

The invasion of *Lophocladia* (Rhodomelaceae, Lophotalieae) at the northern coast of Ibiza (western Mediterranean Sea)

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A tropical red alga of the genus *Lophocladia* was found in the coast of Ibiza (western Mediterranean Sea) in 1995. Since then, an important proliferation of *Lophocladia* has been observed. It grows from shallow waters to a depth of 45 m, covers up to 100 % of the available substrate and can be found on bare bedrock as well as on rocks covered with different species of algae and on the leaves of *Posidonia oceanica*.

Keywords: Introduction, invasion, *Lophocladia*, Mediterranean Sea, Ibiza.

INVASIÓ DE *LOPHOCLADIA* (RHODOMELACEAE, LOPHOTALIEAE) AL NORDOEST DE LA COSTA D'EIVISSA (MEDITERRÀNIA OCCIDENTAL). L'alga vermella tropical del gènere *Lophocladia* fou trobada a la costa d'Eivissa (Mediterrània occidental) durant 1995. Després del temps transcorregut s'ha observat una important proliferació de *Lophocladia*. Creix des d'aigües someres fins a profunditats de 45 m, cobreix fins al 100% del substrat disponible i es pot trobar tant a roca nua com a roques cobertes per diferents espècies d'algues i sobre fulles de *Posidonia oceanica*.

Paraules clau: introducció, invasió, *Lophocladia*, Mediterrània, Eivissa.

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Introduction

Various species of algae have been introduced into the Mediterranean Sea by human activities (Verlaque, 1994). The present paper describes an enlarged occurrence of the tropical alga *Lophocladia lallemandii* (Montagne) Schmitz (Rhodomelaceae, Lophotalieae) in the coasts of Ibiza.

This species seems to be native in the Indian Ocean and the Red Sea and could have been introduced into the Mediterranean via the Suez canal. It is quite common in the eastern part of the Mediterranean, in Turkey, Syria, Egypt, Libya and Tunisia (Petersen, 1918; Mayhoub, 1978; Aysel, 1981; Verlaque, pers.

comm.) but rare in the western part. It has been reported from Algeria, Spain (Murcia), Sardinia and south of Italy (Feldmann & Feldmann, 1938; Furnari & Scammacca, 1971; Brambati *et al.*, 1980; Soto & Condé,

1988; Cormaci *et al.*, 1992; Ould-Ahmed, 1994) (Fig. 1). However, from none of this places a strongly increased propagation causing a serious danger for other algae and invertebrates has been described.

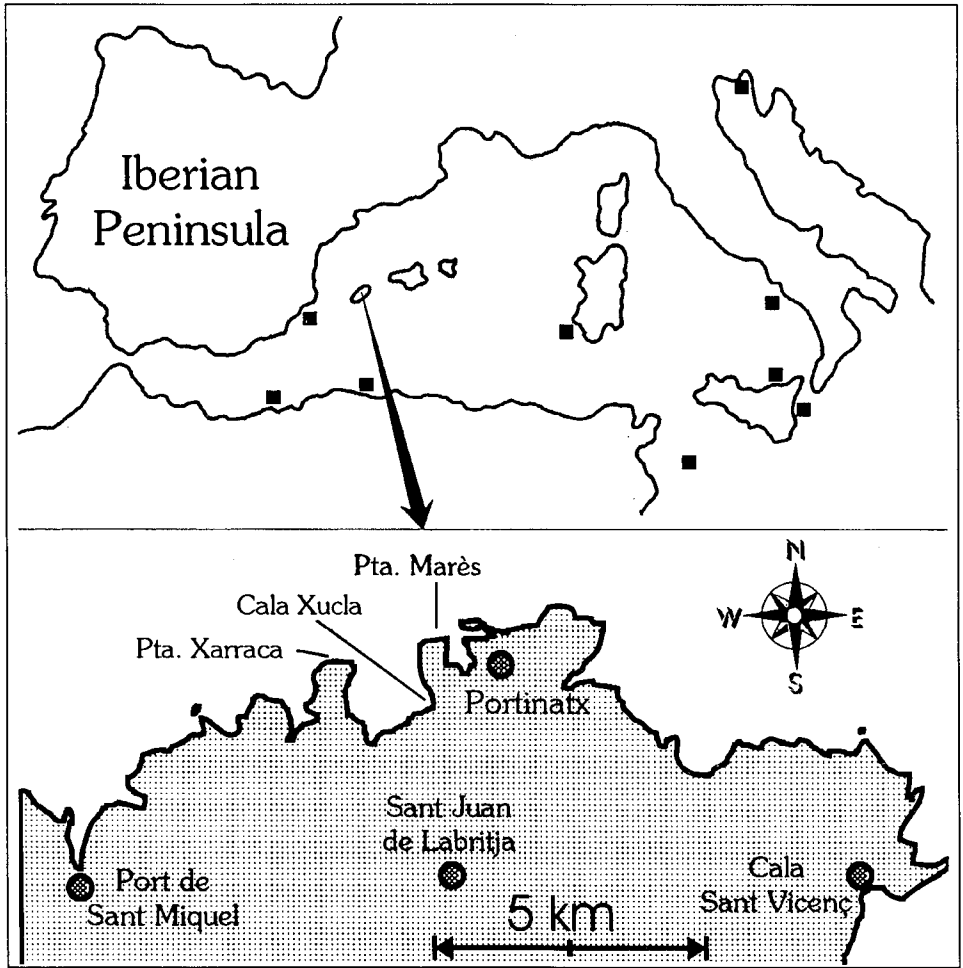


Fig. 1. Map of localities at the northern part of the Ibiza island. ■ = previous records in the western Mediterranean and Adriatic Sea, according to Brambati *et al.* (1980), Cormaci & Motta (1985), Soto & Condé (1988), Cormaci *et al.* (1992) and Ould-Ahmed (1994).

Fig. 1. Localitats al nordoest de l'illa d'Eivissa. ■ = cites prèvies a la Mediterrània occidental i la mar Adriàtica, d'acord amb Brambati et al. (1980), Cormaci i Motta (1985), Soto i Condé (1988), Cormaci et al. (1992) i Ould-Ahmed (1994).

Material and Methods

In the north of Ibiza, Balears, Spain, around the village of Portinatx (Fig. 1), the coastal area was investigated for the distribution of *Lophocladia* in August and September 1995, in August 1996, and in May and September 1997. Besides a few sandy beaches only rocky littoral can be found there. In a depth between 2 m (in bays) and 45 m the rocks turn into flat sandy areas. Close to the coast no place deeper than 45 m can be found. In many cases the flat regions are covered by meadows of the seagrass *Posidonia oceanica* down to 30 m depth. Observations were made by snorkeling and by SCUBA diving. Material collected in several depths and of several expositions was fixed in

5 % formaldehyde in sea water. The taxonomic determination was performed by M. Verlaque (Marseille). It was appointed to the genus *Lophocladia* Schmitz and provisionally attributed to *L. lallemandii* (Montagne) Schmitz.

Results

The remarkably increasing expansion of *Lophocladia* at the northern part of Ibiza is demonstrated in Fig. 2. In August and September 1995 the alga was observed for the first time (Fig. 2a). It grew in single patches with a diameter from 15 to 30 cm between green and brown alga, dominated by *Padina pavonica* (L.) Lamouroux. The water depth was between 3 and 5 m. But at this time no special attention was paid to the depth ranges occupied by *Lophocladia*. One year later the scene had changed remarkably, the alga overgrew all types of substrate and covered up to 100 % substrate in an enlarged area (Fig. 2b). The eastern end of the distribution could not be found out, the western end was at Punta Mares. No *Lophocladia* was found at Punta Xarraca and further to the west in August 1996. One year later the alga has spread much further (Fig. 2c).

In the settlement of *Lophocladia* one has to distinguish between 'dense settlement' whereby the substratum is covered up to 100 %, and 'patch settlement' where only patches between 10 and 50 cm in diameter are found. The covering of *Lophocladia* in this area moves between 10 and 30 %. As it was observed in the successive years the patch settlement was the beginning of the dense settlement. However, this was not the fact in all cases. In parts of protected bays patch settlement was observed in 1996 as well as in 1997. No effective changes could be seen. A similar phenomenon happened in areas with strong water movements in a depth down to 5 m. e.g. at Punta Mares a dense settlement of *Lophocladia* can only be observed from around 5 m downwards (Fig. 3).

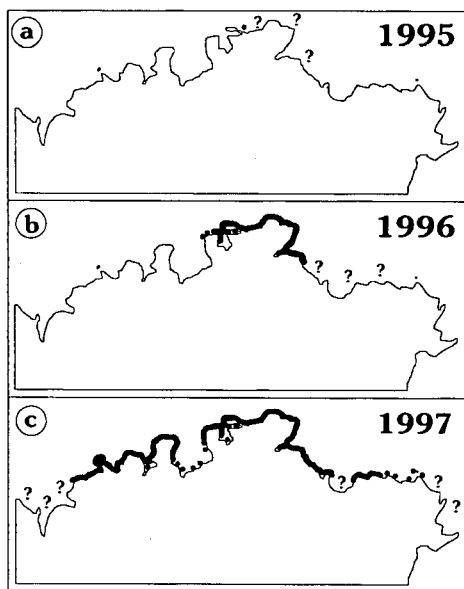


Fig. 2. Spread of *Lophocladia* within the years 1995 to 1997. Question marks indicate areas not investigated.

Fig. 2. Distribució de *Lophocladia* entre els anys 1995 a 1997. Els interrogants indiquen àrees no prospectades.

Lophocladia appears in two colour forms. The 'red form' is of a rather dark, strong red. It is usually found in light protected areas such as steep shady walls, shaded areas of boulders, the bottom of large sponges or the rhizomes of *Posidonia*. Also below 35 m depth the alga is stained reddish. On the other hand some single patches in protected bays on flat rocks in water depth of less than 1 m were also of the red form. However, the more common form is the 'brown form' of light brown colour. The large overgrowings of the dense settlement as well as most patch settlements are brownish coloured. All the samples of *Lophocladia* of both settlement types and both color types taken in different depths and at different localities were fertile tetrasporophytes.

Depth distribution: *Lophocladia* was found from shallow water to a depth of 45 m. No deeper observations could be made (see 'material and methods'). The shallowest occurrence was at a depth of 30 cm in single patches at a protected bay (see above).

Exposition: In shallow water of strongly exposed areas no *Lophocladia* could be observed. The situation at Punta Marès in 1997 was as follows: The settlement starts at

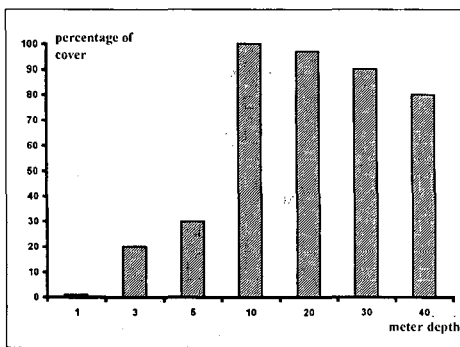


Fig. 3. Percentage of substrate covered by *Lophocladia* at different depths at Punta Marès (see Fig. 1) in September 1997.

Fig. 3. Percentatge del substrat cobert per *Lophocladia* a diferents profunditats a Punta Marès (veure Fig. 1) durant setembre de 1997.

a depth of around 2 m with single smaller patches. Down to a depth of 5 m the size of the patches increases. At this depth there is an edge of the rocky bottom falling from 20 to 60°. From that edge on the settlement is 'dense' down to 45 m (Fig. 3). In deep bays, protected towards the east (e.g. Cala Xucla), no overgrowth of *Lophocladia* was found before 1997.

Covering: In the main distribution areas at water depth between 5 and 30 m all types of substrates, horizontally (0°) to vertically (90°) exposed are covered by *Lophocladia* at 100%. In water depths down to 20 m also overhangs to about 100° are completely overgrown, usually by the 'red' form. At around 110° some single patches can be observed, especially on rising structures like other algae or sessile animals (see below). Only overhangs of more than 115° are completely free of *Lophocladia*.

Substrate: As already stated, *Lophocladia* overgrows all types of substrates. It can be found on bare bedrock as well as on rocks covered with different species of algae. It first starts to settle on other algae (e.g. *Padina pavonica*); however, in 'dense settlements' the overgrown algae have already disappeared. Also the rhizomes as well as the leaf of *Posidonia oceanica* can be settled by *Lophocladia*. In sun exposed areas only sponges like *Ircinia fasciculata* Pallas and *Sarcotragus spinosula* (Schmidt) and sea anemones *Anemonia sulcata* (Pennant) are not covered by *Lophocladia*. In 1997 in some areas a slight coat of *Lophocladia* could even be found on the red alga *Peyssonnelia squamaria* (Gmelin) Decaisne and on the bryozoan *Myriapora truncata* (Pallas), both living in light protected areas. Sandy areas below the rocks are partially covered by dead, broken *Lophocladia* to a height of 5 to 10 cm.

Influence on the environment: Nearly all the areas now densely settled by *Lophocladia* showed a cover of different algae and sessile invertebrates before the invasion of *Lophocladia*. Most of them have

disappeared. Also several benthic animals like molluscs (e.g. *Hypselodoris elegans* (Contraire), *Platydoris argo* (L.)) and fishes (e.g. *Parablennius rouxi* (Cocco), *Gobius vittatus* Vinciguerra) have not been observed any more. Free swimming fishes seemed to be not obviously disturbed. In the sandy areas covered by dead *Lophocladia*, benthic animals were absent (e.g. *Pomatoschistus* sp.).

Discussion

Recently several marine plants have been introduced into the Mediterranean Sea. Verlaque (1994) lists and discusses ninety-four macroscopic algae and one species of seagrass. Three major routes of invasion are possible: passive transport by ships, active immigration through the Suez canal, aquaculture or setting free from aquaria. The latter has been the case with the green alga *Caulerpa taxifolia* (Meinesz *et al.*, 1994). In the Mediterranean Sea low temperature accustomed species from the cold-temperate Pacific and the Atlantic Sea have only settled successfully in the Adriatic Sea and the Gulf of Lions (France). However, subtropical or several tropical ones are dispersed over large areas. Verlaque (1994) states that some introduced algae proliferate to the detriment of the indigenous vegetation of the Mediterranean Sea. In contrast to some terrestrial introductions, to date no population crash has been observed in the Mediterranean.

The data presented here indicate that the invasive potential of *Lophocladia* is important. Within three years a coastal area of more than 20 km length was occupied by this algae from shallow water to more than 40 m depth. It is uncertain how it will further develop and which ecological effects it will cause. In the present state of investigations it is difficult to formulate relevant conclusions on the impact of this alga in the regions of Ibiza.

In my opinion it is of great importance that new records of *Lophocladia* are an-

nounced to scientific institutions (marine biological stations, universities, museums) as soon as possible in order to follow the expansion of this species in the Balearic islands.

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