

THE MORE FREQUENTLY OCCURRING MACROALGAE IN ALBANIAN RUNNING WATERS

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Abstract

Little information exists on macrophytic freshwater algae in Albania. Therefore, a preliminary list of species encountered by us is given here, focused mainly in the occurrence of *Chara*, *Chladophora* and *Hydrurus* in running waters. About 25 taxa of macroalgae have been mentioned, but the complete list and distribution is far to be complete. Data on the most dominant periphyton community (diatoms) is also given, mostly for *Chladophora* and *Hydrurus*. The study of macrophytic algae is important either to know and complete further the biodiversity of our freshwaters, but also to assess the bioquality and human impact in the freshwater ecosystems, or to forecast their economical benefits and harmful effects.

Keywords: Albanian freshwaters, macrophytic algae, periphyton community.

Përmbledhje

Pak të dhëna ka lidhur me algat makrofite të ujërave të ëmbla në Shqipëri. Për këtë, këtu jepet një listë paraprake llojesh të takuara prej nesh, duke u përqendruar kryesisht në përhapjen e gjinive *Chara*, *Chladophora* dhe *Hydrurus* në ujërat e rrjedhshme. Përmenden rreth 25 taksa algash makrofite, por është ende herët që kjo listë të jetë e plotë. Jepen gjithashtu të dhëna mbi llojet mbizotëruese në perifitonin e tyre (diatometë), kryesisht për llojet *Chladophora* dhe *Hydrurus*. Studimi i algave makrofite ka rëndësi, jo vetëm për njohjen dhe plotësimin më tej të njohurive mbi biodiversitetin e ujërave tona të ëmbla, por edhe për të vlerësuar cilësinë biologjike dhe ndikimin e njeriut në këto ekosisteme, ose të parashikohen vlerat ekonomike të tyre dhe ndikimet e dëmshme.

Fjalëkyçe: Ujërat e ëmbla shqiptare, algat makrofite, perifitoni mbizotërues.

Introduction

Algae are a diverse group of photosynthetic organisms that vary considerably in size, shape, and growth form, from single cells, filamentous or colonial (both microscopic) to fairly complex multi-cellular organisms (macrophytic). The macroalgae are large enough either as individuals or communities to be readily visible without the aid of optical magnification. They resemble true plants in that appear to have stems and leaves and are attached to the bottom. Many algal taxa have particular environmental tolerances or requirements, and are ecologically restricted, but still geographically widespread (Wehr & Sheath, 2003)

The main groups of macroalgae that may occur in Albanian freshwater are Green Algae (Chlorophyta), Stonewort (Charophyta), and less common belong to Red Algae (Rhodophyta), Yellow-Green Algae (Tribophyta), etc.

This paper presents a preliminary list of species encountered by us in running waters in the last years, including those previously recorded. Some taxa are not identified at the species level, but as a first approach this publication may help and stir up the interested researchers to deal with it in the future.

Material and methods

Data were based mostly in the personal algal material of L. Kashta, collected in field trips throughout Albania, and on periphyton samples collected in years by A. Miho and his collaborators during bioquality survey on freshwaters (rivers). Some of the periphyton samples had casually submersed macroalgae, where benthic microscopic algae (diatoms) were examined and the quality indexes were calculated, belonging first to the bioquality study in most impacted rivers of the Adriatic Lowlands (2002-2004) (Miho *et al.*, 2005; 2010; Kupe, 2006), in rivers throughout Albania (Miho *et al.*, 2010; Meço *et al.*, 2014), and other present approaches in process. For the macrophytic species encountered in periphyton samples, data on most dominant diatoms are given (that represent relatively more than 3-4% of the periphyton community) and of biological quality of the water, as well. The methods of study and more detailed data about it are given in publications of Miho *et al.* (2005; 2010), Kupe (2006), Meço *et al.* (2014), Miho *et al.* (2014), etc.

The species identification was carried on using keys of Bazzichelli & Abdelahad (2009), Bellinger & Sigeo (2010), Bourrelly (1970-1981), Cirujano *et al.* (2007), Krammer & Lange-Bertalot (1986-2001), Krause (1997), AlgaeBase (Guiry & Guiry, 2016), etc.

Results and discussion

Among the freshwater macroalgae of Albania, charophytes are the most known. Out of 47 species recorded in the Balkans (Blaženčić *et al.*, 2006), 24 species were found in Albania, mostly from northern and north eastern parts of the country (Kashta, 1994; 2009; Rakaj & Kashta, 1999; Hospers & Hospers, 2001; Kashta *et al.*, 2013; Langangen, 2015). Most of them are found in stagnant waters (lakes, ponds and reservoirs). There are also few records on other algae in rivers of Albania: *Bangia atropurpurea* (Vau i Dejes, Drini river); *Lemanea fluviatilis* (Shkumbini river, close to village Xhyre); *Hydrurus foetidus* (Tamara, Cemi river; Thethi river) (Kashta, 1994).

About 25 taxa of macroalgae have been mentioned for Albanian running waters, but the full list and distribution is far to be complete. The main

genera and species encountered by us in fresh waters are discussed in the following.

Charophyta

The Chara species occur mainly in fresh water, particularly in limestone areas throughout the northern temperate zone, where they grow submerged, attached to the muddy bottom. They prefer less oxygenated and hard water, and are covered with calcium carbonate deposits (Bellinger & Sigee, 2010).

***Chara aspera* Detharding ex Willdenow:** Velipoja (Shkodra), close to the mouth of Buna river, 16.05.2006 (Kashta, 2009). *Chara aspera* has been reported from Shkodra and Vlora coastal area and from Lake Ohrid (Kashta, 2009; Kashta *et al.*, 2013).

***Chara connivens* Salzmann ex A.Braun:** Velipoja (Shkoder), close to mouth of Buna river, 16.05.2006 (Kashta, 2009);

***Chara globularis* Thuillier:** torrent in the hilly area of Bardhaj (Shkodra), 04.06.1985 (Kashta, 1994);

***Chara gymnohylla* A.Braun:** Drini river (Kulla e Lumes, Kukesi), leg. Kümmerle, 1918 (Filarszky, 1926); Srica river (Petka, Kukesi) (Kosanin, 1939); Tamara, in slow-flowing watercourse close to Cemi river, 05.07.2006; Bardhanjor (Shkodra), small pond in the torrent to the left of the village, 08.10.2001 (Kashta, 2009); Terkuza stream, (Bovilla, Tirana), 24.11.2007; Linza torrent, south-west of Dajti mountain, 08.10.2006; Mati river, close to Skuraj village, in pools on the riverbed, 05.10.2006; Shkumbini river, near Librazhdi, 26.10.2006; Devolli river, close to Bilishti, 22.08.2011; Devolli, about 4 km far from Gramshi, in slowly flowing waters, 25.10.2006; Kodovjati, cold watercourse, about 18 km from Gramshi, 25.10.2006; Helmësi (Korça), torrent along the road Erseka - Korça, 20.10.2006; watercourse in Qafe Molla, near Tirana, 02.07.2006 (Fig. 1A); thermal springs of Benja, Permeti, 27.06.2006; Llogara, watercourse, 27.6.2012; Shkumbini river, close to village Dritaj, leg. Muzhaqi (2012), det. Kashta; upstream of Osumi river (Vithkuqi, Leshnje), 04.11.2011;

***Chara gymnohylla* f. *condensata* Sydow:** Boboshtica torrent (Korça), in serpentine soil, 16.10.2007.

***Chara vulgaris* var. *vulgaris* L.:** Drino river (Tepelena), in slow flowing water, 19.10.2006; Rodoni Cape (Durrësi), a small watercourse, 15.09.2014; *C. vulgaris* is a common species in Albania

***Chara vulgaris* f. *longibracteata* (Kützting) H.Groves & J.Groves:** Korça, drainage channel near the village Zgradeci, 27.07.2006; Devolli river, Poloska bridge, 27.07.2006; Shkumbini river, Librazhdi near the village Dritaj, 15.10.2007; Drino river, Tepelena, in slow flowing water, 19.10.2006; thermal springs of Benja, Permeti, 27.06.2006.

Chara vulgaris var. *papillata* K.Wallroth: Velipoja (Shkodra), near the Buna river mouth, 16.05.06.

Nitella batrachosperma (Thuillier) A.Braun: Velipoja (Shkodra), near the Buna river mouth, 27.05.1999 (Kashta, 2009).

Zygnema sp. (*Zygnematophyceae*) was encountered in Valbona springs (Bajram Curri) in July 2012, together with *Hydrurus foetidus*. Diatom community was dominated by *Achnanthes minutissima* (up to 71%), mixed with *Encyonema minutum*, *Diatoma mesodon*, *Gomphonema micropus*, *G. pumilum*, *Navicula cryptotenelloides*, etc. (Meço *et al.*, 2014).

Xanthophyta

Vaucheria sp. was mentioned occasionally in a torrent in Shishtaveci (Kukesi), in September 2009 and in Erzeni river (Tirana), in April 2012

Tribonema cf. *minus* (Wille) Hazen was encountered very dense in the thermal springs Llixha (Peshkopi), in July 2014; *Tribonema* sp. was mentioned also in Curraj Mill (Valbona, Bajram Curri) in July 2012.

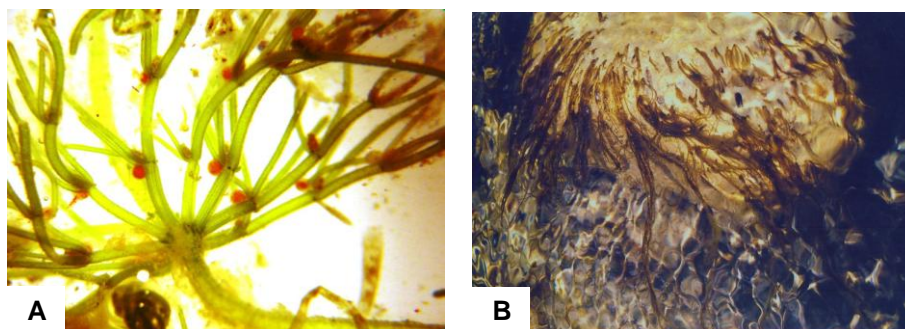


Figure 1: A, *Chara gymnophylla*, from a watercourse in Qafe Molla, near Tirana, 2006; B, *Hydrurus foetidus*, Cemi river (Photos: L. Kashta)

Chrysophyta

Hydrurus foetidus (Villars) Trevisan was found in streams and rivers in mountainous region of Northern Albania, characterized by cold waters of very good quality (Meço *et al.*, 2014), i.e. along upstream of Cemi river (Tamara, Bordoleci), respectively in July 1976 and June 1980 (Kashta, 1994); Thethi River in October 1976 (Kashta, 1994); along Valbona river (Shoshani, Curraj, Valbona village) in July 2011 and 2012; along Cemi river in June 2005 (Fig. 1B), July 2006 and June 2012; in Lepusha and Vermoshi rivers (Sheu Lepushes, Vermoshi), June 2011 and 2012; very dense in Radomira river (1200 m) and Radomira torrent (1600 m, Peshkopi); dense in Kurbneshi river (downstream Merkurthi), in April 2013; very dense in Mati river (downstream Grykes se Vashave, Klosi) in July 2014, mixed also with other macrophytic algae: *Chaldophora* sp., *Lemanea* sp. and *Nostoc* sp. It is also found in mountainous districts of Central Albania, like in Bushtrica torrent (Librazhdi) in June 2012.

Its thalli, mucilaginous macroscopic colonies, are dark brown, branched and bushy, up to 20 cm long that can resist strong currents. It can be recognized by a characteristic powerful pungent odor emanated from collected samples. *Hydrurus foetidus* is an exclusive inhabitant of cold mountain streams, but it is distributed worldwide (Wehr & Sheath, 2003). Few samples were examined for the microphytic community, mostly dominated by *Achnanthes minutissima* (up to 70%), with *Diatoma mesodon*, *Encyonema minutum*, *Gomphonema micropus*, *G. pumilum*, *Navicula cryptotenelloides*, etc.

Rhodophyta

Freshwater red algae (Rhodophyta) appear to be a threatened algal group in many European countries (Eloranta & Kwandrans, 2004).

***Bangia atropurpurea* (Mertens ex Roth) C.Agardh:** Drini river (Vau i Dejes, Shkodra) in June 1974 (Kashta, 1994) and near Shkodra in July 2007 (Fig. 2A); Dukati river (Vlora) in April 2007; Black Drini (Topojani, Peshkopi) in July 2014.

***Batrachospermum gelatinosum* (Linnaeus) De Candolle:** Terkuza stream (Bavilla, Tirana) in June 1997 (Fig. 2C).



Figure 2: A, *Bangia atropurpurea* from Drini river, 2007; B, *Paralemanea catenata*, Shkumbini river, 2011; C, *Lemanea* sp. from Vermoshi river, 2011; D, *Batrachospermum gelatinosum* from Terkuza stream, Tirana (Photos: L. Kashta)

***Batrachospermum* sp.:** Vermoshi (14.07.1976), mucilaginous tuft of brown - olive colour on a wood immersed in a source of cold water; Lezha (09.06.1978), on boulders, in running cold water, near a spring (Kashta, 1994); upstream of Cemi river (Kelmendi; Malesi e Madhe).

Paralemanea catenata (Kützing) M.L.Vis & R.G.Sheath was found in Shkumbini river, early in August 1973 (Kashta, 1994 as *Lemanea fluviatilis*) and recently in July 2011, leg. Muzhaqi, det. Kashta (Fig. 2B).

Lemanea spp. (under identification to species level) were encountered by us in Vermoshi river in June 2011 (Fig. 2C); in Valbona river in July 2011; in Gryka e Çajes (Kukesi) in June 2012; in Mati river (downstream Grykes se Vashave, Klosi) in July 2014, mixed also with other macrophytic algae: *Chldophora* sp., *Hydrurus foetidus* and *Nostoc* sp.; in Bulqiza river (Valikarth) in July 2014, mixed with *Chldophora* sp. and mosses. They are generally indicators of good water quality (Eloranta & Kwandrans, 2004). In Austria *Lemanea* is regarded as indicative of high-altitude streams with low nutrients (Pipp & Rott, 1994).

Chlorophyta

Cladophora glomerata (L.) Kützing seems to be the most common filamentous green alga in Albanian rivers (Miho *et al.*, 2005; Kupe, 2006); but we do think that other species within the genus can also be. Its blooming period is May-July, and mostly in waters with moderate-good quality (Miho *et al.*, 2005; 2010; Kupe, 2006). *Cladophora* was never found in heavy turbid parts of rivers in Adriatic Western Lowland, like in rivers Tirana, Lana and Gjola downstream Tirana town, Gjanica (downstream Fieri), Semani (Mbrostari), Drini downstream (Lezha). It was found in Shkumbini (very dense in Qukesi, in Labinot Fushe, Paperi, Rogozhina) (Fig. 3A); Osumi (upstream Berati, Ura Vajgurore), Tirana (Brari), Devolli (Zvezda) in Mati (Shkopeti, Miloti) during the spring period 2002-2004; in Mati (downstream Grykes se Vashave, Klosi) in July 2014; Roskoveci-Hoxhara drainage channel (Fieri), Gjanica (upstream Fieri), Vjosa (Mifoli), in April 2012; in Valbona (Bujani, Bajram Curri) in July 2012; in Black Drini (Topojani, Peshkopi) in April 2013 and July 2014; in Bulqiza river (very dense in Gjorrica and Valikarthi) in July 2014; in a torrent Shishtaveci (Kukesi) in June 2013; etc.

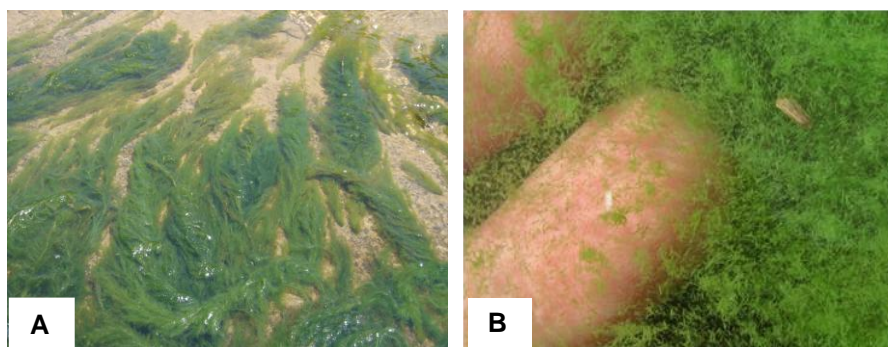


Figure 3: **A**, *Cladophora glomerata*, from Shkumbini river, Qukesi, June 2010; **B**, flocks of blooming *Aphanizomenon flos-aquae*, from Fierza lake, Kukesi, July 2014 (Photos: respectively L. Kashta; A. Palushi).

Chladophora host dense periphyton composed mostly of *Achnanthes minutissima* (up to 30%), *Navicula veneta* (18%), *Gomphonema parvulum* (11%), *Nitzschia incospicua* (10%), *N. palea* (4%) (in relatively polluted waters like Gjanica upstream Fieri) (Miho *et al.*, 2005; Kupe, 2006; Miho *et al.*, 2010); or in Roskoveci-Hoxhara channel (Fieri) only by *Cocconeis pediculus* (up to 84%) and *Gomphonema parvulum* (11%); in Mati (Miloti) by *Achnanthes minutissima* (53-90%), mixed with *Cocconeis pediculus* and *Cymbella microcephala*; in Valbona (Bujani) dominated by *Achnanthes minutissima* (10%), *A. biasoletiana* (27%), *Gomphonema pumilum* (30%), and *G. tergestinum*, *G. micropus*, *Diatoma ehrenbergii*, *D. vulgaris*; in Topojani (Black Drini) dominated mainly by *Diatoma vulgaris* (up to 56%) and *D. ehrenbergii* (up to 11%), mixed with *Cocconeis pediculus*, *Fragilaria capucina*, *F. ulna*, *Gomphonema olivaceum* and *Nitzschia dissipata* (Meço *et al.*, 2014).

After Higgins *et al.* (2008), *Chladophora glomerata* is potentially the most widely distributed macroalga throughout the world's freshwater ecosystems. It is a fast growing species, probably due to the increase of eutrophication in rivers (nitrogen and phosphorous).

Oedogonium sp. was mentioned by us in a torrent in Grama (1700 m a.s.l.; Korabi, Peshkopi) in July 2014.

Hydrodictyon reticulatum (Linnaeus) Bory de Saint-Vincent was found in very slowly flowing waters near the village of Vau Deja Lac (Shkodra), 3.07.1974.

Spirogyra sp.: found abundand in Benja thermal springs, Permeti (11 May 2014) (Fig. 4A&B).

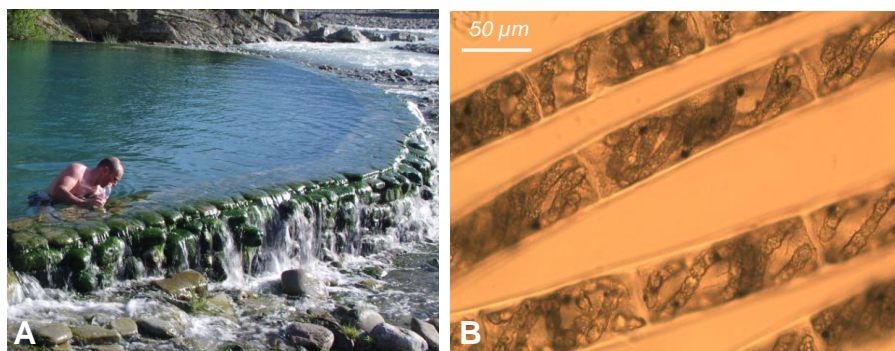


Figure 4: A, *Spirogyra sp.*, in Benja thermal springs, Permeti (11 May 2014) (Photo: A. Maxoni); B, colonies at the microscope.

Ulotrix sp. was found in slowly flowing water, near the village of Vau Deja Lac (Shkodra), 3.07.1974.

Draparnaldia glomerata (Vaucher) C.Agardh was mentioned by us in a source of cold water, close to Shkodra lake, in May 2003.

Bacillariophyceae

***Diatoma vulgare* Bory** is a microscopic diatom more or less common in the periphyton of running waters with good biological quality (Meço *et al.*, 2014). However, we have encountered it forming macroscopic colonies, dark brown, mucilaginous, similarly with *Hydrurus*, but thinner and unbranched, in Black Spring, Kelcyra, in November 2011. The diatom community was dominated by *D. vulgare* (69%), and with *Achnanthes minutissima*, *Cocconeis pediculus*, *Diatoma moniliformis*, *Gomphonema olivaceum*.

Cyanophyta

***Aphanizomenon flos-aquae* Ralfs ex Bornet & Flahault:** Miho *et al.* (2014) reported for the first time in Albanian fresh waters the presence of the bloom of *Aphanizomenon flos-aquae* (up to about 33 thousands trichomes/ml) in Fierza Lake, Kukesi, in July 2014. The bloom lasted quite shortly and its presence almost disappeared in August and later. In solitary trichomes it was found also in the phytoplankton of Bovilla reservoir (Tirana) (Miho *et al.*, 2009).

***Nostoc* spp.:** colonies of were encountered in Cemi river (Selce) growing together with *Hydrurus foetidus*, in June 2005; Mati river (downstream Grykes se Vashave, Klosi) in July 2014, mixed also with other macrophytic algae: *Chladophora* sp., *Lemanea* sp. and *Hydrurus foetidus*; Shkumbini river (Kukesi) in June 2010. *Nostoc* species form olive-green coatings and are more frequent about the water line in rivers and ponds.

***Oscillatoria* sp.:** dense filamentous colonies of were found in thermal spring of Benja (Permeti), in October 2005. Microscopic diatoms were dominated by *Brachysira neoexilis* (up to 68%), *Diatoma moniliformis* (up to 22%), *Achnanthes minutissima* (9-31%), *Nitzschia elegantula* (up to 10%), and with *Encyonema ventricosum*, *Encyonopsis microcephala*, *Cymbella affinis*, *Fragilaria capucina*, *F. ulna*, *Navicula halophila*, *Nitzschia constricta*, *N. palea* var. *debilis*. *Oscillatoria* species are also known to produce toxic populations, or even coloring the water (i.e. the Red Sea) (SWCSMH, 2007).

As conclusion, macrophytic algae, like *Chara*, *Chladophora*, *Hydrurus*, *Lemanea*, etc. can be indicators of water quality, habitat integrity and human impact. As mentioned, the intense growth of macrophytic green or blue-green algae show heavy load of the water with the nutrients of human origin. The *Chladophora* species can be a major nuisance causing major alteration to benthic conditions linked particularly with increased phosphorus loading, as it was observed in Bulqiza river (Gjerica), in Shkumbini (Prrenjasi), etc. *Chladophora* is accused of damaging the fishing industry and shoreline property values. Nutrient pollution - an overabundance of nitrogen and phosphorus - can fuel algal blooms, as it was mentioned about the blooming of *Aphanizomenon flos-aquae* in Fierza (Kukesi). Some species of cyanobacteria can produce toxins and lead to harmful algal blooms that can be a concern for public health, recreation, fisheries and aquatic ecosystems.

On the other side, in some countries *Cladophora* or *Aphanizomenon* are commonly used as food. Therefore, the study of macroalgae is quite important either to know and complete further the biodiversity of our freshwaters, but also to assess the bioquality and human impact in the freshwater ecosystems, as precondition to forecast their economical benefits and harmful effects.

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