YUNUS Research Bulletin 2016 (4): 321-328
www.yunus.gov.tr
ISSN 1303 - 4456
DOI: 10.17693/yunusae.v16i26717.281031

Araştırma Makalesi
Research Article

Assessment of Regional Water Resources and Eco-Biological Parameters in İstanbul

Arzu MORKOYUNLU YÜCE

Kocaeli University, Hereke O. I. Uzunyol Vocational School, 41000, Turkey

*Corresponding Author Tel.: +90 262 511 56 75
E-mail: arzu.yuce@kocaeli.edu.tr

Received: 20.10.2016
Accepted: 28.10.2016

Abstract

In this study was done between January and December 2013; Topuzlu and Neşetsuyu Springs of phytoplankton, epilitic, epipelic algae and water quality parameters were determined. It was found to be totally 27 taxa in Topuzlu Spring and 21 taxa in Nesetsuyu Spring. Generally in both research area Ochrophyta members were dominant organisms. In both springs, *Cocconeis pediculus*, *Gomphonema olivaceum* in epilithic and *Oscillatoria prolifica*, *Euglena acus* in epipelic samples were found. Average dissolved oxygen (8.7 - 9.7 mg l^{-1}) and pH (7.1 -7.3) and water temperature (10.1 – 14.7 ^{0}C) and electrical conductivity (127.3 - 144.6 µS/cm) was determined in Topuzlu Spring. In the Neşetsuyu spring average dissolved oxygen (9.1 - 9.8 mg l^{-1}) and pH (7.1 - 7.3) and water temperature (9.8-14.5 ^{0}C) and electrical conductivity (126.6- 136.2 µS/cm) was determined. The study, which has been carried out to determine hydrobiological features of the springs, has also great importance as being the first study.

Keywords: Phytoplancton, Pyhsicochemical, Aquatic environment.

Öz

İstanbul'da Bölgesel Su Kaynakları ve Eko-Biyolojik Parametrelerin Değerlendirilmesi

Ocak-Aralık 2013 tarihleri arasında yapılan bu çalışmada; Topuzlu Kaynağı ve Neşetsuyu kaynağının, phytoplankton, epilitik, epipelik ve su kalitesine ait parametreler belirlenmiştir. 27 taxon Topuzlu Kaynağında, 21 taxon Neşetsuyu kaynağında tespit edilmiştir. Her iki kaynakta da Ochrophyta üyeleri baskın olarak belirlenmiştir. Her iki kaynakta, *Cocconeis pediculus*, *Gomphonema olivaceum* epilitik, *Oscillatoria prolifica*, *Euglena acus* epipelik örneklerde tespit edilmiştir. Topuzlu kaynağında yapılan ölçümlerde ortalama çözünmüş oksijen (8.7 -9.7 mg l^{-1}), pH (7.1 -7.3), su sıcaklığı (10.1-14.7 C^0) ve iletkenlik (127.3 - 144.6 µS/cm) ölçülmüştür. Neşetsuyu kaynağında, çözünmüş oksijen (9.1-9.8 mg l^{-1}), pH (7.1 - 7.3), su sıcaklığı (9.8 -14.5 C^0) ve iletkenlik (126.6-136.2 µS/cm) olarak belirlenmiştir. Bu çalışma hidrobiyolojik yapının belirlenmesi amacıyla, bu kaynaklarda yapılan ilk çalışma olması bakımından oldukça önemlidir.

Anahtar Kelimeler: Phytoplankton, Fizikokimyasal, Sucul çevre.

Introduction

Water resources are greatly important in both natural and socioeconomic systems. The populations with an increasing demand for water resources have led to lack of water worldwide. Sustainability for the protection of water resources requires a more comprehensive and

Integrated approach to transcend disciplinary boundaries, overcome fragmented governance, and create solutions through collaborative planning (Bowmer, 2011; Bowmer, 2014; Shikun et al., 2016). The hydrological cycle is based on water circulation and the ecology of a region and therefore maintain the ecological balance among the sustainable development of water resources, and the support of social and the other development. Effective water management is essential because it can integrate social, economic, and environmental aspects into all processes of water resource management (Juwana et al., 2010; Gleick, 2010; Shikun et al., 2016). Evaluation of regional water resources contribute to understanding the evolution of the water system and its effects, which contributes to creating the sustainable management of water resources (Shikun et al., 2016).

In Turkey, studies on forest-water relation was started to be conducted in the late 1950s. The hydrologic effects (water amount, regime and quality in a basin) of both forest and forestry practices, they constitute a part of water basin management. Belgrade Forest has many streams of varying sizes. In order to utilize the forest in a more functional way, picnic areas were arranged around the streams and they started to serve the people of Istanbul as a recreational area. Today, Belgrade Forest continues to serve as a recreational area, a source of water and coppice forest (Özcan and Destan, 2010; Anonymous 2010-2011; Kurdoğlu et al., 2011).

In the study, planktonic, epilithic and epipelic algae and some water quality parameters were evaluated.

Figure 1. The study areas.

Materials and Methods

Study Area;

This study was carried out in Topuzlu and Neşetsuyu **S**prings in Belgrade Forest (Sariyer-Bahcekoy) in the European Side of Istanbul, located north of the settlement areas between the 28° 53' 25" - 29° 00' 55" eastern longitudes and 41° 09' 44" - 41° 14' 40" northern latitudes (Figure 1).

Water temperature, pH, conductivity, (with CTD probe, YSI Incorporated) and dissolved oxygen were measured at each surface. The physical and chemical parameters were given figure 2.

Planktonic, epilithic and epipelic algae samples were collected from a total of 7 stations, 4 on Topuzlu spring and 3 on Neset-suyu spring, from January 2013 to December 2013. Since there were no real aquatic plants on study stations, sampling was not carried out. Permanent slides were prepared after boiling the diatom samples with acidic solution and then the diatom samples were fixed in Entellan medium. Taxonomic identifications were made according to literatures (Hustedt, 1985 ; Patrick and Reimer, 1966; Cleve-Euler, 1966; Patrick and Reimer, 1975; Gönülol et al., 1996; Aysel, 2005; Gönülol, 2015 ; Guiry and Guiry, 2016). List of the algae was given in the Table 1-2 and figure 2.

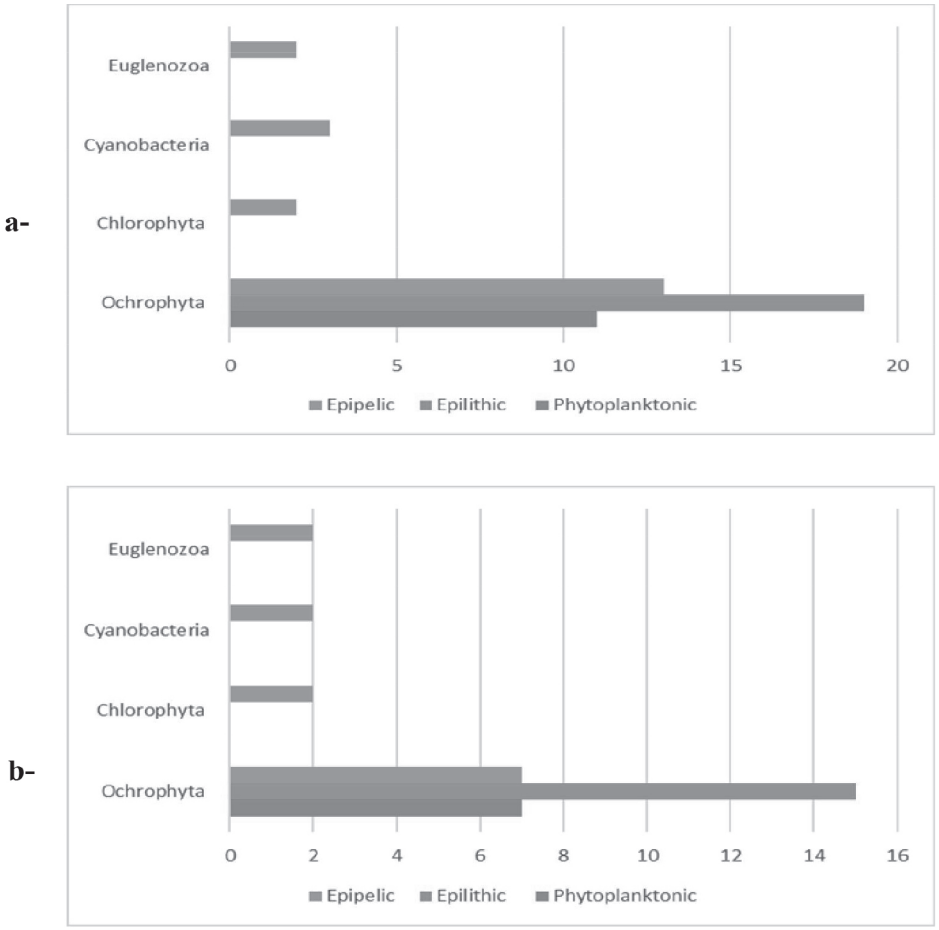

Figure 2. **a-**The Algal Groups of Topuzlu Spring and **b-** Neşetsuyu Spring.

Results

A total of 27 taxa were determined in Topuzlu Spring of these, 20 belong to the Ochrophyta, 2 to the Euglenozoa, 3 to the Cyanobacteria, and 2 to the Chlorophyta divisions. At the same time a total of 21 taxa were identified in Nesetsuyu Spring of these, 15 taxa belonging to Ochrophyta,, 2 taxa belonging to Chlorophyta, 2 taxa belonging to Cyanobacteria, and 2 taxa belonging to Euglenozoa. The identified species are listed in Table 1 and Table 2 .

According to habitat and division were given in the figure 2. Although similar to other species, *A. lanceolata, E..minitum, G. olivaceum, N.linearis, U. delicatisma, O. prolifica* only determined in Topuzlu Spring.

The annual value of water quality were determined in the springs. In the Topuzlu spring of maximum and minimum values respectively water temperature (20.6-9.6 ^{0}C), pH (7.7 -7.1) and electrical conductivity (148.7-120.5 µS/cm) were determined in August and January. The dissolved oxygen (10.4- 8.1 mg l^{-1}) was found in February and October. Also in the Neşetsuyu spring of water temperature (19.6-8.6 ^{0}C), pH (7.6-6.7) and electrical conductivity (140.7-120.5 µS/cm) were determined in August and January. The dissolved oxygen (10.8 - 8.8 mg l^{-1}) was found in April and August. In the research, electrical conductivity, water temperature, pH and dissolved oxygen averages was given Table 3-4.

Discussion

In the research, species richness and environmental variables (water, temperature, conductivity, and pH) showed a seasonal fluctuation. Annual average pyhsicochemical values were found as similar in the springs. According to the pH values were determined slightly alkaline. The dissolved oxygen quantity decrease in summer time when temperature is high.

A total of 27 taxa in Topuzlu Spring and 21 taxa were identified in Nesetsuyu Spring. In the study, same results were determined in both sources. Pollution in indicating species such as *Gomphonema olivaceum*, *Synedra ulna*, *Oscillatoria limosa*, *Oscillatoria prolifica*, *Oscillatoria tenuis, Euglena acus* were frequently observed in the samples taken from the 3rd and 4th stations in the Topuzlu Spring particularly in periods of hot weather and due to the fact that these stations are prone to allochthonous factors. *Synedra* genera members, which were frequently recorded in the two springs, are distributed and accepted as true epilithic and epipelic diatoms. *Oscillatoria limosa* and *Oscillatoria prolific* and *Oscillatoria tenuis* grow better and are more common in the summer months. In addition, members of Cyanobacteria are known to be abundant in eutrophic waters and on sediments polluted with organic matter (Kolaylı and Şahin, 2009). Ochrophyta was predominant in the algal flora at both Springs.

It can say that the presence of benthic algae species together with those of phytoplankton may have be the result of wind affecting the water surface in shallow lakes. Reported that algal biomass and growth were positively correlated with light intensity and water temperature. The growth of benthic algae in Topuzlu and Neşetsuyu Springs supports these results, because the density of benthic algae was lower in early spring, when water temperature was low. Higher temperatures supported the growth and density of benthic algae in both of springs, which were at their

Table 1. List of the phytoplancton and epipelic and epilithic algae of Topuzlu Spring

Taxa	Phytoplankton	Epilithic	Epipelic
Ochrophyta			
Achnanthes lanceolata (Bréb. ex Kütz.) Grunow	+	+	-
Cocconeis pediculus Ehr.	+	+	+
Craticula cuspidata (Kütz.) D.G.Mann	+	+	+
Cymatopleura solea (Breb.) W. Smith	+	+	-
Cymbella affinis Kütz.	-	+	+
Denticula tenuis Kütz.	-	-	+
Encyonema minutum (Hilse) D.G. Mann	+	+	+
Gomphonema angustatum (Kütz.) Rabh.	-	+	-
Gomphonema olivaceum (Hornemann) Brébisson	+	+	+
Gomphonema parvulum (Kütz.) Kütz.	-	+	+
Hantzschia amphioxys (Ehr.) Grun	+	+	-
Navicula tripunctata (O.F.Müll.) Bory Saint -Vin.	-	+	-
Navicula radiosa Kütz.	+	+	+
Nitzschia linearis W. Smith	-	+	+
Nitzschia recta Hantzsch ex Raben.	+	+	-
Nitzschia sublinearis Hustedt	+	+	+
Pinnularia major (Kütz.) Raben.	-	+	+
Rhoicosphenia abbreviata (C.Ag.) Lange-Bertalot	+	+	-
Synedra ulna (Nitz.) Ehr	-	+	+
Ulnaria delicatisma (W.Smith) M.Ab.&P.C. Silva	-	+	+
Chlorophyta			
Pediastrum boryanum (Turpin) Meneghini	-	-	+
Pediastrum duplex Meyen	-	-	+
Cyanobacteria			
Oscillatoria limosa C. Agardh ex Gomont	-	-	+
Oscillatoria prolifica (Grev.) Gomont	-	-	+
Oscillatoria tenuis C. Agardh ex Gomont	-	-	+
Euglenozoa			
Lepocinclis acus (O.F.Müll.) B. Marin & Melkonian	-	-	+
Trachelomonas oblonga Lemm	-	-	+

Table 2. List of the phytoplancton and epipelic and epilithic algae of Nesetsuyu Spring

Taxa	Phytoplankton	Epilithic	Epipelic
Ochrophyta			
Cocconeis pediculus Ehr.	+	+	+
Craticula cuspidata (Kütz.) D.G.Mann	+	+	+
Cymatopleura solea (Brébisson) W.Smith	+	+	-
Cymbella affinis Kütz.	-	+	+
Denticula tenuis Kütz.	-	+	+
Gomphonema angustatum (Kütz.) Rabh.	-	+	-
Gomphonema parvulum (Kütz.) Kütz.	-	+	+
Hantzschia amphioxys (Ehr.) Grun	+	+	-
Navicula tripunctata (O.F.Müll.) Bory Saint -Vin.	-	+	-
Navicula radiosa Kütz.	+	+	-
Nitzschia recta Hantzsch ex Raben.	-	+	-
Nitzschia sublinearis Hustedt	+	+	+
Pinnularia major (Kütz.) Raben.	-	+	+
Rhoicosphenia abbreviata (C.Ag.) Lange-Bertalot	+	+	-
Synedra ulna (Nitz.) Ehr	-	+	+
Chlorophyta			
Pediastrum boryanum (Turpin) Meneghini	-	-	+
Pediastrum duplex Meyen	-	-	+
Cyanobacteria			
Oscillatoria limosa C. Agardh ex Gomont	-	-	+
Oscillatoria tenuis C. Agardh ex Gomont	-	-	+
Euglenozoa			
Lepocinclis acus (O.F.Müll.) B. Marin & Melkonian	-	-	+
Trachelomonas oblonga Lemm	-	-	+

highest levels in summer. Algae species identified in both springs are similar to the species available in the fresh waters of Turkey (Gönülol et al., 1996; Aysel, 2005; Solak et al., 2012). In the study it was determined that the water temperature and conductivity values of the spring waters are high during summer and low during winter. Exhibiting quite small variation depending on the season and stations, the determined values are in line with the general

Table 3. Pyhsicochemical Values in Topuzlu Spring

Parameters	Average	Maximum	Minimum
Water temperature (^{0}C)	14.2	20.6	9.6
pH	7.2	7.7	7.1
Dissolved oxygen (mg l^{-1})	9.2	10.4	8.1
Electrical conductivity (µS/cm)	134.4	148.7	120.5

Table 4. Pyhsicochemical Values in Neşetsuyu Spring

Parameters	Average	Maximum	Minimum
Water temperature (^{0}C)	12.5	19.6	8.6
pH	7.2	7.6	6.7
Dissolved oxygen (mg l^{-1})	9.4	10.8	8.8
Electrical conductivity (µS/cm)	130.1	140.7	120.5

values of the spring waters in Turkey (Ertan and Morkoyunlu 1998; Kara and Şahin, 2001; Kolaylı and Şahin, 2009). Today, above capacity usages and planning concerning the Belgrade Forest and the springs in it causes rapid pollution in surface waters. Comparing these practices with the natural structure in Belgrade Forest shows that they cause deterioration in the natural balance in stream beds, decrease in water flow, and affect aquatic ecosystems negatively with the impact of heated stream waters.

As a result of picnic activities carried out in this nature park particularly on weekends, domestic wastes are introduced to the environment. It is considered that the cooperation among related public institutions and organizations, local administrations and nongovernmental organizations. Social responsibility projects to raise environmental consciousness, and planning and implementing sustainable water resource management peculiar to the area are essential in order to prevent these problems that arise as a consequence of human activities.

References

Aysel, V. 2005. Check-List of The Freshwater Algae of Turkey, Journal of the Black Sea/Mediterranean Environment, Volume 11, Number 1

Anonymous. 2010-2011. Ministry of Environment and Urbanization, Istanbul Environmental Situation Report, 413 pp.

Bowmer, K. H. 2011.Water resource protection in Australia: links between land use and river health with a focus on stubble farming systems. Journal of Hydrology 403 (1): 176-185.

Bowmer, K. H. 2014. Water resources in Australia: deliberation on options for protection and management. Australasian Journal of Environment Management 21: 228-240.

Cleve-Euler, A. 1966. Die Diatomen von Schweden und Finnland. Verlag von J.Cramer,458 .

Ertan, O. O. and Morkoyunlu, A. 1998. The Algae Flora of Aksu Stream (Isparta-Turkey) Turkish Journal of Botany 22,4: 239-255

Gleick, P. H. and Palaniappan, M. 2010. Peak water limits to freshwater withdrawal and use. Proc. Natl. Acad. Sci. USA (107): 11155-11162.

Gönülol, A., M. Öztürk and M. Öztürk. 1996. Check-List of The Freshwater Algae of Turkey. Ondokuz Mayıs University, Faculty of Science and Literature, Scientific Journal,7:46.

Gönülol, A. 2015.Turkish algae electronic publication, Samsun, Turkey. http://turkiyealgleri.omu.edu.tr (accessed date:07 August 2015).

Guiry, M. D. and G. M. Guiry. 2016. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org. (accessed date: 03 October 2016).

Hustedt, F.1985. The Pennat Diatoms, a translation of Husted 'Die Kieselalgen 2.Teil' with supplement by Norman G. Jensen, Koeltz Scientific Books, Koenigstein, 918pp.

Juwana, I., Perera, B. J. and Muttil, N. A. 2010. Water sustainability index for West Java. Part 1: developing the conceptual framework. Water Sci. Technol. 2: 1629-1640.

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

Kolaylı, S. and Şahin, B. 2009. Benthic Algae (Except Bacillariophyta) and Their Seasonal Variations in Karagöl Lake (Borçka, Artvin-Turkey), Turkish Journal of Botany , 27-32

Kurdoğlu, O., Düzgüneş, E. and Kurdoğlu, B. C. 2011. Evaluation of conceptual legal and environmental aspects of urban forests, Journal of Artvin Çoruh University Forestry Faculty ,12(1): 72-85

Özcan, M. and Destan, S. 2010. Evaluation of recreational areas in reservoir serie of Belgrade Forest from forest management point of view, Journal of Istanbul University Forestry Faculty, 60(2):17-31

Patrick, R. and Reimer, C. W. 1966. The Diatoms of The United States I, Acad. Sci, Philadelphia, 687 pp.

Patrick, R. and Reimer, C. W. 1975. The Diatoms of The United States, ll Acad. Sci, Philadelphia, 213 pp.

Shikun, S., Yubao, W., Jing, L., Huanjie, C., Pute, W., Qingling, G. and Lijun, X. 2016. Sustainability assessment of regional water resources under the DPSIR framework, Journal of Hydrology,532, 140-148.

Solak, C. N., Barinova S., Acs, É. and Dayıoğlu, H. 2012. Diversity and ecology of diatoms from Felent creek (Sakarya river basin),Turkey, Turkish Journal of Botany 36: 191-203 doi:10.3906/bot-1102-16.