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Determination of benthic algae at Karapınar Stream (Erdemli/Mersin)

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ABSTRACT

Inland waters have a wide variety of uses, such as agricultural, industrial and domestic activities, and quality of these waters is one of the main issues for their use. Inland waters can be grouped as lotic and lentic systems. Streams (part of the lotic system) are often investigated for their algal flora. Algae are abundant in such environments and they are widely used to assess trophic state of rivers and streams. In this study it was aimed to investigate the algal flora, considering that the physical and chemical properties of Karapınar stream is stable throughout the year and it is different from other habitats. The research was conducted between March 2019 and June 2019, identifying the benthic algae sampled from Karapınar stream in Mersin. Before sampling, the temperature, pH, dissolved oxygen and conductivity of water has been quantified. In this study, 33 taxa were identified. 30 of these taxa belong to Bacillariophyta, 1 to Cyanophyta, 1 to Charophyta, and 1 to Chlorophyta. Moreover, 6 taxa that belong to Bacillariophyta couldn't be identified in terms of their genus. The study shows that Bacillariophyta is the dominant divisio among the identified species. The taxa that have been found at Karapınar stream are first records in this area, and this contributes to Turkey's algal flora diversity research. Also, these taxa show that there is a need for further research before any kind of utilization of this stream.

K E Y W O R D S: Diatom, Benthic algae, Karapınar Stream, Mersin.

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1. Introduction

Inland waters consist from combination of lentic and lotic systems (Fakıoğlu, 2014). Water bodies in the lentic systems don't move continuously into a direction. These systems consist mostly of lakes, lagoons, wetlands, and marshy lands. However in lotic systems (river, stream, creek etc.), water bodies continuously move into a direction (Tanyolaç, 2006; Bulut, 2012; Bektaş, 2016). Rivers and streams are often used for navigation and fisheries and in time for domestic, agricultural, and industrial purposes. However anthropogenic activities, and the pollution cause loss of habitats and introduction of new species to these areas, thus accelerate the process of the change in rivers (Smol, 2008).

Diatoms (Bacillariophyceae) are microscopic algae, and one of the most abundant species in the rivers and streams, they are very important elements in the respect of biodiversity (Patrick, 1961). Despite it is not being exactly known how many species exist around the globe, the estimated number of orders is around 105 taxa (Mann & Droop, 1996). Diatoms show distributions in different formations within the lake and rivers systems, for instance planktonic diatoms live throughout the pelagic zone, benthic diatoms exist on the surfaces of rocks, stones, gravels and sand. They are always in replication and migration, and these characteristics give them the chance to react to the changes in the water accordingly (Charles & Smol, 1990; Kingston et al., 1992a). Diatoms are very sensitive to the physical and chemical changes in the rivers and streams. In this respect, they can be used as indicators about the environmental conditions of many aquatic ecosystems (Smol, 1992; Moser et al., 1996). Benthic diatoms are sessile in their aquatic environment, thus they can provide evidence about the quality of water at present and the past (Breen, 1998). Light sources, nitrogen and phosphorus, pH, temperature, and toxic compounds directly affect the diatom presence in aquatic environments. The effect of abiotic factors on diatom populations can change in accord with the climate, geological character of the area and the land utilization (Biggs, 1995; Stevenson, 1997).

There are many examples of usage of the diatoms for assessing the ecological situation in the rivers and streams. In the USA and Europe, diatoms are accepted as indicators in large scale environmental assessment programmes. (Kelly et al., 2009; Stoermer & Smol, 2010). One of these programmes is EPA (Environmental Protection Agency)'s assessment 'National Rivers and Streams Assessment' which the aim was to assess the quality of water between 2008 and 2011 in the USA (2016).

In this study, it is aimed to assess the quality of Karapınar stream water in Erdemli/Mersin by investigating the benthic algae.

2. Material and Method

Karapınar stream is at Elvanlı which is one of the villages in Mersin and jointly disembogue with Karacaoğlan stream. In this area, there is intense agricultural activity. In addition to domestic and agricultural usage of the stream, there are three rainbow trout production facilities (Figure 1.). One of these facilities is close to the stream, while the other two are on the same distributary but in a more distant position (Koca, 2014).

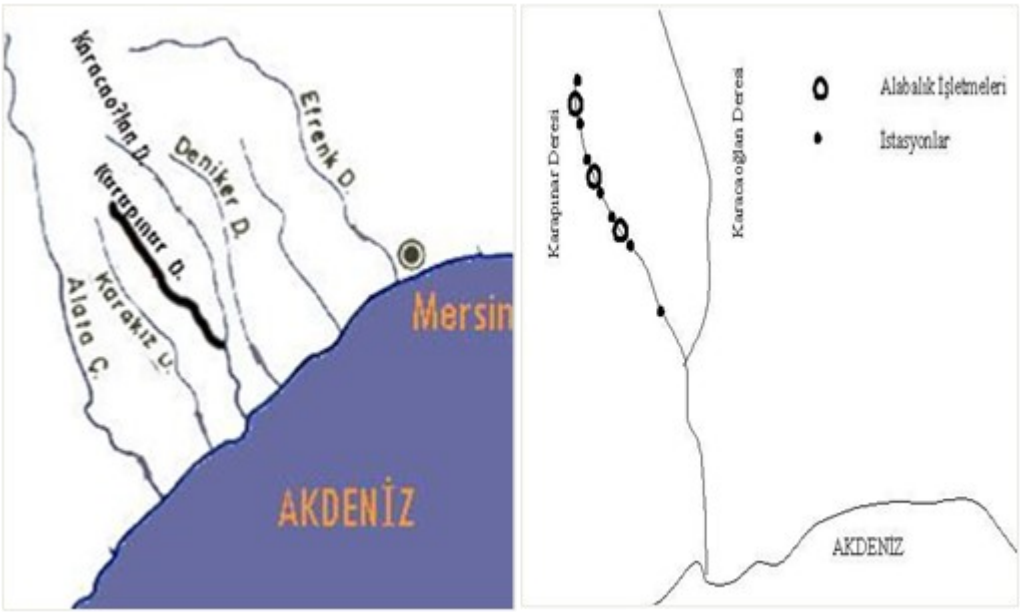

Figure 1. Karapınar stream, rainbow trout facilities, the sampling stations on the map (Koca, 2014).

For the sampling, the time was chosen when there is no rain and floods. The samples are taken between March and June 2019. While sampling is being done, the water temperature, pH, electrical conductivity, and dissolved oxygen levels in the water have been measured by Hach Lange multiparameter device (Table 1.).

Composite samples were prepared from river samples, and Olympus BX53 microscope and Supra 55 electron microscope in MEITAM (Mersin University Advanced Technology, Education, Research and Implication Center) were used to identify the algal flora.

For the identification of the algae samples, Foged (1981,1982,1985), Huber-Pestalozzi (1938, 1955, 1982), Hustedt (1985), John et al. (2002), Korshikov (1987), Krammer, Lange–Bertalot (1986,1988,1991a,1991b), Lund & Lund (1995), Patrick & Reimer, (1975), Prescott (1975), Round (1960), Sims (1996) & Wehr & Sheath (2003) and Algaebase, 2019 database were used.

3. Results

Minimum, maximum and average values of pH, water temperature, dissolved oxygen, and conductivity in the Karapınar stream are shared in Table 1.

Table 1. Chemical and physical properties of Karapınar stream

	pH	Water temperature (°C)	Dissolved oxygen (mg/L)	Conductivity (µs/cm)
Minimum	7.160	15.50	7.5	518
Average	7.227	15.57	8.1	520
Maximum	7.350	15.70	8.5	522

In Karapınar stream, measured dissolved oxygen level was rather low 7.5-8.5 mg/L, and the water temperature was 15 °C and stable throughout the year, also pH was almost neutral. Conditions for the habitat was novel, and that was very important for this study.

During the sampling, epilithic, epiphytic and epipelic samples are gathered from Karapınar stream. 33 taxa that mostly consisted of pennate diatoms have been found from the slides prepared for identification of algae. Among these diatoms, *Mastogloiales* order is abundant and diverse. In addition to that most of the benthic habitat consists of diatoms, this group is important for its members are used widely in the studies for monitoring the water quality (Çapar, 2008). The taxa that have been identified is shared in Table 2.

Table 2. Algal flora of Karapınar Stream

Alg Florası
Bacillariophyta
Achnanthes lanceolata var. *boyei* (Østrup) Lange-Bertalot
Achnanthidium minutissimum (Kützing) Czarnecki
Caloneis aerophila W.Bock
Caloneis silicula (Ehrenberg) Cleve
Fragilariforma bicapitata (A.Mayer) D.M. Williams & Round
Fragilaria crotonensis Kitton
Fragilaria vaucheriae (Kützing) J. B. Petersen
Gomphonema consector Hohn & Hellerman
Gomphonema parvulum (Kützing) Kützing
Gomphonema angustum C. Agardh
Meridion circulare (Greville) C. Agarh
Meridion constrictum Ralfs
Navicula cari Ehrenberg
Navicula cincta (Ehrenberg) Ralfs
Navicula phyllepta Kützing
Navicula metareichardtiana Lange-Bertalot & Kusber
Nitzschia acicularis (Kützing) W.Smith
Nitzschia balcanica Hustedt
Nitzschia fonticola (Grunow) Grunow
Nitzschia linearis W.Smith
Nitzschia palea (Kützing) W.Smith
Nupela neogracillima Kulikovskiy & Lange-Bertalot
Planothidium ellipticum(Cleve) M.B.Edlund
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot
Planothidium joursacense (Héribaud) Lange-Bertalot
Planothidium lanceolatum (Brébisson ex Kützing) Lange-Bertalot
Planothidium rostratum (Østrup) Lange-Bertalot
Psammothidium marginulatum (Grunow) Bukhtiyarova & Round
Pseudostaurosira brevistriata (Grunow) D.M.Williams & Round
Staurosirella lapponica (Grunow) D. M. Williams & Round
Cyanophyta
Nostoc spp.
Charophyta
Spirogyra spp.
Chlorophyta
Gloeotilopsis spp.

4. Discussion

There are a great number of studies that aimed to investigate the algal flora of many rivers and streams in Turkey.

Kara & Şahin (2001), identified a total number of 74 algae in Değirmendere stream. The distribution regarding their divisio is as follows; Bacillariophyta (52), Chlorophyta (10), Cyanophyta (9) and Euglenophyta (3).

Kalyoncu et al. (2008), conducted a study which they found taxa from Bacillaophyta (80), Chlorophyta (40), Cyanophyta (15), Euglenophyta (2) and Rhodophyta (1), 138 species in total.

Varol & Şen (2014), identified 390 taxa in Dicle river, 153 of these belong to Bacillariophyta, 125 to Chlorophyta, 72 to Cyanophyta, 29 to Euglenophyta, 5 to Chrysophyta, 3 to Pyrrophyta, 1 to Cryptophyta, 1 to Xantophyta, and 1 to Rhodophyta.

Baran (2015) found 154 taxa of which 113 belong to Bacillariophyta, 21 to Chlorophyta, 19 to Cyanophyta, and 1 to Euglenophyta in Tohma stream.

Yüce et al. (2018), identified 25 taxa, 20 of these belong to Bacillariophyta, 2 to Chlorophyta, 2 to Cyanophyta, 1 to Charophyta.

Considering the studies mentioned above, it can be said that members of Bacillariophyta divisio is mostly abundant in benthic algal flora of Turkey. Generally diatoms are accepted as good indicators for the freshwater systems. Ecological characteristics of the taxa that are identified in this study, can indicate the water quality of Karapınar stream. In previous studies, some of these taxa were also reported in respect their occurrence in the water systems. Some of them are as follows;

Achnanthidium minutissimum (Kützing) Czarnecki can be seen in alkali waters which have low-to moderate electrolyte content and they can be seen in the rivers polluted by sewage (Round, 1993).

Fragilaria crotonensis Kitton; this cosmopolit taxon, usually exists in the lakes and lentic systems, and can be seen in waters with moderate electrolyte content and mildly-eutrophic (Taylor et al., 2007).

Gomphonema angustum C. Agardh is situated in the waters with low-to moderate nutrient content, and water hardness (Patrick & Reimer, 1975).

Meridion circulare (Greville) C.Agarh; usually occurs in cold waters in the northern hemisphere, in rather small rivers and streams (Cassie, 1989).

Navicula cari Ehrenberg is another cosmopolit taxon and can be seen in waters with low-to moderate electrolyte content which are low-to moderate eutrophic. They are rarely seen in low nutrient waters (Lange-Bertalot, 2001).

Navicula cincta (Ehrenberg) Ralfs, occurs in oligotrophic and calcareous-rich waters.

Nitzschia fonticola (Grunow) Grunow is also a cosmopolit taxon which occurs in water with moderate to high electrolyte content, and can be seen in polluted waters in very low concentrations. It is often regarded as an indicator that shows water is clean.

Nitzschia linearis W.Smith, can be seen in many ecological conditions, occurs in waters that are oxygen rich, moderate to high electrolyte content. This taxon has tolerance for moderately polluted waters.

Nitzschia palea (Kützing) W.Smith is a cosmopolit taxon which often occurs in eutrophic and highly polluted waters with moderate to high electrolyte content (Taylor et al., 2007).

Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot is a very widely distributed taxon among benthic diatoms, and it has very high tolerance to pollution.

Planothidium joursacense (Héribaud-Joseph) Lange-Bertalot, this taxon indicates that the rivers and lakes they occur in are very high quality (Bishop & Potapova, 2017).

When considering the conditions that all these taxa (*Achnanthidium minutissimum* (Kützing) Czarnecki , *Nitzschia linearis* W. Smith, *Nitzschia palea* (Kützing) W.Smith , *Fragilaria crotonensis* Kitton, *Navicula cari* Ehrenberg, *Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot) are present in the study area, it can be said that they exist in moderate to highly polluted waters. Though our sampling area was not in the route of direct pollution, and normally the expectation would be that this stream is a clean water source, the identified taxa are related to moderate pollution in lotic systems. The reason for that can be the nearby rainbow trout production facilities and the intense agricultural activities.Therefore the anthropogenic pressure

seems to be very high, and the water quality is close to eutrophic waters. All these indicate that the water quality is not as good as it would have been expected.

5. Conclusion

Similar to the studies which were conducted previously, species that belong to Bacillariophyta divisio, are also dominant in regard to their diverse range of species and population. The identified taxa in this study are first records for the Karapınar stream and can make contribution to Turkey's algal flora studies in this regard. At the same time, these taxa indicate that the water is very polluted with anthropogenic effects. It is recommended that this stream should be further investigated before any utilization.

References

Exopolysaccharides : Composition, Biosynthesis and Biotechnological Applications. In: A.K. Mishra, D.N. Tiwari, A.N. Rai (Eds), Cyanobacteria, Academic Press, London, pp 347-358.

Baran, N. (2015) Tohma Çayı'nın (Malatya) Bentik Algleri ve Mevsimsel Değişimlerinin İncelenmesi. Yüksek Lisans Tezi, Fırat Üniversitesi, Elazığ.

Bektaş, S. (2016) Samsun Mert Irmağı Alg Florası Üzerine Araştırmalar. Yüksek Lisans Tezi, Ondokuz Mayıs Üniversitesi, Samsun.

Biggs, B. J. F. (1995) The Contribution of flood disturbance, catchment geology and land use to the habitat template of periphyton in stream ecosystems. Freshwater Biology, 33, 419–38.

Bishop, I., Potapova, M. (2017) In Diatoms of North America. Reached 30 July 2019 on https://diatoms.org/.

Breen, P. (1998) Diatoms, ecosystem health assessment and water quality biomonitoring. In Newell, P. (Ed), *Proceedings of the First Australian Diatom Workshop, Deankin University, Australia*.

Bulut, D. (2012) Samsun Kürtün Çayı Alg Florası Üzerine Araştırmalar. Yüksek Lisans Tezi, Ondokuz Mayıs Üniversitesi, Samsun.

Cassie, V. (1989) A contribution to the study of New Zealand diatoms. Biblioth Diatomol, 17:1–266.

Charles, D. F., Smol, J. P. (1990) 'The PIRLA II Project: Regional Assessment of Lake Acidification Trends', Verh. Int. Verein. Limnol. 24, 474--480.

Çapar, S. (2008) Sulak Alan Siliatları (Protozoa: Ciliophora) ve Morfolojik Farkları. E.Ü. Su Ürünleri Dergisi, 25(4), 359-364.

Fakıoğlu, Y. E. (2014) Akgöl Lagünü (Silifke/Mersin) Su Kalitesi ve Alg Florasının Belirlenmesi. Yüksek Lisans Tezi, Mersin Üniversitesi, Mersin.

Foged, N. (1982) Diatoms in Bornholm, Denmark. J. Cramer, Germany, 174.

Foged, N. (1985) Diatoms in Samos, a Greek Islands in the Aegean, Diatoms in Kos and Kalymnos, two Greek Islands in the Aegean. J. Cramer, Germany, 105.

Foged, N. (1981) Diatoms in Alaska, Germany. J. Cramer, Germany, 310.

Huber–Pestalozzi, G. (1938) Das Phytoplankton Des Süβwassers 1. Teil. Germany: E. Schweizerbartsche Verlagsbuchhandlung.

Huber–Pestalozzi, G. (1955) Das Phytoplankton Des Süβwassers 4. Teil Euglenophyceen. Germany: E. Schweizerbart'sche Verlagsbuchhandlung.

Huber–Pestalozzi, G. (1982) Das Phytoplankton Des Süβwassers 8. Teil Conjugatophyceae. Zygnematales and Desmidiales. Germany: E. Schweizerbart'sche Verlagsbuchhandlung.

Hustedt, F. (1985) The Pennat Diatoms a translation of hustedt's "die kieselalgen, 2. teıl " with supplement by Norman G. Jensen, Germany. Koeltz Scientific Books, pp: 917.

Kalyoncu, H., Barlas, M., Yorulmaz, B. (2008) Aksu Çayı'nda (Isparta-Antalya) Epipelik Alg Çeşitliliği ve Akarsuyun Fizikokimyasal Yapısı Arasındaki İlişki. Ekoloji Dergisi, 66, 15 22.

Kara, H., Şahin, B. (2001) Epipelic and Epilithic Algae of Değirmendere River (Trabzon-Turkey). Turkish Journal of Botany, 25(4), 177-186.

Kelly, M., Bennett, C., Coste, M. (2009a) A comparison of national approaches to setting ecological status boundaries in phytobenthos assessment for the European Water Framework

Directive: results of an intercalibration exercise. Hydrobiologia, 621, 169–82.
Kingston, J. C., Birks, H. J. B., Uutala, A. J., Cumming, B. E, and Stool, J. E. (1992a) 'Assessing Trends in Fishery Resources and Lake Water Aluminum from Paleolimnological Analyses of Siliceous Algae', Can. J. Fish. Aquat. Sci. 49, 116-127.
Koca, H. M. (2014) Karapınar Deresi(Erdemli/Mersin) Üzerinde Bulunan Alabalık Tesislerinin Su Kalite Parametrelerine Olan Etkileri. Yüksek Lisans Tezi, Mersin Üniversitesi, Mersin.
Korshikov, O. A. (1987) The Fresh Water Algae of the Ukrainian SSR. Bishen Singh Mahendra al Singh and Koletz.
Krammer, K., Lange–Bertalot, H. (1986) Süβwasserflora von Mitteleuropa, Bacillariophyceae Band 2 / 1, 1. Teil: Naviculaceae. Stuttgart: Gustav Fischer Verlag.
Krammer, K., Lange–Bertalot, H. (1988) Süβwasserflora von Mitteleuropa, Bacillariophyceae Band 2 / 2, 2. Teil: Bacillariaceae, Epithemiaceae, Surirellaceae. Stuttgart, Gustav Fischer Verlag.
Krammer, K., Lange–Bertalot, H. (1991a) Süβwasserflora von Mitteleuropa, Bacillariophyceae Band 2 / 3, 3. Teil: Centrales, Fragilariaceae. Stuttgart; Gustav Fischer Verlag.
Krammer, K., Lange–Bertalot, H. (1991b) Süβwassers von Mitteleuropa, Bacillariophyceae Band 2 / 4, 4. Teil: Achnanthaceae, Kritische Ergönzungen zu Navicula (Lineolatatae) ubnd Gomphonema Gesamtliteraturverzeichnis. Stuttgart: Gustav Fischer Verlag.
Lund, H. C., Lund, W. G. J. (1995) Freshwater algae their microscopic world explored. Biopress Ltd.
John, D.M., Whitton, B.A., Brook, A.J. (2002) The freshwater algal flora of the British Isles: an identification guide to freshwater and terrestrial algae. Cambridge: Cambridge University Press.
Mann, D. G., Droop, J. M. (1996) Biodiversity, biogeography and conservation of diatoms. Hydrobiologia, 336, 19–32.
Moser, K. A, MacDonald G. M, Smol J. P. (1996) Applications of freshwater diatoms to geographical research. Progress in Physical Geography: Earth and Environment.; 20(1):21-52.
Patrick, R. (1961) A study of the numbers and kinds of species found in rivers of the Eastern United States. Proceedings of the Academy of Natural Sciences of Philadelphia, 113, 215–58.
Patrick, R., Reimer, C. W. (1975) The Diatoms of The Unıted States. Amerika:Sutter House
Prescott, G. W. (1975) “Algae of The Western Great Lakes Area”, Michigan, W. M. C. Brown Company Publishers.
Round, F .E. (1960). The epipelic algal flora of some Finnish Lakes. Arch Hydrobiol, 57(1-2), 161-178.
Round, F. E. (1993) A Review and Methods for the Use of Epilithic Diatoms for Detecting and Monitoring Changes in River Water Quality (Methods for the Examination of Waters and Associated Materials). London, UK: Her Majesty’s Stationery Office.
Smol, J. P. (2008) Pollution of Lakes and Rivers, a Paleoenvironmental Perspective, 2nd edition, Malden, MA: Blackwell Publishing.
Smol, J. P. (1992). Paleolimnology: an important tool for effective ecosystem health. Journal of Aquatic Ecosystem Health 1: 49–58.
Stevenson, R. J. (1997) Scale-dependent causal frameworks and the consequences of benthic algal heterogeneity. Journal of the North American Benthological Society, 16, 248–62.
Stoermer, E. F., Smol, J. P. (2010) *The Diatoms : Applications for the Environmental and Earth Sciences*. New York: Cambridge University Press.
Tanyolaç, J. (2006) Limnoloji–Tatlısu Bilimi. Sivas: Cumhuriyet Üniversitesi Fen-Edebiyat Fakültesi.
Taylor, J. C., Harding, W. R., Archibald, C. G. M. (2007) An Illustrated Guide to Some Common Diatom Species from South Africa. Pretoria, South Africa: Water Research Commission.
U.S. Environmental Protection Agency. Office of Water and Office of Research and Development. National Rivers and Streams Assessment 2008-2009: A Collaborative Survey (EPA/841/R-16/007). Washington, DC. March 2016.
Varol, M., Şen, B. (2014) Dicle Nehri’nin Planktonik Alg Florası. Journal of Fisheries Sciences.com, 8(4), 252-264.

Yüce, A. M., Gönülol, A., Ertan, Ö. O., Erkebay, Ş. (2018) Hereke Deresi Alg Florası (Kocaeli-Türkiye). Limnofish-Journal of Limnology and Freshwater Fisheries Research, 4(1), 25-29.