

FIRST RECORD OF THREE SPECIES OF THE GENUS *CLADOPHORA* KÜTZ. IN THE COASTAL WATERS OF SLOVENIA

Claudio BATTELLI

University of Ljubljana, Faculty of Education, Department of Koper, SI-6000 Koper, Cankarjeva 5

ABSTRACT

Three species of the genus *Cladophora* Kützing have been recorded in the coastal waters of Slovenia (Gulf of Trieste - Adriatic Sea) for the very first time. A general description of these species is given, as well as its basic morphological features and their habitats in the Slovene coastal waters.

Key words: *Cladophora*, Chlorophyta, occurrence, Slovene coastal waters

PRIMA TESTIMONIANZA DELLA PRESENZA DI TRE SPECIE DEL GENERE *CLADOPHORA* KÜTZ. NELLE ACQUE COSTIERE DELLA SLOVENIA

SINTESI

Per la prima volta viene segnalata la presenza di tre specie del genere *Cladophora* Kützing nelle acque costiere della Slovenia (Golfo di Trieste - mare Adriatico). Nell'articolo vengono forniti: la descrizione generale, le caratteristiche morfologiche di base e gli habitat di queste specie nelle acque costiere slovene.

Parole chiave: *Cladophora*, Chlorophyta, evento, acque costiere slovene

INTRODUCTION

According to Galiardo *et al.* (1993), 24 species of *Cladophora* occur in the Adriatic Sea. According to Giaccone (1978) and van den Hoek (1963), 21 of these are present in the Gulf of Trieste (excluding Slovene coastal waters).

Among the Slovene scientists who have dealt with the algal flora of the Slovene coastal waters and prepared its checklist are: Matjašič & Štirn (1975), Vuković (1980, 1981, 1982, 1984) and Battelli (1997). According to them, 19 species of *Cladophora* occur in the Slovene coastal sea.

From July to September 1998, three species of the genus *Cladophora* (*Cladophora hutchinsiae* (Dillwyn) Kützing, *Cladophora lehmanniana* (Lindenberg) Kützing

and *Cladophora nigrescens* Zanardini ex Frauenfeld) were recorded for the first time in the coastal waters of Slovenia (Gulf of Trieste).

This article deals with the occurrence of these species in the Slovene coastal sea. A morphological description and habitats of these species are given. A general synoptic table of the basic characteristics of the dealt with species is also given.

COLLECTION AND OBSERVATION

Samples were collected in the coastal waters of Slovenia (from Debeli rtič in the north to the mouth of the Dragonja river in the south) in the lower midlittoral and in the upper infralittoral to a depth of about 6-8 metres (Fig. 1)

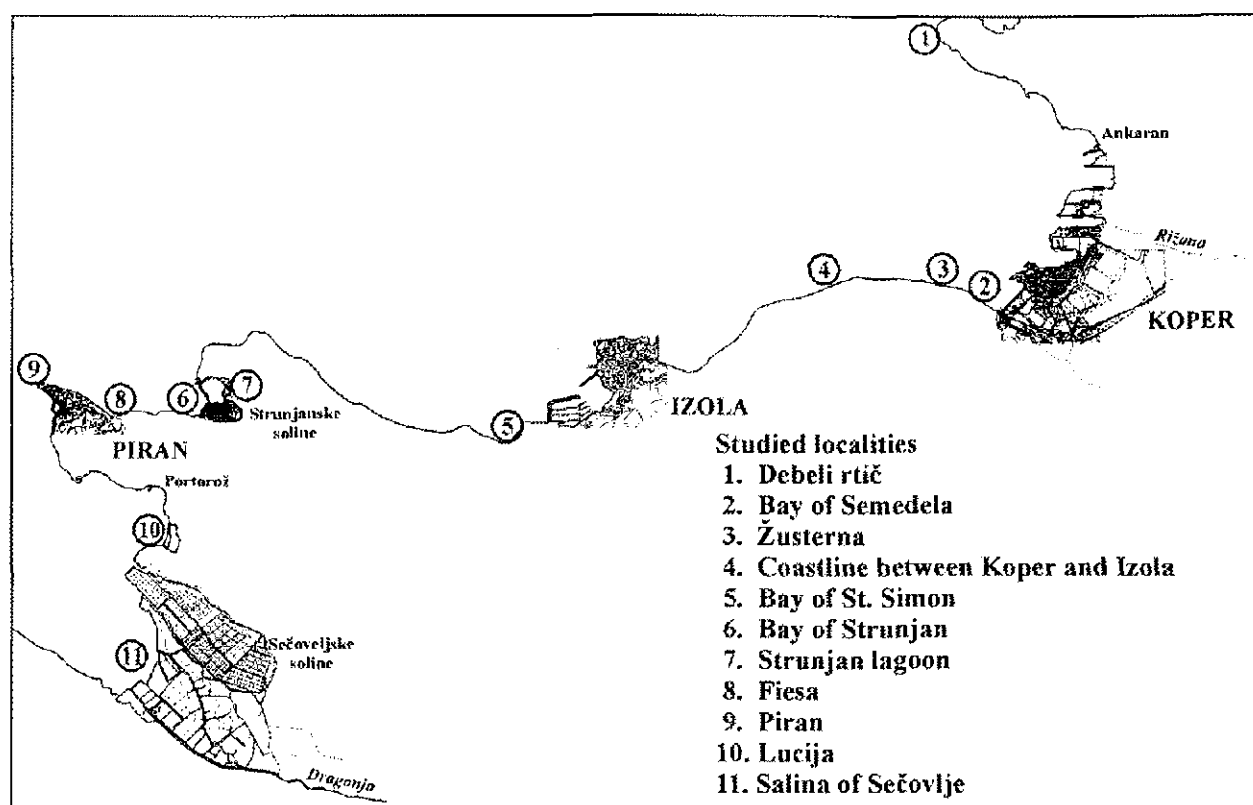


Fig. 1: Study area with sampling stations.

Sl. 1: Obravnavano območje z vzorčevalnimi postajami.

Samples were kept as dry herbarium specimens and chemically treated as wet preparations in 4 % methanol (formalin) solution in seawater.

The algae were identified according to the criteria by van den Hoek (1963), Giaccone (1972-1973) and Noailles (1995). These criteria include:

- thallus organization (acropetal, not acropetal)
- growth (apical, intercalary)
- insertion of the branches (apically, laterally)
- features of the attachment organ (primary, secondary, annular constriction)
- diameter of apical cells
- length of basal cell
- width of cell wall
- colour of dry samples

List of the dealt with species:

1. *Cladophora hutchinsiae* (Dillwyn) Kützinger
2. *Cladophora lehmanniana* (Lindenberg) Kützinger
3. *Cladophora nigrescens* Zanardini ex Frauenfeld

DESCRIPTION OF THE SPECIES

The species are presented in alphabetical order.

Cladophora hutchinsiae (Dillwyn) Kützinger

Synonyms: *Conferva diffusa*
Cladophora diffusa Harvey

Samples had also been found in the mid-nineteenth century in the Gulf of Trieste (off Trieste) as *Cladophora virgata* by Stossich (professor at a secondary school in Koper and Trieste) and identified by Grunow (Austrian algologist) (van den Hoek, 1963).

Description

Thallus densely, pseudodichotomously branched, about 2-3 cm long, dark green (Fig. 2). Thallus attached to hard substratum with dense carpets. Dominating intercalary growth. In the apical region acropetal organization. Branches obliquely inserted at the apical poles of the cells with oblique cross-wall. Cells generally cylindrical in shape. Cell-walls thin. Diameter of apical cells 100-140 µm; diameter of ultimate branches 100-250 µm; diameter of main branches 240-400 µm.

Samples were found in the upper subtidal habitats (station 8) on sheltered and shady sites.

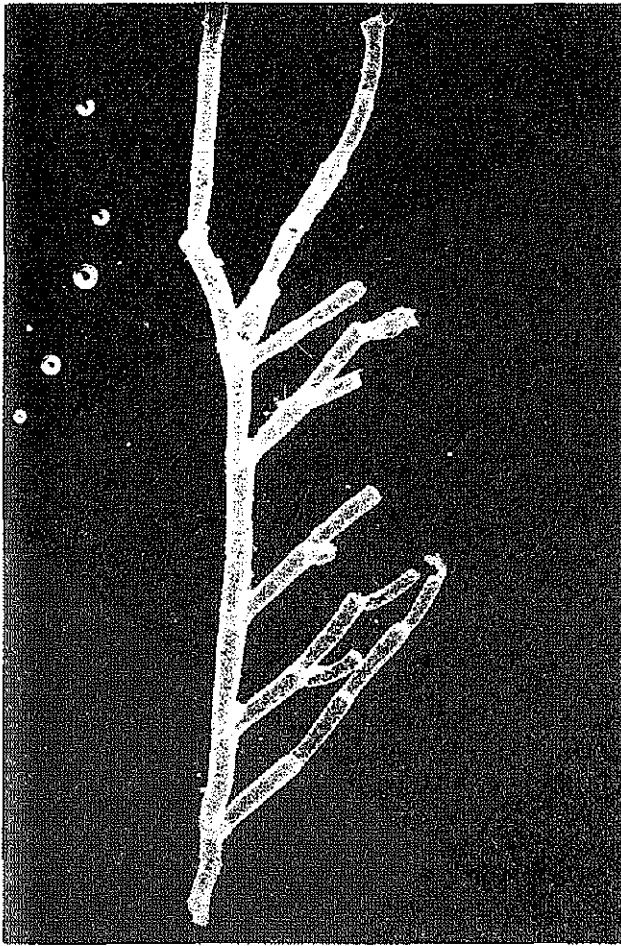


Fig. 2: Part of thallus of *C. hutchinsiae* (Photo: M. Richter).

Sl. 2: Del steljke *C. hutchinsiae* (Foto: M. Richter).

Distribution

C. hutchinsiae is a sub-cosmopolitan species. It is known from the NE Atlantic: Netherlands, Ireland, Britain, France, Portugal, Madeira (Burrows, 1991); from the Mediterranean Sea: Spain, Balearic Islands, France, Corsica and Sardinia, Western Italy, Sicily, Adriatic, the Black and Azov Seas, Turkey, Libya, Greece, Tunisia, Algeria (Gallardo *et al.*, 1993); from NE Pacific: Alaska, British Columbia, Washington, Oregon (Burrows, 1991); from the Indian Ocean: Pakistan, South Africa (Silva), as well as from southern Australia and Japan (C. van den Hoek, *pers. comm.*).

Cladophora lehmanniana (Lindenberg) Kützinger

Synonyms: *Cladophora ramulosa* Meneghini
Cladophora utriculosa Kützinger

The species was found in the Gulf of Trieste (off Trieste) as *Cladophora utriculosa* and near Miramare

(Trieste) as *Cladophora catenata* by Hauck in the mid-nineteenth century (van den Hoek, 1963).

The species was also found in the Bay of Koper by Giuseppe Accurti (professor at a secondary school in Koper) in 1858 (Accurti, 1858), but the identification of the samples still needs to be confirmed.

Description

Thallus is densely pseudodichotomously branched, with stiff texture, about 10-15 cm long, dark green. Mainly apical growth; intercalary growth starting at some distance from the apex (Fig. 3). Insertion of the branches oblique at the apical pole of a cell with a nearly horizontal cross-wall. Cells are cylindrical, sometimes slightly club-shaped. Cell-walls generally 10 µm thick. Diameter of apical cells 95-110 µm; diameter of ultimate branches 90-120 µm; diameter of main branches about 200 µm.

Samples were found in the upper subtidal habitats (stations 4 and 5) on sheltered and shady sites.

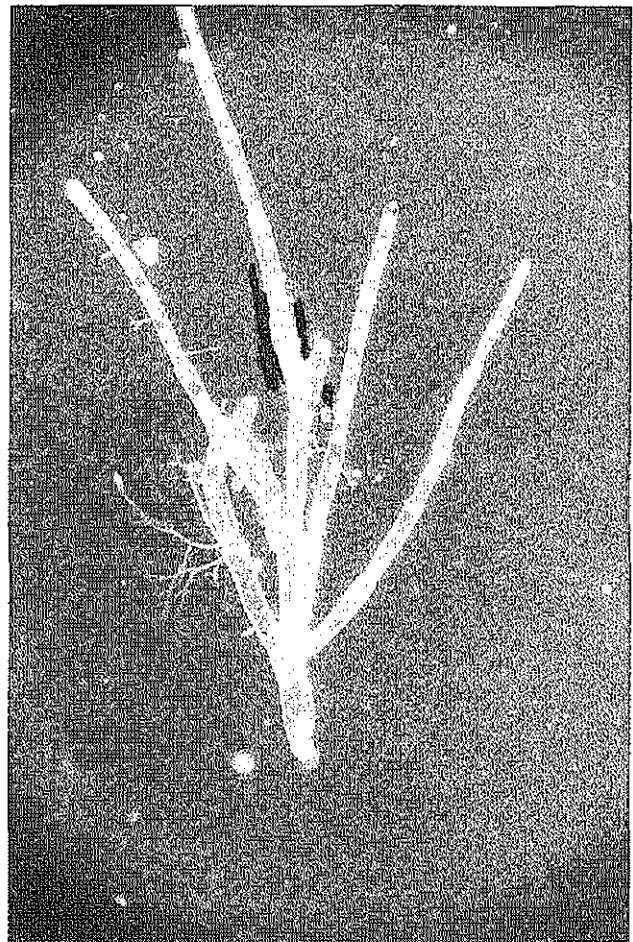


Fig. 3: Part of thallus of *C. lehmanniana* (Photo: M. Richter).

Sl. 3: Del steljke *C. lehmanniana* (Foto: M. Richter).

Distribution

C. lehmanniana is an Indo-Atlantic species. It is known from the NE Atlantic: Ireland, Britain, France, Morocco (Burrows, 1991); from the Mediterranean Sea: Spain, Balearic Islands, France, Corsica and Sardinia, Western Italy, Sicily, Adriatic, Greece, the Black and Azov Seas, Turkey, Levant States, Egypt, Libya, Tunisia, Algeria, Morocco (Gallardo *et al.*, 1993); from the Indian ocean: Australia, India, Laccadive Islands, Somalia, South Africa, Tanzania (Silva), and from southern Australia (C. van den Hoek, *pers. comm.*).

Cladophora nigrescens Zanardini ex Frauenfeld

The species was found at Trieste as *Cladophora scoparioides* by Hauck in 1876 (van den Hoek, 1963).

Description

Thallus is densely branched and about 4-6 cm long. Living thalli are dark green, dried specimens are dark brown colour (Fig. 4). Rhizoids with annular constrictions. Thallus mainly with acropetally organization. Insertion of the branches almost laterally inserted with steeply inclined cross-wall. Cells elongated and slightly club-shaped. Cell-walls generally 10 µm thick. Diameter of apical cells 40-75 µm; diameter of ultimate branches 45-80 µm; diameter of main branches about 120 µm.

Samples were found in the upper subtidal habitats (station 4) on sheltered sites.

Distribution

C. nigrescens is an Atlantic - boreal species. It is known from the Mediterranean Sea: Spain, Balearic Islands, Western Italy, Sicily, Corsica, Adriatic, Greece, the Black and Azov Seas (Gallardo *et al.*, 1993).

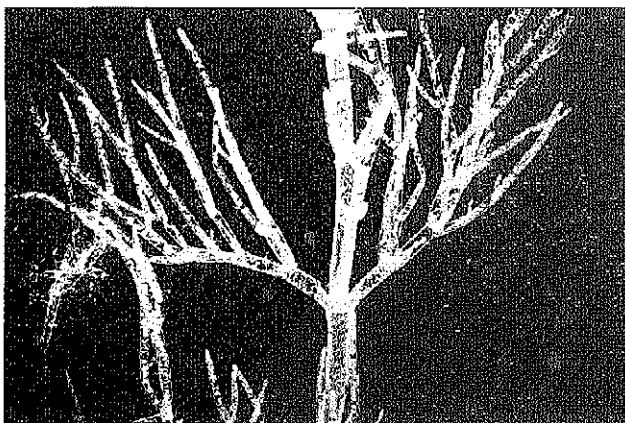


Fig. 4: Part of thallus of *C. nigrescens* (Photo: M. Richter).

Sl. 4: Del steljke *C. nigrescens* (Foto: M. Richter).

DISCUSSION AND CONCLUSION

In this work we report on the occurrence of 18 species of *Cladophora* (see Tab. 1). If we include all the species according to Matjašič & Štirn (1975) and Vuković (1980, 1981, 1982, 1984), 22 species of *Cladophora* occur in the Slovene coastal waters.

N.	SPECIES	ADRI- ATIC SEA	GULF OF TRIESTE	SLOVENE COASTAL WATERS			
1	<i>C. aegagropila</i>	+1	-	-	-	+4	-
2	<i>C. albida</i>	+1	+1	+2	+3	+5	+6
3	<i>C. battersii</i>	+1	-	-	+3	-	-
4	<i>C. coelothrix</i>	+1	+1	+2	+3	+4	+6
5	<i>C. dalmatica</i>	+1	+1	-	+3	+5	+6
6	<i>C. echinus</i>	+1	+1	+2	+3	+4	-
7	<i>C. feredayi</i>	+1	+1	+2	+3	+4	-
8	<i>C. fracta</i>	+1	-	-	-	-	-
9	<i>C. glomerata</i>	+1	+1	-	+3	+5	+6
10	<i>C. hutchinsiae</i>	+1	+1	-	-	+5	-
11	<i>C. laetevirens</i>	+1	+1	+2	+3	+5	+6
12	<i>C. lehmanniana</i>	+1	+1	-	-	+5	-
13	<i>C. liebetruthii</i>	+1	+6	-	-	-	-
14	<i>C. liniformis</i>	+1	+1	-	+3	+5	+6
15	<i>C. nigrescens</i>	+1	+6	-	-	+5	-
16	<i>C. pellucida</i>	+1	+1	+2	+3	+4	-
17	<i>C. prolifera</i>	+1	+1	+2	+3	+4	+6
18	<i>C. pseudopellucida</i>	+1	-	-	-	+4	-
19	<i>C. retroflexa</i>	+1	+1	+2	+3	+4	-
20	<i>C. ruchingeri</i>	+1	+1	-	+3	+5	-
21	<i>C. rupestris</i>	+1	+1	-	+3	+5	-
22	<i>C. sericea</i>	+1	+1	+2	+3	-	-
23	<i>C. socialis</i>	+1	+1	-	+3	-	-
24	<i>C. vadorum</i>	+1	+6	-	-	-	-
25	<i>C. vagabunda</i>	+1	+1	+2	-	-	+6
		24	21	10	16	18	8

Tab. 1: Synoptic table indicating the occurrence of species of the genus *Cladophora* in the Adriatic sea, in the Gulf of Trieste, and in the coastal waters of Slovenia.

Tab. 1: Preglednica, ki ponazarja pojavljanje vrst iz rodu *Cladophora* v Jadranskem morju, v Tržaškem zalivu in v slovenskem obalnem morju.

Legend/ Legenda: + presence/pojavljjanje, - absence/odsotnost

Sources/Viri: 1 (Gallardo *et al.*, 1993; Giaccone, 1978), 2 (Matjašič & Štirn, 1975), 3 (Vuković, 1980, 1981, 1982, 1984), 4 (Battelli, 1997), 5 (this work), 6 (van den Hoek, 1963)

SPECIES	Diameter of apical cells (µm)	Insertion of the branches	Cross-walls	Cell walls	Rhizoids
<i>C. hutchinsiae</i>	90-190	apical/oblique	oblique	thin	coralloid holdfast
<i>C. lehmanniana</i>	100-150	apical/oblique	oblique	thin	coralloid holdfast
<i>C. nigrescens</i>	40-60	lateral	vertical	thick	annular constrictions

Tab. 2: General synoptic table of the basic characteristics of the dealt with species of the genus *Cladophora*.

Tab. 2: Splošna preglednica osnovnih lastnosti obravnavanih vrst iz rodu *Cladophora*.

ACKNOWLEDGEMENTS

The author is greatly indebted to Prof. dr. Giuseppe Giaccone, algologist from Department of Botany at the University of Catania (Italy), for revising the manuscript, Dr. Di Martino Vincenzo and Dr. Blundo Maria Concetta for their help in identifying the *Cladophora* samples. We wish to express special thanks to Prof. Dr. Christian van den Hoek from Dept. of Marine Biology at the University of Groningen (Netherlands) for his precious information on *Cladophora* species. Further thanks are due to Marjan Richter for his photographic material.

PRVO ZABELEŽENO POJAVLJANJE TREH VRST IZ RODU *CLADOPHORA* KÜTZING V SLOVENSKEM OBALNEM MORJU

Claudio BATTELLI

Univerza v Ljubljani, Pedagoška fakulteta - Enota v Kopru, SI-6000 Koper, Cankarjeva 5

POVZETEK

V članku obravnavamo tri vrste iz rodu *Cladophora*, ki doslej niso bile zabeležene v slovenskem obalnem morju. To so: *C. hutchinsiae* (Dillwyn) Kützinger, *C. lehmanniana* (Lindenberg) Kützinger in *C. nigrescens* Zanardini ex Frauenfeld. Raziskovano je bilo območje jugovzhodnega dela Tržaškega zaliva od Debelega rtiča (Koprski zaliv) do izliva reke Dragonje (Piranski zaliv) v mediolitoralu in v infralitoralu do globine 6-8 m. Vzorci so bili nabrani od julija do septembra 1998. leta med prostim potapljanjem na naslednjih postajah: Debeli rtič, Smedelski zaliv, Žusterna, obala Koper-Izola, zaliv San Simon, Strunjanski zaliv, Strunjanska laguna, Fiesa, rt Madona, Lucija in Sečoveljske soline. Vzorci so shranjeni kot suhi preparati v algariju in kot mokri preparati v 4-5 % metanalu (formalinu) v morski vodi. Za vsako obravnavano vrsto podajamo splošne morfološke značilnosti in geografsko razširjenost v svetovnih morjih ter podatke o rastiščih v slovenskem obalnem morju. Dodajamo preglednico, ki ponazarja pojavljanje vrst iz rodu *Cladophora* v Jadranskem morju, v Tržaškem zalivu in v slovenskem obalnem morju. Na koncu podajamo tudi splošno preglednico osnovnih lastnosti obravnavanih vrst.

Ključne besede: *Cladophora*, zelene alge, pojavljanje, slovensko obalno morje

REFERENCES

- Accurti, G. (1858): Cenno sulle alge di Capodistria. Programma dell' I.R. ginnasio di Capodistria. Trieste, Lloyd Austr., 1-9.
 Battelli, C. (1997): Prispevki k poznavanju makrobentoskih alg slovenskega obalnega morja: rod *Cladophora* (Chlorophyta). Annales, 11, 47-56.

- Burrows, E. M. (1991): Seaweeds of the British Isles. Vol. 2: Chlorophyta. Nat. Hist. Mus., London, xi- 238.
 Gallardo, T., A. Gomez Garretta, M. A. Ribera, M. Cormaci, G. Furnari, G. Giaccone & Ch. F. Boudouresque (1993): Check list of Mediterranean Seaweeds II. Chlorophyta. Bot. mar., 36(5), 399-421.

Giaccone, G. (1972-1973): Elementi di botanica marina II. Chiavi di determinazione per le alghe e le angiosperme marine del Mediterraneo. Pubbl. Ist. Bot. Univ. Trieste, serie didattica, 4-121.

Giaccone, G. (1978): Revisione della flora marina del mare Adriatico. Suppl. WWF, TS, 6/19, 108-111.

Hoek, C. van den (1963): Revision of the European species of *Cladophora*. Leiden, E. J. Brill, 248 pp.

Matjašič, J. & J. Štirn (1975): Flora in favna severnega Jadrana. Pris. 1., SAZU, Ljubljana, 4, 19-23.

Noailles, M. C. (1995): Les especes de *Cladophora* (Chlorophyta) les plus communes des côtes Nord-Finistère, région de Roscoff en particulier (France). Cah. Biol. Mar., 36, 81-121.

Vukovič, A. (1980): Asociacije morskih bentoških alg v Piranskem zalivu. Biol. vestn., 28(2), 103-124.

Vukovič, A. (1981): Značilnosti bentoških združb v izol-skem zalivu. Slovensko morje in zaledje, 4-5, 101-106.

Vukovič, A. (1982): Bentoška vegetacija Koprškega zaliva. Acta Adriatica, 23(1/2), 227-235.

Vukovič, A. (1984): Prispevek k poznavanju flore morskih alg Slovenije. Slovensko morje in zaledje, 7(6-7), 187-193.