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Charophytes (*Charales*) from Crete (Greece) collected in 2010

Abstract

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In this article charophytes are reported from the island of Crete, the largest island in Greece. On 9 visited localities, charophytes have been found in six. All localities, except one (loc. 6) are freshwater. Totally six different species were found: *Chara aspera*, *C. connivens*, *C. corfuensis*, *C. vulgaris*, *Nitella hyalina* and *N. tenuissima*. The most interesting locality is Lake Kourmas which is an eutrophic *Chara*-lake with rich vegetation of four species: *Chara corfuensis*, *C. aspera* and the two species of *Nitella*.

Key words: Crete, Greece, *Chara aspera*, *C. connivens*, *C. corfuensis*, *C. vulgaris*, *Nitella hyalina*, *N. tenuissima*.

Introduction

The island of Crete is the largest island in Greece and is situated in the southernmost part of the country. I visited several water bodies, lakes, reservoirs and seasonally wet meadows. The localities are listed in Table 1, and of nine, charophytes were found in six. Charophytes have earlier been reported from Crete in several works e.g. Corillion (1957), Koumpli-Sovantzi (1997), Bergmeister & Abrahamczyk (2008).

Materials and methods

This work is based on material collected in Crete (Greece) in the given localities in 2010 (Fig. 1). The specific conductivity of the water was measured with a Milwaukee, SM 301 EC meter, range 0-1990 $\mu\text{m}/\text{cm}$. pH was measured with a Milwaukee pH meter, type pH 52. The calcium content was measured with LaMotte, calcium hardness (Hardness PHT-CM-DR-LT).

The coordinates are from Google Earth and are given in degrees, minutes and seconds.

Specimens collected are deposited at the Botanical Museum, University of Oslo (Herb. O).

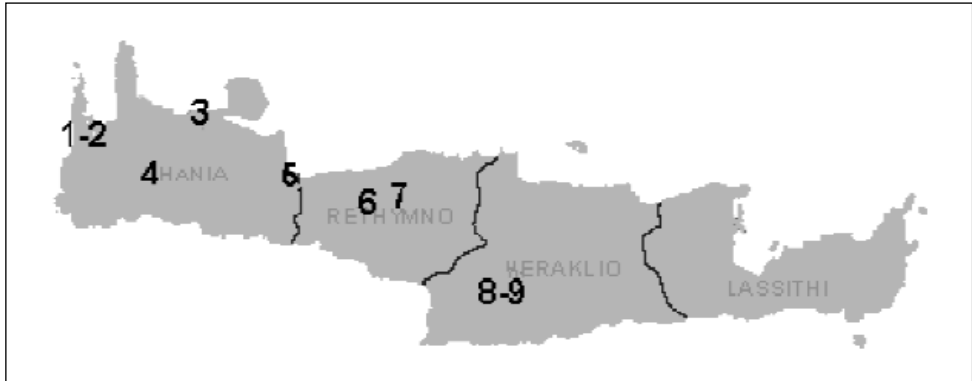


Fig. 1. Map of Crete with the visited localities.

Results

THE LOCALITIES

The visited localities can be found in Table 1. The localities are briefly commented on below.

Falasarna, pond 1 (loc. 1)

A small pond on this sandy beach was more or less filled with *Chara vulgaris* and some scattered specimens of *Chara aspera*. The water is brackish.

Table 1. The visited localities in Crete, coordinates from Google Earth, pH, specific conductivity and calcium and charophytes found in each locality.

Locality	Coordinates	pH	Specific conductivity uS/cm	Ca ²⁺ mg/L	Charophytes
1. Chania: Falasarna pond. 1	35°28'57''N, 23°34'52''E	-	7820	-	<i>Chara vulgaris</i> (brackish water)
2. Chania: Falasarna pond. 2	35°28'55''N, 23°34'47''E	-	-	-	<i>Chara aspera</i> (the pond was dry)
3. Chania: Agia lake	35°28'30''N, 23°56'14''E	8.0	770	88	<i>Chara connivens</i> , <i>C. vulgaris</i>
4. Chania: Pond Omalos plateau	35°19'26''N, 23°53'37''E	9.2	270	24	(<i>Chara braunii</i>)
5. Chania: Kournas lake	35°19'18''N, 24°14'03''E	8.2	1680	130	<i>Chara aspera</i> , <i>C. corfuensis</i> , <i>Nitella hyalina</i> , <i>N. tenuissima</i>
6. Rethymno: Argiroupolis spring	35°18'19''N, 24°19'44''E	7.6	450	40	<i>Chara corfuensis</i>
7. Rethymno: Potamon dam (Voleones)	35°16'58''N, 24°34'06''E	8.4	490	40	<i>Chara vulgaris</i>
8. Heraklion: Lake Votomos	35°07'50''N, 24°54'17''E	8.2	290	20	no charophytes
9. Heraklion: Faneromenis dam (Zaros)	35°05'37''N, 24°51'03''E	9.3	450	32	no charophytes

Falasarna, pond 2 (loc. 2)

This is a seasonally wet meadow with domination of *Scirpus* sp. When I visited the locality was dry, but filled with dried specimens of *Chara aspera* (Fig. 2).

Lake Agia (loc. 3).

This is a highly eutrophic artificial lake. Dense stands of *Chara connivens* were found in an area around the outlet of the lake, where dried specimens formed a white cover. Below the water level *Enteromorpha* sp., *Fontinalis* sp., *Zanichellia palustris* and *Ceratophyllum demersum* grew in dense stands. Some specimens of *Chara vulgaris* were also found here. The lake is surrounded by dense stands of *Typha* sp., *Phragmites australis* and other waterplants. Mats of filamentous algae covered most of the surface of this lake.

Pond on Omalos plateau (loc. 4).

The pond was nearly without vegetation, only with scattered specimens of *Ranunculus peltatus*. I did not find any specimens of *Chara braunii*, which has been reported from this high mountain area (1050 m) (Koumpli-Sovantzi 1997; Bergmeier & Abrahamczyk 2008).

Lake Kournas (loc. 5) (Fig. 3)

According to the Nordic lake-system (Forsberg 1965) Lake Kournas is an eutrophic *Chara*-lake. The water color is green-blue along the shores and deep blue in deeper water. The bottom is sand or grayish lime marl. The water was slightly unclear, although the depth of visibility was 8 m.

Along the shores there is a good growth of charophytes, with species *Chara aspera*, *Nitella tenuissima* and *N. hyalina*. *Chara aspera* grew to 3 m depth, while the two other species only occurred in shallow parts of the lake. In deeper water a bigger species, *Chara corfuensis* dominate in mixed populations with *Najas marina*.

In deeper water, outside the *Chara corfuensis* belts *Potamogeton* sp. dominated in dense populations. The vegetation here was partly covered with filamentous algae.

Argiroupolis - spring (loc. 6)

This is a large spring area with several fish dams. In one of these dams I found *Chara corfuensis* mixed with *Najas marina*. The bottom and parts of the surface were covered with filamentous algae.

Potamon Dam (Voleones) (loc. 7).

This is a very big, artificial lake. I did not find charophytes in the lake itself, but in a small pond below the outlet where *Chara vulgaris* grew in small dense stands (Fig. 4). The bottom was brown clayish soil. Other dominating plants in the locality are *Typha* sp. and *Veronica anagallis-aquatica*.

Votomos lake (Zaros) (loc. 8)

This lake has been formed by the springs of Koutsoulitis river. This is a nice small lake with green water without vegetation.

Faneromenis dam (Zaros) (loc. 9)

This dam has been created by the water of Koutsoulitis river. Highly eutrophic artificial dam with rich growth of water plants, including *Najas marina*. No charophytes were found.

THE CHAROPHYTES*Chara aspera* C.L. Willdenow

This species is found in three localities (loc. 1, 2, 5).

One of the localities is brackish (loc. 1), one is dry (probably brackish, loc. 2) and one is a freshwater lake (loc. 5). Specimens from the last locality can briefly be described as dioecious plants, to 30 cm long, triplostichous to isostichous cortex, strongly encrusted, both female and male plants were found. The fertility was low. Some specimens from deeper water are phenotypically similar to *Chara strigosa* (cfr. Icon 81 in Wood & Imahori 1964). The brackish water specimens were up to 10 cm long, the fertility was high and they had black, ripe oospores.

Chara connivens P. Salzmänn ex A. Braun

Chara connivens was only found in Lake Agia (loc. 3).

Both female plants and male plants were found. Some female plants had ripe, black oospores.

Chara corfuensis J. Groves in N. Filarszky (Fig. 5)

This species has been found in two localities (Loc. 5, 6).

Monoecious species, to 60 cm long. Cortex diplostichous, in some specimens irregular, tylacanthous. Spine-cells single or in pairs, some very short and others up to 2x stem diameter, dense in young and spreading in older internodes. Stipulodes diplostephanous, developed in both rows, both long acute or long in upper and short in lower. Cortex on few segments, often only the lowest. Many specimens have ecori-cated branchlets (f. *gymnophylla*). Bract-cells and bracteole verticillate and as long as the spine-cells. This gives the plants a bushy appearance. The specimens in Lake Kournas were richly fertile, and some ripe, black oospores were found. The oospores were 800 µm long. Some of the specimens collected are habitually similar to *Chara fibrosa* (f. *gymnophylla*).

Chara vulgaris L.

This species was found in three localities (loc. 1, 3, 7).

All the specimens found were the normal type of *Chara vulgaris*. Specimens were up to 30 cm long, depending on the growth conditions, strongly encrusted, and richly fertile with ripe oospores. In loc. 3 the oospores were black, while in loc. 7 they were brown.

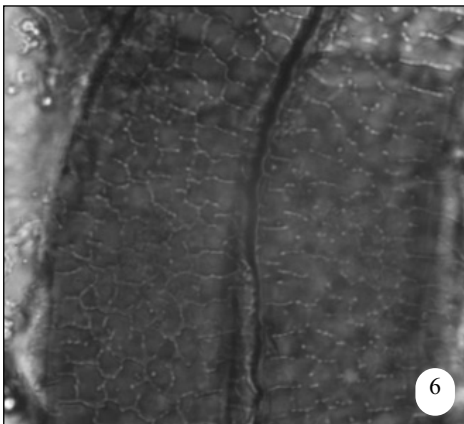
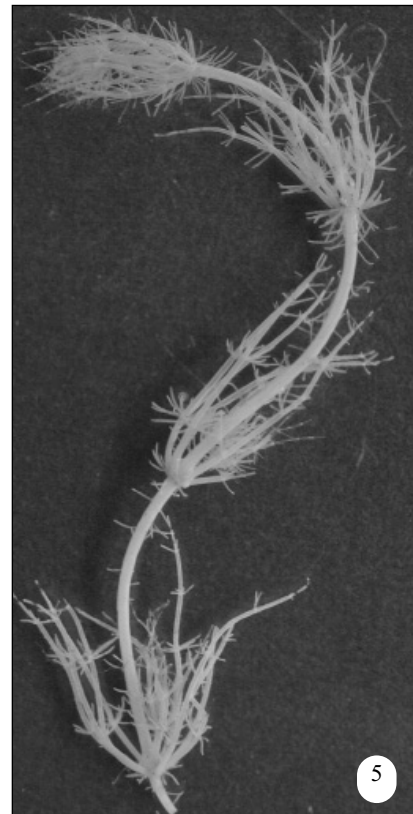


Fig. 2. Loc. 2. Dense masses of dried *Chara aspera* among other vegetation. Photo 26.5.10.

Fig. 3. Loc. 2. lake Kournas. Photo 24.5.2010.

Fig. 4. Dense stand of *Chara vulgaris* in a pond below Potamon Dam. Photo 25.5.10.

Fig. 5. *Chara corfuensis*. Side shoot from a bigger plant. Length 6 cm. Argiroupolis spring.

Fig. 6. *N. tenuissima*. Part of oospore membrane with two fossae, each 30 um across, and with strongly reticulate membrane. Material from Lake Kournas.

Nitella hyalina (De Candolle) C.Agardh

The species has only been found in Lake Kournas. Monoecious, small plants to 5 cm. Branchlets heteroclemous (two kinds of branchlets at each node, smaller accessory above and ordinary branchlets below), fertile, but no ripe oospores were found.

Nitella tenuissima (Desvaux) F.T.Kützing

The species has only been found in Lake Kournas. Monoecious, plants to 4 cm long. Branchlets uniform in and in one series, richly fertile and with ripe, black oospores (Fig. 6).

Discussion

Crete is the largest island in Greece. I found charophytes in six localities out of nine surveyed water bodies. Two of the localities are brackish (loc. 1, 2) with *Chara aspera* and *C. vulgaris*. These two species have also been found in freshwater in Crete. *Chara aspera* has been found several places in Greece, but is not common (Koumpli-Sovantzi 1997; Langangen 2004). The distribution of this species is restricted to the northern hemisphere, where it is more or less coastal (Corillion 1957). *Chara vulgaris* is a common

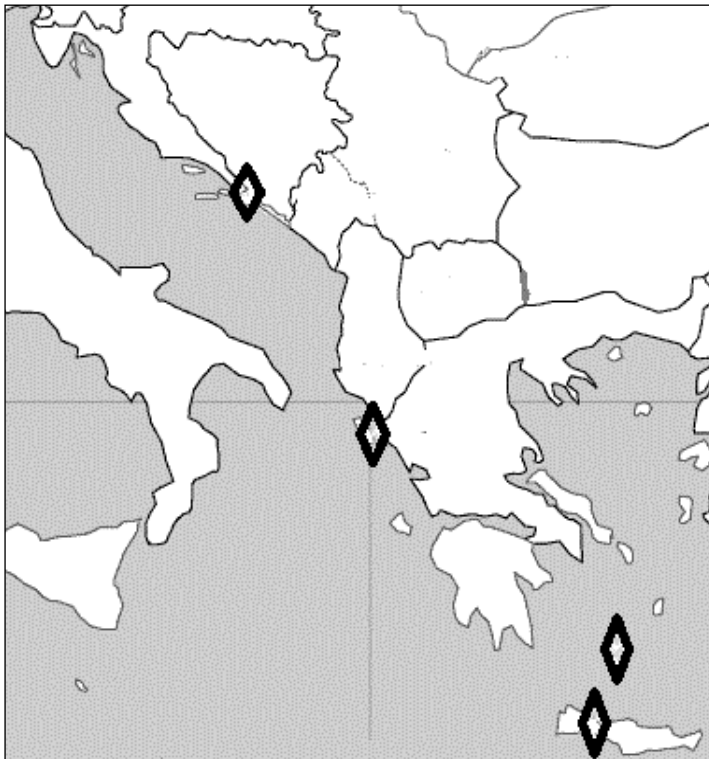


Fig. 7. Known distribution of *Chara corfuensis* in the Balkan.

species in Europe (Krause 1997) and reported from many localities in Greece (Langangen 2004, 2005, 2008, 2009).

Chara connivens is a rare species in Europe (Krause 1997) and in southeast Europe it is red listed as endangered (EN) (Blazencic & al. 2006). The first report of this species for Greece is Blazencic & al. (2006) and Langangen (2010). *Chara connivens* is found in localities with alkaline or mildly brackish water (Moore 1986). Lake Agia is alkaline, and at the same time highly eutrophic.

Chara corfuensis is an endemic species in the Balkan (Fig. 7), and is red listed as critically endangered (CR) (Blazencic & al. 2006). It belongs to the *Chara hispida* group (Wood & Imahori 1965). Details around the determination are discussed in Langangen (2007).

Since the species have few localities, it is necessary to protect some of them. In this context Lake Kournas is a good candidate. This lake has many qualities, it has several species of charophytes and other interesting water plants, it has blue water, grey marl bottom and is an eutrophic *Chara*-lake. The somewhat unclear water is a concern as it can be caused by pollution. It is a fact that Lake Kournas is an important tourist resort, and is visited by a large number of tourists every day.

Van Raam (2005) reports *Chara fibrosa* from Crete. This species was not found by me, but a very similar taxon *Chara corfuensis* f. *gymnophylla* was found in Lake Kournas. One important difference is the number of rows of stipulodes, which in *C. fibrosa* is one and in the other taxon two. In *C. corfuensis* f. *gymnophylla* both types of stipulodes were found.

Nitella tenuissima and *N. hyalina* are distributed through Europe, but are not common (Corillion 1957; Krause 1997). Both species are also reported from Greece (Koumpli-Sovantzi 1997; Raabe & Koumpli-Sovantzi 2000; Blazencic & al. 2006). In lake Kournas both species were found in mixed populations, which may be the reason why only *N. hyalina* has been recognized in the lake earlier, and as this species is easier to determine.

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