

Epiphytic algae of *Lemna minor* L. growing in natural habitat and aquarium

Pala G.¹; Selamoglu Z.^{2*}; Caglar M.¹

Received: September 2017

Accepted: November 2017

1-Department of Fundamental Science, Faculty of Fisheries, Firat University, Elazig, Turkey

2-Department of Medical Biology, Faculty of Medicine, Nigde Ömer Halisdemir University, Nigde, Turkey

*Corresponding author's Email: zselamoglu@ohu.edu.tr

Keywords: *Lemna minor*, Aquarium, Natural habitat, Epiphytic algae.

Introduction

Algae, which are one of the most relevant biological components in identification of environmental habitats in aquatic environments, are also used as bio-monitors in water quality detection. Diatoms, which are quite sensitive to changes in water chemistry, form a wide variety of niches in lotic environments. Most of them live on the rocks (epilithic), on the plants (epiphytic), on mud and silt (epipelic), or on the sand (episammic). These are important feeding and resting grounds for angiosperms, waterfowls, fishes and other organisms (Palmer, 1980).

L. minor is tall aquatic plants with leaf-like stems floating on the water surface either on their own or in groups of a few. Their leaf-like stems are thick and they contain entrapped air, lined up in two layers. Their upper surface is dark green, they may also turn into colors like red or pink (Altinayar, 1988).

In Turkey, there are many studies on epiphytic algae (Elmaci and Obali, 1999; Akkoz *et al.*, 2000; Albay and Aykulu, 2002; Soylu *et al.*, 2005; Maraslioglu *et al.*, 2007; Fakioglu *et al.*, 2014; Ozer and Pala, 2014).

Epiphytic algae form the most part of the algal flora of particularly shallow lakes, and contribute to the productivity of lakes largely. In this study, the epiphytic algae of *L. minor* collected from its natural habitat and of *L. minor* grown in aquarium were compared, and the reasons for similarities and differences between these two habitats were discussed.

Materials and methods

Lemna minor was collected from ponds within the borders of Elazığ province (Turkey) between April-September 2016. It was ladled out with an effort not to stir its contents and was placed in nylon bags. Epiphytic algae were extracted from *L. minor* by means of washing up with distilled water. For

species identification of diatoms, a sample of 20 ml was taken and treated by 10 ml HNO₃ + 10 ml H₂SO₄ acid. It was boiled on heat table at 120 °C for 15 minutes and turned into permanent preparates through purification with distilled water until it turned neutral (Round, 1953). For the identification of algae other than diatoms, temporary preparates were prepared with glycerin. The related sources were used in identification (Bourelly, 1968; Germain, 1981; Grimes and Rushforth, 1982; Krammer and Lange Bertalot, 1986, 1988, 1991a, 1991b; John *et al.*, 2002). Nikon-branded binocular microscope was used for counting the epiphytic diatoms and the results were given as "organism/ml". Sorensen Similarity Index was used to define the similarity between epiphytic algae.

Sorensen Similarity Index: $Q = 2J/A+B$

A=Total number of species in the first sample

B=Total number of species in the second sample

J=Number of species common to both samples (Sorensen, 1948).

Results and discussion

During this research, a total of 15 taxa, 1 belonging to Cyanophyta and 14 belonging to Bacillariophyta, were recorded for *L. minor* taken from aquarium, and a total of 36 taxa, 3 belonging to Cyanophyta, 5 belonging to Chlorophyta, 1 belonging to Euglenophyta, and 27 belonging to Bacillariophyta, were recorded for *L. minor* collected from natural habitat (Table 1).

While the algae recorded in samples taken from *L. minor* were the same for each month (Table 2), the algae recorded on *L. minor* collected from its natural habitat showed changes in some months (Table 3). This proves that natural habitat is affected by environmental conditions. Thus, Sorensen similarity index between the epiphytic algae of *L. minor* grown in aquarium and of *L. minor* collected from natural habitat was found as 39%. In this study, a total of 41 epiphytic algal taxa have been recorded. While 15 taxa were recorded on *L. minor* in aquarium, 36 taxa were recorded on *L. minor* in natural habitat. This may be regarded as an indication of the fact that natural habitat is under the influence of environmental conditions, and the conditions of an aquarium environment are stable. The high individual numbers of diatoms on *L. minor* in both environments prove that the diatoms are cosmopolitan and make better use of environmental conditions in comparison to other algae. The diatoms represented by the most number of species among the epiphytic diatoms were Navicula (5 species) and Cymbella (4 species). While the algae represented by the most number of species on *L. minor* in aquarium was Navicula (3 taxa), the algae represented by the most number of species on *L. minor* grown in natural habitat were Navicula (4 taxa), Scenedesmus (3 taxa), Cyclotella (3 taxa) and Cocconeis (3 taxa). These findings point to the fact that the species belonging to these types can grow better in their habitats compared to other algae. It was also reported by

Chessman (1986) that particularly the species *Navicula* and *Nitzschia* are cosmopolitan (Chessman, 1986). Moss (1988), underlined that although different algal groups can be found in epiphytic communities, diatoms are the permanent organisms of these communities.

Diatoms have been dominant organisms in epiphytic algae studies carried out in different regions of our country. Some of these studies are as follows: In the study titled Algal Flora of Beşgöz Lake (Sarayönü/Konya) by Akkoz *et al.* (2000), diatoms were the dominant organisms in the lake. In Pala (2014)'s study titled Epiphytic Diatom Flora in Hazar Lake (Suluçayır Plain), epiphytic algae were also completely composed of diatoms (Akkoz *et al.*, 2000; Pala, 2014). The reason why the algae recorded on *L. minor* grown in aquarium were the same and less in number compared to those in natural habitat might be the fact that the conditions do not change in aquarium environment. On the other hand, in natural environment, physical and chemical parameters constantly change according to environmental conditions.

In both environments, the centric diatoms on *L. minor* were inferior to pennate diatoms in terms of their number of species and number of individuals. Also in the study titled Epilithic and Epiphytic Diatoms in Pulus Creek (Erzurum) by Fakioglu *et al.* (2014), centric diatoms were far below pennate diatoms in terms of relative density (Fakioglu *et al.*, 2014).

In Pala (2014)'s study on Epiphytic Diatom Flora in Hazar Lake (Suluçayır Plain), while *Amphora ovalis*, *Synedra ulna*, *Cymbella affinis* and *Epithemia turgida* were among important diatoms, on *L. minor*, the diatoms *Amphora ovalis* and *Cymbella affinis* were detected but *Synedra ulna* and *Epithemia turgida* were not detected (Pala, 2014).

This study shows that among the epiphytic algal community, diatoms make better use of the conditions when compared to other algal communities; they are cosmopolitan and may be found on any kind of substrata.

Table 1: Presence features of the algae recorded on *Lemna minor* L. in aquarium and in natural habitat.

Algal taxa	<i>L. minor</i> (Aquarium)	<i>L. minor</i> (Natural habitat)
Cyanophyta		
<i>Chroococcus minutus</i> (Kütz.) Nageli	+	+
<i>Chroococcus turgidus</i> (Kütz.) Nageli	—	+
<i>Lyngbya digueti</i> Gomont	—	+
<i>Oscillatoria tenuis</i> C. Agardh ex Gomont	—	+
Chlorophyta		
<i>Ankistrodesmus falcatus</i> (Corda) Ralfs	—	+
<i>Coelastrum microporum</i> Nageli	—	+
<i>Scenedesmus arcuatus</i> (Lemmermann) Lemmermann	—	+
<i>Scenedesmus naegelli</i> Brebisson	—	+
<i>Scenedesmus quadricauda</i> (Turpin) Brebisson	—	+
Euglenophyta		

Table 1 continued:

<i>Euglena gracilis</i> G.A. Klebs	–	+
Bacillariophyta		
<i>Achnantheidium minutissimum</i> (Kütz.) Czarnecki	+	–
<i>Amphora ovalis</i> (Kütz.) Kütz.	+	+
<i>Cocconeis disculus</i> (Schumann) Cleve	–	+
<i>Cocconeis pediculus</i> Ehr.	+	+
<i>Cocconeis placentula</i> Ehr.	+	+
<i>Cyclotella glomerata</i> H. Bachmann	–	+
<i>Cyclotella kützingiana</i> Thwaites	+	+
<i>Cyclotella meneghiniana</i> Kütz.	–	+
<i>Cymbella affinis</i> Kütz.	–	+
<i>Cymbella cistula</i> (Ehr.) O. Kirchner	–	+
<i>Cymbella laevis</i> Nageli	+	–
<i>Cymbella neoleptoceros</i> Krammer	+	–
<i>Diatoma elongata</i> (Lyngbye) C.Agardh	–	+
<i>Diatoma vulgare</i> Bory	+	+
<i>Encyonema gracile</i> Rabenhorst	–	+
<i>Encyonema ventricosum</i> (C.Agardh) Grunow	–	+
<i>Fragilaria brevistriata</i> (Grun.) Grunow	–	+
<i>Gomphonema angustatum</i> (Kütz.) Rabenhorst	–	+
<i>Gomphonema gracile</i> Ehr.	–	+
<i>Mayamae atomus</i> (Kütz.) Lange-Bertalot	–	+
<i>Navicula cincta</i> (Ehr.) Ralfs	+	+
<i>Navicula gregaria</i> Donkin	+	+
<i>Navicula minima</i> Grunow	+	–
<i>Navicula phyllepta</i> Kütz.	–	+
<i>Navicula radiosa</i> Kütz.	–	+
<i>Nitzschia dissipata</i> (Kütz.) Rabenhorst	–	+
<i>Rhoicosphenia abbreviata</i> (C.Agardh) Lange-Bertalot	+	+
<i>Surirella minuta</i> Brebisson ex Kützing	–	+
<i>Surirella robusta</i> Ehr.	–	+
<i>Tryblionella angustata</i> W. Smith	+	–
<i>Tryblionella apiculata</i> W. Gregory	+	+

Table 2: Monthly (for 6 month) individual numbers in ml of the algae recorded on *Lemna minor* grown in aquarium.

Taxa	April	May	June	July	August	September
Cyanophyta						
<i>Chroococcus minutus</i>	6	8	2	2	2	4
Bacillariophyta						
<i>Cyclotella kützingiana</i>	5	7	3	5	4	5
<i>Achnantheidium minutissimum</i>	4	2	3	3	6	3
<i>Amphora ovalis</i>	3	1	5	3	3	4
<i>Cocconeis placentula</i>	2	6	5	7	7	6
<i>Cocconeis pediculus</i>	7	3	2	4	3	1
<i>Cymbella laevis</i>	1	3	1	1	2	1
<i>Cymbella neoleptoceros</i>	1	4	2	1	1	2
<i>Diatoma vulgare</i>	2	1	3	2	2	1
<i>Navicula cincta</i>	1	3	2	3	3	1
<i>Navicula gregaria</i>	1	4	1	2	2	1
<i>Navicula minima</i>	3	4	3	2	4	5
<i>Tryblionella angustata</i>	2	2	1	1	3	1
<i>Tryblionella apiculata</i>	3	1	2	3	2	2
<i>Rhoicosphenia abbreviata</i>	2	1	1	4	1	2

Table 3: Monthly (for 6 month) individual numbers in ml of the algae recorded on *Lemna minor* grown in natural habitat.

Taxa	April	May	June	July	August	September
Cyanophyta						
<i>Chroococcus minutus</i>	3	2	—	2	2	2
<i>Chroococcus turgidus</i>	—	1	2	1	—	—
<i>Lyngbya digueti</i>	2	3	3	—	1	4
<i>Oscillatoria tenuis</i>	7	2	3	2	1	5
Chlorophyta						
<i>Ankistrodesmus falcatus</i>	—	—	4	4	6	6
<i>Coelastrum microporum</i>	4	—	—	2	3	—
<i>Scenedesmus arcuatus</i>	—	—	4		8	4
<i>Scenedesmus quadricauda</i>	4	6	4	12	—	10
<i>Scenedesmus longus</i>	4	—	—	8	4	4
Euglenophyta						
<i>Euglena gracilis</i>	—	1	—	2	3	5
Bacillariophyta						
<i>Cyclotella meneghiniana</i>	2	9	17	5	4	8
<i>Cyclotella kützingiana</i>	7	13	2	4	1	3
<i>Cyclotella glomerata</i>	—	—	1	—	3	2
<i>Amphora ovalis</i>	4	3	21	9	7	6
<i>Cocconeis placentula</i>	42	14	8	6	10	7
<i>Cocconeis pediculus</i>	8	3	10	5	2	6
<i>Cocconeis disculus</i>	—	2	2	—	1	3
<i>Cymbella affinis</i>	4	11	5	24	50	38
<i>Cymbella cistula</i>	2	—	1	2	—	1
<i>Encyonema gracile</i>	—	3	2	2	7	—
<i>Encyonema ventricosum</i>	1	12	3	15	12	2
<i>Diatoma elongata</i>	5	4	19	6	2	3
<i>Diatoma vulgaris</i>	1	1	3	6	—	—
<i>Fragilaria brevistriata</i>	7	3	2	1	3	3
<i>Gomphonema gracile</i>	4	2	7	8	5	3
<i>Gomphonema angustatum</i>	2	3	1	2	7	5
<i>Mayamae atomus</i>	25	12	14	13	3	11
<i>Navicula cincta</i>	1	2	2	1	5	6
<i>Navicula gregaria</i>	—	3	1	2	4	6
<i>Navicula phyllepta</i>	8	4	7	6	5	3
<i>Navicula radiosa</i>	3	12	14	—	3	2
<i>Tryblionella apiculata</i>	1	2	5	—	—	—
<i>Tryblionella angustata</i>	12	8	—	3	—	—
<i>Nitzschia dissipata</i>	3	4	1	2	2	1
<i>Rhoicosphenia abbreviata</i>	2	2	3	4	8	8
<i>Surirella robusta</i>	—	—	2	2	3	2
<i>Surirella minuta</i>	1	1	2	—	1	2

Epiphytic diatoms are more readily available in the aquarium environment. Because the tap water is used in aquariums and the stones in the aquarium cause silicon to multiply and cause the diatoms to multiply. So the diatom type to be cultured can be obtained more easily than an aquarium.

References

Akkoç, C., Kucukoduk, M., Obali, O., Ozturk, C. and Dogan, H.H., 2000. Beşgöz Lake (Sarayönü/Konya) Alg Flora: Epilithic and Epiphytic Algae. *Selcuk University, Journal of Engineering, Science and Technology*, 1(16), 5-12.

- Albay, M. and Aykulu, G., 2002.** Invertebrate grazer-epiphytic algae interactions on submerged macrophytes in a mesotrophic Turkish Lake. *Ege University Journal of Fisheries and Aquatic Sciences*, 19 (1-2), 247-258.
- Altınayar, G., 1988.** Water weirs, Ministry of public works and settlement general directorate of state and water affairs, Ankara, Turkey. 239 P.
- Bourelly, P., 1968.** Les algues d'eau douce: initiation a la systematique. Vol. II: Les algues jaunes et brunes. Chrysophycees, pheophycees, xanthophycees et diatomees N. Baunes, Paris, France. 439 P.
- Chessman, B.C., 1986.** Diatom flora of an Australian River system: Spatial patterns and environmental relationships. *Freshwater Biology*, 16(6), 805-819.
- Elmaci, A. and Obali, O., 1999.** Algae flora of Akşehir Lake Coastal Area. *Turkish Journal of Botany*, 22, 81-98.
- Fakioglu, O., Sensurat, M., Atamanalp, M., Senel, T. and Arslan, H., 2014.** Pulur stream epilithic and epiphytic diatoms of pulur stream (Erzurum). *Journal of Egirdir Fisheries Faculty*, 8(1), 1-8.
- Germain, H., 1981.** Flora des diatomees diatomophycees. Societe Nouvelle Des Editions Boubée, Paris France. 444 P.
- Grimes, J. and Rushforth, S.R., 1982.** Diatoms of recent bottom sediments of Utah Lake, Utah U.S.A. *Bibliotheca phycologica Germany*, 55, 1-179.
- John, D.M., Whitton, B.A. and Brook, A.J., 2002.** The freshwater algal flora of the British Isles: An identification guide to freshwater and terrestrial algae, Cambridge University Press. Cambridge. 702 p.
- Krammer, K. and Lange-Bertalot, H., 1986.** Bacillariophyceae. 1. Teil: Naviculaceae. in Ettl, H., Gerloff, J., Heynig, H. and Mollenhauer, D. (eds) Süßwasser flora von Mitteleuropa, Band 2/1. Gustav Fischer Verlag: Stuttgart, New York. 876 P.
- Krammer, K. and Lange-Bertalot, H., 1988.** Bacillariophyceae. II. Teil: Bacillariaceae, Epithemiaceae, Surirellaceae in Ettl, H., Gerloff, J., Heynig, H. And Mollenhauer, D. (Eds) Süßwasser Flora Von Mitteleuropa, Band 2/2. Veb Gustav Fischer Verlag: Jena. 596 p.
- Krammer, K. and Lange-Bertalot, H., 1991a.** Bacillariophyceae. Iii. Teil: Centrales, Fragilariaceae, Eunotiaceae, in Ettl, H., Gerloff, J., Heynig, H. And Mollenhauer, D. (Eds) Süßwasser Flora Von Mitteleuropa, Band 2/3. Gustav Fischer Verlag: Jena. 576 P.
- Krammer, K. and Lange-Bertalot, H., 1991b.** Bacillariophyceae. Iv. Teil: Achnanthaceae, Kritische Ergänzungen Zu Navicula (Lineolatae) und Gomphonema, Gesamtliteraturverzeichnis Teil I-Iv. In Ettl, H., Gerloff, J., Heynig, H. And Mollenhauer, D. (Eds) Süßwasser Flora Von Mitteleuropa, Band 2/4. Gustav Fischer Verlag: Jena. 437 P.

- Maraslioglu, F., Soylu, E.N. and Gonulol, A., 2007.** Seasonal variation and occurrence of diatoms in mats of *Cladophora Glomerata* (Chlorophyta) in Lake Ladik, Turkey. *Cryptogamie Algologie*, 28(4), 373-384.
- Moss, B., 1988.** The ecology of freshwaters, man and medium, past to future 3rd edn. Blackwell Scientific Publications, Oxford, UK. 417 P.
- Ozer, G. and Pala, G., 2014.** Epiphytic algae of *Lemna minor* (L.) collected from some water resource in Elazığ. *Journal of Fisheries*, 29(2), 70-78.
- Pala, G., 2014.** Epiphytic diatoms of Hazar Lake (Suluçayır plain). *Firat University Journal of Science*, 26(1), 45-51.
- Palmer, C.M., 1980.** Algae and water pollution, Castle House Pub. Ltd., Newyork. 110 p.
- Round, F.E., 1953.** An investigation of two benthic algal communities in Malham Tarn, Yorkshire. *The Journal of Ecology*, 4(1), 174-197.
- Sorensen, T., 1948.** A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. *Kongelige Danske Videnskabernes Selskab*, 5(4), 1-34.
- Soylu, E.N., Marashoglu, F. and Gonulol, A., 2005.** Epiphytic diatoms on *Nuphar lutea* L. In three shallow Turkish Lakes. *Journal of Freshwater Ecology*, 20(44), 791-792.