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Biological information and comments on *Halophila decipiens* meadows of the Canary Islands (Hydrocharitaceae, Magnoliophyta)

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RESUMEN: *Halophila* Thouars es un género pantropical de plantas de pequeño porte que forman poblaciones en el sublitoral. *H. decipiens* Ostensfeld forma praderas que se localizan entre los 15-40 m en las costas canarias, y que constituyen la asociación *Halophiletum decipientis* Wildpret & M.C. Gil. *H. decipiens* es una especie protegida y ha sido considerada como planta de “interés especial” en el catálogo de las especies en peligro de plantas Canarias (BOC 2001 / 097). De similar forma *Halophiletum decipientis* ha sido considerado por la Comisión de las Comunidades Europeas, DG Environment, 1999, “Habitat del Interés Comunitario” (nº 111022). Comparte hábitat con *Cymodocea nodosa* (Ucria) Ascherson, también bajo protección, como “planta sensible a la destrucción de su hábitat”, BOC 2001 / 097, y *Cymodocetum nodosae* es considerado hábitat “de interés Comunitario” (nº 111021). En el presente trabajo se pone en evidencia la evolución y la posible amenaza del hábitat *Halophiletum decipientis* por la intromisión de *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman et Boudouresque, una clorofita invasora de origen australiano.

Palabras claves: Especies protegidas; especies invasoras; conservación; *Halophila decipiens*; *Caulerpa racemosa* var. *cylindracea*.

ABSTRACT: *Halophila* Thouars is a pantropical genus of small size seagrasses. *Halophila decipiens* Ostenfeld forms deep-water seagrass beds extending from 15-40 m in the Canarian coasts which constitute the association *Halophiletum decipientis* Wildpret & M.C. Gil. *H. decipiens* is a protected species that was considered as a plant of “special interest” by the Canary Islands Endangered Species Catalogue, BOC 2001/ 097, and *Halophiletum decipientis* was considered by the European Commission, DG Environment, 1999, “Habitat of Community Interest” (No 111022). It shares habitat with *Cymodocea nodosa* (Ucria) Ascherson, also considered under protection, as “sensitive to habitat disturbance”, BOC 2001 / 097, and the community *Cymodocetum nodosae* is also “Habitat of Communitarian interest” (No 111021). In this paper the evolution of *Halophiletum decipientis* in recent years is shown, and the possible threat of the habitat because of the introduction of *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman et Boudouresque, an invasive Australian chlorophyte, is considered.

Keywords: Endangered species; invasive species; conservation; *Halophila decipiens*; *Caulerpa racemosa* var. *cylindracea*.

INTRODUCTION

Seagrass meadows are characteristically found growing on unconsolidated substrata of marine environments in tropical and temperate regions. These flowering plant communities are considered among the most productive in the biosphere (McRoy & Mc Millan, 1977; Young, 1978; Bell & Westoby, 1989; Larkum *et al.*, 1989; Duarte & Chiscano, 1999; Hemminga & Duarte, 2000; Pavon-Salas *et al.*, 2000). Besides, their meadows serve as nursery and breeding grounds for diverse marine organisms (Young, 1978; Bell *et al.*, 1989).

Three marine phanerogams, *Cymodocea nodosa* (Ucria) Ascherson, *Zostera noltii* Hornemann and *Halophila decipiens* Ostenfeld are reported mainly from leeward subtidal sites of the Canary Archipelago (Haroun *et al.*, 2002, 2003). One of them, *H. decipiens*, was designated among the spermatophytes of “special interest” in the Canary Islands Endangered Species Catalogue, BOC 2001 / 097, Decret 151/2001. Furthermore, the community of *H. decipiens* (*Halophiletum decipientis*) is included as “Habitat of Community Interest” (No. 11102) (European Commission, DG Environment, 1999).

H. decipiens, with type locality at Gulf of Thailand off Koh Kahdat (Womersley, 1984; Guiry & Nic Dhonncha 2004), is the second most abundant vascular marine species in the Canary Archipelago, after *Cymodocea nodosa* (Pavón-Salas *et al.*, 2000). It has a pantropical distribution (www.algaebase.com.): Australasia (Womersley, 1984; Huisman, 2000); Pacific Ocean (Payri *et al.*, 2000); Brazil (Oliveira *et al.*, 1983); Caribbean Sea (Littler & Litter, 2000); N Atlantic Ocean, including Canary Islands (Haroun *et al.*, 2002, 2003).

The first report of *H. decipiens* from the Central-East Atlantic Ocean was done by Gil-Rodríguez & Cruz (1982) and Gil-Rodríguez *et al.*, (1982) from collections in few localities along the southeastern coast of Tenerife, and since then several new localities have been added. Later it was recorded for La Palma, in the harbour of Santa Cruz de La Palma between 6-9 m depth (Hernández-González & Gil-Rodríguez, 1993), and also in Gran Cana-

ria, in one locality of the SW coast (Puerto Rico, 19 m depth) (Betancort *et al.*, 1995; Pavón-Salas *et al.*, 2000). Moreira *et al.* (2004) found it growing locally from 20 to 40 m depth in two localities of the SE of Tenerife.

Recent surveys along the Canary coasts have resulted in a much extended knowledge of this interesting species. This study provides some ecological and chorological knowledge of *H. decipiens* meadows in the Canary Islands regarding to environmental status and habitat threatens.

MATERIAL AND METHODS

Study area: The Canary Archipelago is located in the Central East Atlantic Ocean, near to the Northwestern African Coast; the minimum distance with the continent is about 110 km. This volcanic archipelago is composed of seven main islands and several islets. Except in the case of Lanzarote and Fuerteventura, which share the same subtidal shelf, the sea-bottom may reach more than 2000 m depth among the islands. The older islands have wide insular shelves mainly located at the Southern and Southwestern coasts. Extensive sandy bottoms, suitable for seagrass meadows development, may appear in such areas.

Methods: Several transects were sampled between 20-30 m depth along the coast of Tenerife and Gran Canaria islands to characterize the community structure. The sampling was performed using 20 x 20 cm quadrats divided into subquadrats of 10 x 10 cm side (Fig. 1a, b). Phytosociological relevés chosen randomly were compiled following the protocol of the Zürich-Montpellier School (Braun Blanquet, 1979) (Table 1). Numbers in that table refers to the abundance/dominance index. The phytosociological nomenclature is according to Rivas-Martínez *et al.* (2001) for high level syntaxa. The association name and description is according to Rivas-Martínez *et al.* (2002).

At the same time, the frequency, abundance and density of *Halophila* plants in the sampled area was determined, in Tenerife Island (Table 2) following the quadrat method proposed by Dawes (1986, 1998), with quadrats of 18 x 18 cm divided into subquadrats of 2 x 2 cm (Fig. 1c, d), by using the following equations (Dawes, 1986: 400; 1998: 369):

$$\text{Frequency} = \frac{\text{Number of occupied quadrats / units}}{\text{Total number of quadrats / units}}$$

$$\text{Abundance} = \frac{\text{Total number of individual plants (aerial sprouts)}}{\text{Number of occupied quadrats / units}}$$

$$\text{Density} = \frac{\text{Number of individual species / unit area}}{\text{Total number of unit areas}}$$

Voucher specimens are kept in the TFC Herbarium at University of La Laguna (TFC no 43.298; 43.614-43.623; 43.800). Furthermore, underwater pictures of the community were taken on transects along the southeastern coast of Tenerife.

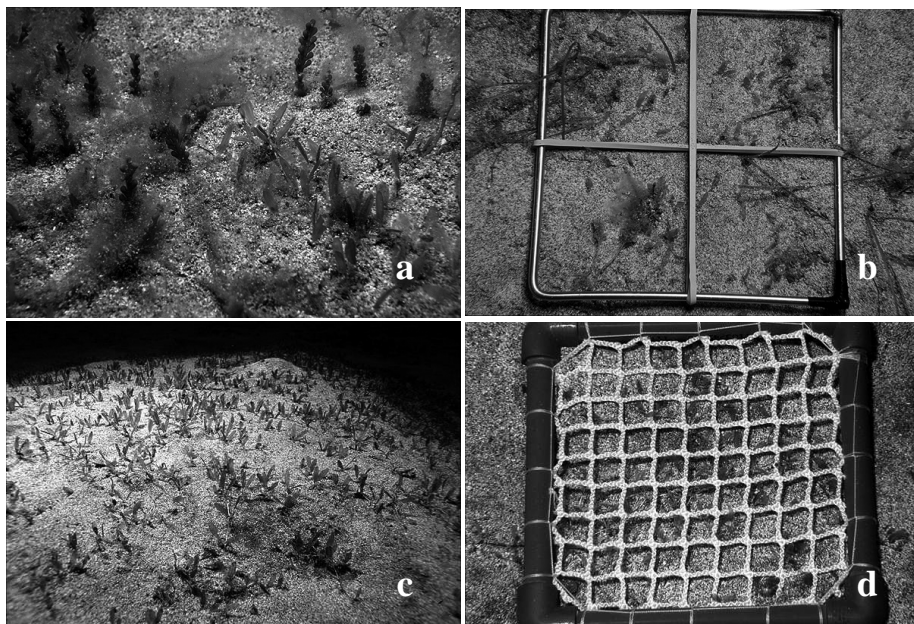


Fig. 1.- 1a: *Halophiletum decipiens*, with *Caulerpa racemosa* var. *cylindracea*.- 1b: 20 x 20 cm quadrat and 10 x subquadrats. 1c: *Halophiletum decipiens* general view.- 1d: 18 x 18 cm quadrat and 2 x 2 subquadrats.

RESULTS

The Canarian specimens of *H. decipiens* fit into the general description of the species, provided among others by den Hartog (1970, 1971) and Gil-Rodríguez & Cruz Simó (1982). *H. decipiens* (Hydrocharitaceae) is a monoecious small plant, with a slender rhizome not exceeding 1 mm in diameter, and internodes 0.5-4.5 cm long. Roots are 2-5 cm long and 0.2-0.5 mm thick. Both, solitary roots and leaves paired, born from sprouts at each node. Leaves elliptic-oblong, with a rounded apex, sometimes cuneate at the base, 5-10 mm in length and not more than 5 mm in width.

The distribution pattern of this species is enlarged to include a new locality in the E coast of Tenerife Island (at 20-25 m depth in Iguete de San Andrés) (Moreira *et al.*, 2004); in the SE coast of Gran Canaria (at 25 m depth in Playa del Cabrón, Arinaga; F. Espino and R. Herrera, *pers. com.*) below *Cymodocea nodosa* meadows and it is now first recorded for Gomera (Punta de la Herradura, at 19 m depth, TFC Phyc 43.800) and La Caleta (El Hierro, recorded by C.L. Hernández-González) where it is present only in small and isolated patches.

In the *Halophiletum decipiens* of San Andrés (E of Tenerife) stand (LIC “sebadales de San Andrés” ES 7020120) has been recently discovered *Avrainvillea canariensis* A. Gepps et E.S. Gepps an endemic chlorophyte species under protection, “sensitive to habitat disturbance” (BOC 2001 / 097).

The expansion of the community has been observed recently in the E and S of Tenerife (Moreira, *com. pers.*) as well as an important change in its composition, which now includes *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman et Boudouresque an invasive chlorophyta species of Australian origin, recorded as such in the Mediterranean basin from Port Menton, near Italy, to Marseille and now in the Canary Islands (Verlaque *et al.*, 2000, 2003, 2004).

Davis *et al.* (2001) reported a competition for nitrogen between the neotropical seagrass *Thalassia testudinum* Banks ex König, and the rhizophytic green macroalga *Halimeda incrassata* Lamouroux in the Florida Keys. Is a similar process operating between *H. decipiens* and *Caulerpa racemosa* var. *cylindracea* in the Canary waters? Further research is needed.

Halophiletum decipientis constitutes along the Canarian coast an oligospecific (sometimes monospecific) meadow community, in deep water, dominated by *H. decipiens*. The macroalgae *Caulerpa racemosa* var. *cylindracea* is frequent in the community, at least in subtidal areas of Tenerife Island. Sometimes *Cymodocea nodosa* as well as *Dictyota dichotoma* (Hudson) J.V. Lamouroux grow in the community (Pavon-Salas *et al.*, 2000). Apart from these plants, only some few epiphytes have been recorded.

Using two different complementary approaches we have tried to evaluate the floristic composition and other quantitative parameters of *Halophiletum decipientis* in Canary Islands. Table 1 shows details of this composition and the phytosociological adscription of the community.

Table 1. *Halophiletum decipientis* Wildpret & M.C. Gil 2002, *Syringodio-Thalasion testudinum* Borhidi 1996, *Thalassio-Syringodietalia filiformis* Borhidi, Muñiz & Del Risco in Borhidi 1996, *Halodulo wrightii-Thalassietea testudinum* Den Hartog ex Rivas-Martínez, Fernández-González & Loidi 1999.

Plot nº	1	2	3	4	5	6	7	8	9	10	11	12
Depth (m)	22	25	23	22	21	20	22	30	26.5	25.5	25	19
Area (cm ²)	400	400	400	400	400	400	400	400	400	400	400	400
Cover (%)	60	25	15	15	45	20	40	15	15	15	60	20
Number of taxa	5	4	4	4	2	1	1	1	1	1	1	1
Character taxa:												
<i>Halophila decipiens</i> Ostenfeld	3	1	1	1	3	2	3	1	1	1	4	2
Companion taxa:												
<i>Caulerpa racemosa</i> var. <i>cylindracea</i> (Sonder) Verlaque, Huisman et Boudouresque	+	2	+		1						+	
<i>Cymodocea nodosa</i> (Ucria) Ascherson				+							1	+
<i>Dictyota dichotoma</i> (Hudson) Lamouroux	2											
Epiphytes												
<i>Ulothrix flacca</i> (Dillwyn) Thuret in Le Jolis	+	+	+	+								
<i>Cyanophycota</i>	+	+	+	+								

Localities – Tenerife: 1.- Cueva de los Camarones; 2, 5, 9 and 10.- El Palm-Mar; 3 and 7.- La Arenita; 4 and 6.- Punta del Bocinegro; 8.- Cueva de La Rasca.

Localities – Gran Canaria: 11.- Playa El Cabrón; 12.- Puerto Rico.

Note: Epiphytes are indicated through presence / absence index.

The structure of the meadows is in evenly distributed homogeneous patches. The vertical distribution pattern of this species is between 6 and 40 m depth, 15-25 m depth being the most common. *H. decipiens* has been found growing on sandy and muddy bottoms.

Table 2, based in Tenerife populations, showing frequency, abundance and density data, refers to the dominant role played by *H. decipiens* in the community. It is still early to relate density of *H. decipiens* and presence of *Caulerpa racemosa* var. *cylindracea*, and monitoring tasks are required in the Canary Archipelago in the future.

Table 2 . *Halophiletum decipientis* Wildpret & M.C. Gil 2002 .

Plot nº	1	2	3	4	5	6	7	8	9	10
Depth (m)	22	25	23	22	21	20	22	30	26.5	25.5
Area (cm ²)	324	324	324	324	324	324	324	324	324	324
Frequency (%)	88	54	55	70	76	53	74	24	49	37
Abundance	5.33	3.13	3.64	2.19	6.79	5.46	5.96	3.75	2.37	2.33
Density	4.70	1.70	2.02	1.54	5.19	2.90	4.91	0.92	1.17	0.86

Localities – Tenerife : 1.- Cueva de los Camarones; 2, 5, 9 and 10.- El Palm-Mar; 3 and 7.- La Arenita; 4 and 6.- Punta del Bocinegro; 8.- Cueva de La Rasca.

DISCUSSION

Halophiletum decipientis constitutes an important submerged community in the Canary Islands, which is probably spread on the sea bottom of all islands. This expansion seems to be related to the combined effect of some environmental factors, among them seawater temperature and substrate characteristics. In Tenerife, we have noticed an increase of the populations in the vicinity of fish cages for aquaculture farming.

In the Canary Islands as in other places [Ceccherelli *et al.*, 2000; Ceccherelli & Campos, 2002; Famà *et al.*, 2000; Modena *et al.*, 2000; Piazzì *et al.*, 2001; Verlaque *et al.*, 2000, 2003, 2004)] we have noticed an important change in the floristic composition of the community because of the progressive expansion of the invasive chlorophyta *Caulerpa racemosa* var. *cylindracea*.

Because of the importance of this particular habitat, nowadays endangered because disturbance and introduction of an invasive algae, we call the attention in order to control the fish cages expansion and its possible relation to nutrients increase.

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