophyta): first record of gametophytes on the Italian coast**

Abstract

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We report *Asparagopsis taxiformis* from Trapani, on the western coast of Sicily, where gametophytes have been collected for the first time in May 2000. This is the first record of gametophytes from Italy and the second record from the western Mediterranean, the previous one being from the Balearic Islands. Yet, the earliest Mediterranean record of sporophytes of *Asparagopsis* (that could represent this species or *A. armata*) dates back to 1883 from the Island of Elba. The Sicilian gametophytes were dioecious, in agreement with some authors, differing from plants recorded in New Zealand and Australia that have been consistently reported to be monoecious. Whether the gametophytes from Trapani represent a recent introduction or are the product of meiosis in local populations of *Falkenbergia* is unknown.

Introduction

Asparagopsis taxiformis (Delile) Trevisan exhibits a heteromorphic life history, where the erect gametophytic stage alternates with a filamentous sporophyte referred to *Falkenbergia hillebrandii* (Bornet) Falkenberg (Chihara 1961; Rojas & al. 1982). The species is presently widespread in the tropics and the subtropics around the globe (Bonin & Hawkes 1987; Womersley 1994; Vijayaraghavan & Bhatia 1997; Wynne 1998; Marshall & al. 1999).

The gametophytic stage was originally described by Delile (1813-1826: 295-296, pl. 57, Fig. 2) from drift material collected near 'du Phare à Alexandrie' (Egypt), while the original description of *F. hillebrandii* was provided by Bornet (in Ardissonne 1883: 376, as *Polysiphonia*) from material collected at the Island of Elba (Italy). Records of gametophytes have been rare in the Mediterranean, and until recently were restricted to the eastern basin (Egypt, Syria and Libya; Delile 1813-1826; Ardissonne 1883; Nizamuddin & al. 1979; with drift material recorded from Algeria, Dixon 1964). However, unequivocal identification of the species has not been possible without the presence of gametophytes,

because the sporophyte phase of *Asparagopsis armata* Harvey [known as *Falkenbergia rufolanosa* (Harvey) Schmitz] is morphologically indistinguishable from *F. hillebrandii* (Dixon 1964; Dixon & Irvine 1977; Guiry & Dawes 1992). Nevertheless, since gametophytes of *A. armata* were first collected in the Mediterranean in 1923 (Verlaque 1994), it is rather likely that older records of *Falkenbergia* from Elba (Ardissone 1883) and Naples (see Preda 1908-1909: 242) belong to *A. taxiformis*.

Materials and methods

Plants of *A. taxiformis* were collected between May 2000 and April 2001 on the coast of Trapani (western Sicily), at the sites P^{ta} Ligny, P^{ta} S. Giuliano, and P^{ta} Pizzolungo. The material was kept either fresh or preserved in 4% formalin-seawater. Examinations were made using light microscopy. Herbarium specimens have been deposited in the Herbarium Mediterraneum (PAL).

Observations and discussion

From a series of underwater observations, gametophytes were first seen in May 2000 and appeared to increase their presence since then, replacing habitats previously occupied by species of *Cystoseira* C. Agardh. In particular, we observed dense patches along the western shore of Sicily, near the city of Trapani, during all seasons with a maximum occurrence in spring. Plants mainly grew in the upper sublittoral zone on rocky substrata and on several species of algae, predominantly on *Corallina elongata* Ellis & Solander (Fig. 1), in sites with strong wave motion and either exposed to the sun light or below a canopy of *Cystoseira amentacea* var. *stricta* Montagne.

We collected dioecious gametophytes in spring and plants with cystocarps in winter. The erect fronds, high up to 30 cm, were attached by means of entangled basal stolons and totally lacked accessory filaments near the base, known as barbs (Fig. 2).

We also observed gland cells in the outer filaments. Such specialised cells are reported to be highly odorous, and in *Asparagopsis taxiformis* are known as a prolific source of volatile halocarbons. A recent biochemical study on *Falkenbergia* stages of *Asparagopsis* spp. (Marshall & al. 1999) has demonstrated release of several bromocarbons, of which 1,2-dibromoethylene and tribromoethylene are previously unreported as natural products.

Our gametophytes were dioecious, with spermatangia and cystocarps on different thalli, which agrees with some reports (e.g. Vijayaraghavan & Bathia 1997; Marshall & al. 1999). On the other hand, Australian and New Zealand plants have been consistently reported as monoecious (Levring 1953; Adams 1994; while Bonin & Hawkes 1987 reported only cystocarpic plants). Whether this genotypic difference marks two geographically distinct groups or simply is a variable character within single populations is unknown. Yet, it should be noted that a molecular analyses of 25 strains of *Falkenbergia* from various places in the world gave evidence of presence of two geographically distinct groups (Caribbean and Pacific strains) within *A. taxiformis* (Ní Chualáin & al. 1997).

Our finding of gametophytes of *A. taxiformis* in western Sicily could represent a recent introduction, either from the eastern Mediterranean, the Central Atlantic or even the

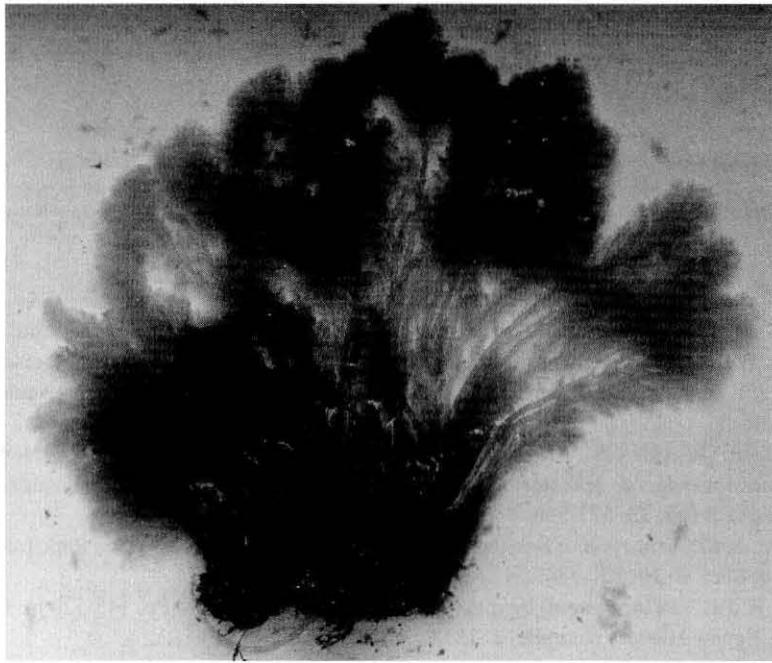


Fig. 1. *Asparagopsis taxiformis* (Delile) Trevisan epiphyte on *Corallina elongata* J. Ellis & Solander.

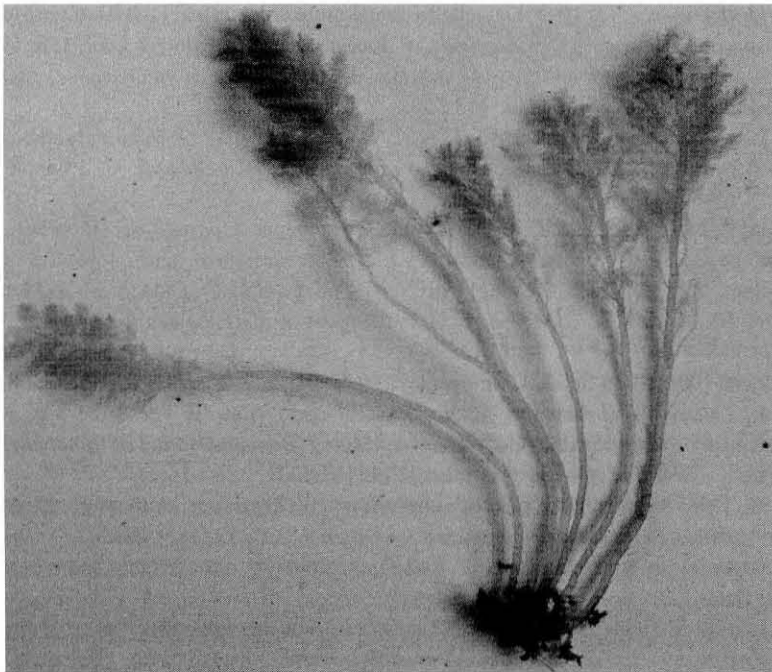


Fig. 2. *Asparagopsis taxiformis* (Delile) Trevisan thallus.

Southern Hemisphere, but it is also possible that meiotic tetrasporogenesis has been triggered by unknown ecological factors in the usually sterile local *Falkenbergia* populations of the species.

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