Acta Aquatica Turcica

E-ISSN: 2651-5474
Home Page: https://dergipark.org.tr/actaquatr 19(4): 368-380, 2023 DOI: 10.22392/actaquatr.1272430

Review **Derleme**

Lakes of Turkey: Comprehensive Review of Lake Abant

Türkiye'nin Gölleri: Abant Gölü'nün Kapsamlı İncelemesi

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Received: 20.04.2023 **Accepted:** 17.07.2023 **Published:** 01.12.2023

How to Cite: Çelekli, A., Yaygır, S., & Zariç, Ö. E. (2023). Lakes of Turkey: Comprehensive review of Lake Abant. *Acta Aquatica Turcica, 19*(4), 368-380. https://doi.org/10.22392/actaquatr.1272430

Abstract: Lake Abant became a nature park on October 21, 1988. The Park is connected to Mudurnu (Bolu) district and is spread over an area including high mountains up to 1800 meters. Lake Abant, located at 1350 m a.s.l, is one of the most critical areas in the center of the park. With a maximum depth of about 18 meters, the Lake is a landslide lake, and its area is about 125 ha. Due to the changing climatic conditions, a more humid and rainier environment is dominant in the region. The existence of many species (e.g., fungi, insects) is not known yet due to the limited number of studies on the biodiversity in the park, which is rich in fauna and flora. However, the potential biological richness of the park is estimated to be much greater than the available information. This article deals with Lake Abant from historical, geographical, ecological, and many other aspects.

Keywords

- Lake Abant
- Biology
- Ecotourism
- Endemic
- Trophic State

Özet: Abant Gölü 21 Ekim 1988 yılında Tabiat Parkı olmuştur. Park, Mudurnu (Bolu) ilçesine bağlı olup, 1800 metreye kadar yüksek dağların bulunduğu bir alana yayılmıştır. Deniz seviyesinden 1350 m yükseklikte bulunan Abant Gölü, parkın merkezindeki en önemli alanlardan biridir. Maksimum derinliği yaklaşık 18 metre olan göl heyelan gölüdür ve alanı yaklaşık 125 hektardır. Değişen iklim koşulları nedeniyle bölgede daha nemli ve yağışlı bir ortam hakimdir. Fauna ve flora açısından zengin olan parkta biyoçeşitliliği ile ilgili sınırlı sayıda çalışma olması nedeniyle pek çok türün (örneğin mantar, böcek) varlığı henüz bilinmemektedir. Ancak parkın potansiyel biyolojik zenginliğinin mevcut bilgilerden çok daha fazla olduğu tahmin edilmektedir. Bu makale Abant Gölü'nü tarihi, coğrafi, ekolojik ve daha birçok yönüyle ele almaktadır.

Anahtar kelimeler

- Abant Gölü
- Biyoloji
- Ekoturizm
- Endemik
- Trofik Durum

1. INTRODUCTION

Turkey is in one of the world's leading regions, with its freshwater treasures. It has 90 natural lakes of 946,400 ha. In addition to being used for electricity, irrigation, drinking water, and fishing, Turkey's existing water resources are also used for recreational purposes due to their natural beauty. Lake Abant is one of Turkey's most important natural lakes and is a frequent destination for many local and foreign tourists due to its natural beauty. The first tourism activities in the Abant region started with the construction of the first 12-room wooden building in the 1930s. Due to its biological richness and natural beauties, the General Directorate of National Parks converted an area of 1150 hectares into Abant Nature Park on October 21, 1988, with the second paragraph of the 23rd article of the National Parks Law dated August 9, 1983, and numbered 2873 (Müderrisoğlu et al., 2005). Lake Abant, which is located in the park area, is prohibited from fishing. After Lake Abant was declared a nature park, it turned into a water system without human intervention. The reeds, lotus fields, and underwater trees around the lake started to increase. Despite its rich biodiversity, practices, climate change, and acid rain residues, the roots of the trees have been flooded, the diversity has decreased and even endemic species such as otters are on the verge of extinction. The fact that not much research has been done on Lake Abant has forced us a lot while writing this article. Therefore, in this article, Lake Abant has been comprehensively discussed.

1.1. Lake Abant

Lake Abant is a natural lake located in the Western Black Sea Basin, 30 km from Bolu, at the coordinates of 31°, 16' 735 E, and 40°, 36' 713 N (Figure 1). The area of Lake Abant is 125 ha; its height above sea level is 1340 m; its maximum depth is approximately 18 m (Figure 2); and its circumference is 6 kilometers (Çelekli & Külköylüoğlu, 2006; Karakaya et al., 2011). Abant Lake is a natural landslide-set lake that closes the Abant Stream valley to the mass falling from steep and sloping slopes (Tosun, 2014). The main water sources of the lake are rain and melting snow waters and various streams. It is known that the behavior of the lake is completely mixed at least once a year, and the volume of water obtained varies according to the season and the year. The rapid cooling of the air in winter causes the lake to freeze completely from the shore (Mater & Sunay, 1985; Müderrisoğlu et al., 2005). The lake is fed by snow and rainwater, especially in the winter and early spring seasons, and excess water from Lake Abant merges with Abant Creek and flows into Büyüksu Stream flowing towards the Bolu region (Külköylüoğlu et al., 2005; Çelekli, 2006).

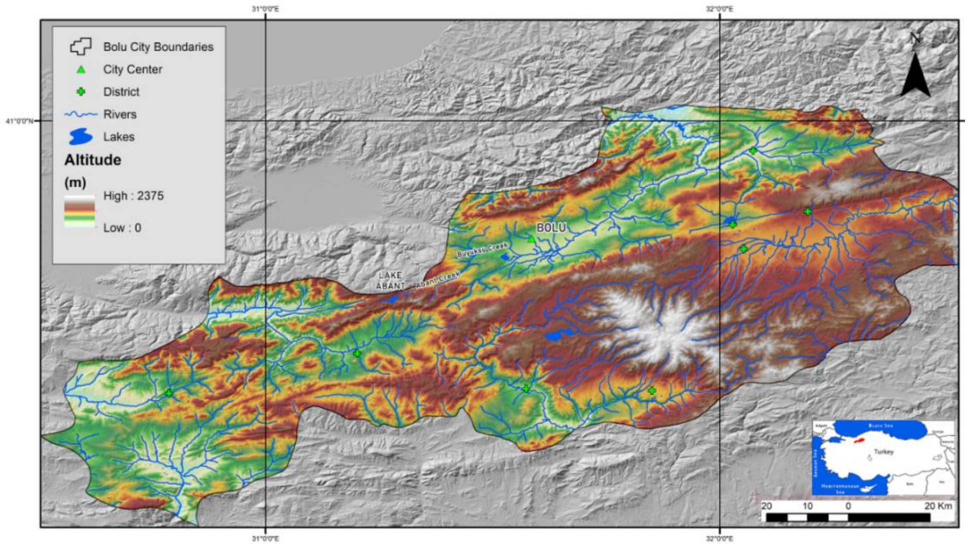

Figure 1. Map of Bolu province with Lake Abant

The tectonic-origin lake is located on the North Anatolian fault line. Lake Abant is controlled by tectonic activities in the west of the study area, at the western end of the Gerede segment, where the main fault direction changes between 75–80 and 80–85 degrees. The lake is located at the end of the 1944 earthquake rupture and the beginning of the 1957 and 1967 earthquake ruptures (Demirtaş, 2000). Earthquake fractures passed through the northwest corner of the lake and continued in the northeast-southwest direction.

The development of Lake Abant and its surroundings formed sandy, clayey, and calcareous soils by melting the schist and serpentine forming the bedrock during various Paleozoic tectonic events (Mater & Sunay, 1985). However, the most effective change occurred when the first humans settled around the lake (Bottema et al., 1995). At this stage of events, the lake surface area was expanded to create shallow habitats for rainbow trout (*Oncorhynchus mykiss*, Walbaum, 1792).

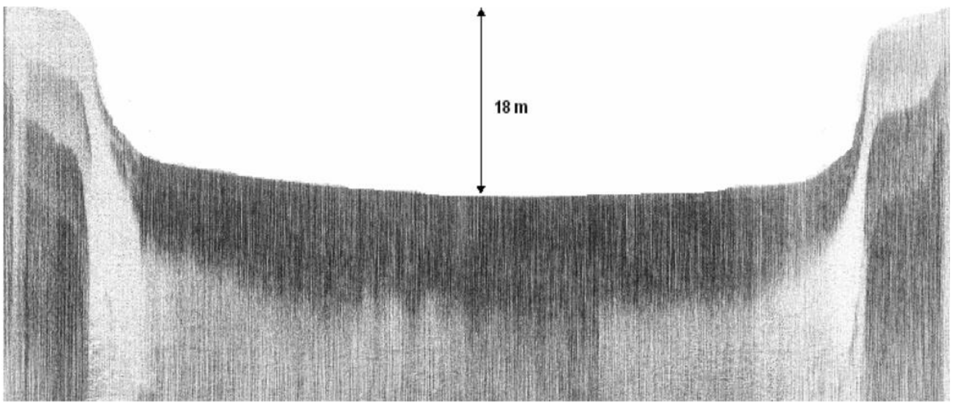

Figure 2. First bathymetric painting for Lake Abant (Dügel et al., 2008).

1.2. Physicochemical Variables

Physicochemical variables (e.g., temperature, pH, dissolved oxygen, carbon dioxide, Secchi disc depth, orthophosphate, etc.) are one of the ecological factors that affect the lake ecosystem and its biodiversity. Environmental variables of Lake Abant between 2003 and 2005 are given in Table 1. In the study, the highest value in temperature was 15.54 ^oC in August 2004, and it is seen that the temperature increases with the mixing of the lake and the change in the climate in spring and autumn, and the dissolved oxygen decreases accordingly (Çelekli & Külköylüoğlu, 2006). Another limnological study showed that the water temperature in Lake Abant seasonally varied from 5.1 ^oC in winter to 25 ^oC in summer, and dissolved oxygen decreased from 9.3 mg/L in winter to 8.5 mg/L in spring (Atıcı et al., 2019). Physicochemical variables changed seasonally as well as depending on the year. Çelekli (2006) reported that chlorophyll-a varied from 0.98 µg/L in April 2004 to 4.65 µg/L in January 2005. Atıcı and Obalı (2002a) found that chlorophyll-a concentration in Lake Abant ranged from 3.5 µg/L and 10.8 µg/L. They reported that electrical conductivity (EC) varied from 200 µmhos/cm in the winter to 280 µmhos/cm in the summer. Çelekli (2006) stated that eEC ranged from 207,83 µS/cm to 236,14 µS/cm and its average is 219,51 µS/cm. According to Turkish surface water quality regulation standards (TSWQR, 2016), Lake Abant has class I water quality based on EC, PO_4, NO_3-N, dissolved oxygen, and pH variables.

Table 1. Physical and chemical variables of Lake Abant during two years between August 2003 and August 2005 (Külköylüoğlu et al., 2005; Çelekli & Külköylüoğlu, 2006).

	Temp	pH	DO	Cond.	BOD	NTU	Chlo-a	SD	N-NO_3	P-PO_4
August03	14.09	8.21	5.52	236.14	3.10	1.29	1.91	4.98		
September03	15.20	8.12	6.51	211.16	3.45	0.39	1.71	6.45		
October03	13.38	8.13	6.05	212.10	3.62	0.70	1.77	7.45		0.038
November03	9.52	8.14	6.38	210.17	3.30	4.77	2.93	3.55		0.043
December03	5.68	7.94	11.86	210.34	7.60	4.25	3.26	5.08		0.037
January04	1.47	8.09	10.20	213.07	5.11	0.19	4.45	2.78		0.033
April04	3.07	7.64	8.96	220.30	5.30	13.90	0.98	3.10	0.001	0.036
March04	7.89	7.86	10.32	228.07	5.26	0.82	3.46	2.65	0.001	0.039
June04	11.05	7.50	7.63	225.49	3.80	1.33	3.55	4.50	0.001	0.050
July04	13.06	7.54	6.49	227.78	2.54	3.93	2.47	6.08	0.001	0.034
August04	15.54	7.99	7.69	216.76	3.96	1.14	1.78	2.95	0.000	0.018
September04	15.24	7.74	7.74	212.22	4.52	2.49	1.89	6.74	0.003	0.048
October04	14.01	7.71	6.92	207.83	5.73	7.06	2.67	6.35	0.004	0.035
November04	11.66	7.22	6.54	208.23	3.09	10.05	3.12	6.03	0.003	0.041
December04	4.93	7.35	10.78	210.80	5.08	3.59	1.32	5.13	0.001	0.039
April05	5.37	7.49	11.43	218.65	5.98	7.85	2.82	3.68	0.001	0.052
March05	11.29	7.38	12.95	229.18	8.81	1.84	4.65	3.43	0.001	0.035
June05	13.14	7.26	8.39	230.69	6.12	1.66	2.27	4.62	0.001	0.052
July05	13.7	8.24	7.30	234.73	3.95	2.99	3.89	5.35	0.001	0.031
August05	14.4	8.05	6.60	226.45	3.53	1.22	1.85	3.96	0.001	0.017
Mean	10.68	7.78	8.31	219.51	4.69	3.57	2.64	4.74	0.001	0.038

Temp. temperature, DO dissolved oxygen, Cond. conductivity, Chlo-a chlorophyll-a, BOD, biological oxygen demand, SD Secchi depth, N-NO_3–nitrate, P-PO_4-phosphate, and NTU Nephelometric turbidity unit.

Cadmium, lead, mercury, and chromium were found in the samples of water and planktonic organisms in Lake Abant (Atıcı et al., 2019). The heavy metal level varied seasonally. The order of heavy metals in water samples is Cd > Pb > Cr > Hg in spring; Pb > Cr > Cd > Hg; Pb > Cd > Cr > Hg in autumn; and Pb > Cr > Cd > Hg in winter. Cadmium (Cd) was at its highest concentration at 108.5 µg/l in the water in the spring period and with 100.81 µg/gr in plankton during the winter in Lake Abant. The maximum concentrations of lead (Pb) were found in the water during the summer at 267.0 µg/l and in the plankton in the autumn at 589.82 µg/gr. Mercury (Hg) was at its highest concentration in the water during the winter at 1.28 µg/l and in the plankton at 1.63 µg/gr in the spring. In the spring, the water contained 58.00 µg/l of chromium (Cr), while the plankton contained 144.64 µg/gr during the summer (Atıcı et al., 2019).

1.3. Biological feature

Lake Abant and its surroundings are very rich in flora and fauna due to factors such as the coexistence of forest and lake ecosystems, climate, land structure, and height difference. There are approximately 1305 scientifically defined species in the nature park area of Lake Abant (Külköylüoğlu, 2014). It is reported that there are more than 50 endemic plants in this area (Türker & Güner, 2003). Among these, one of the best-known is *Crocus abantensis* (Abant Crocus, Figure 3). This plant grows on some high plateaus in a special soil structure that has adapted to cold climates and is very sensitive to aeration expectations. For this reason, the European Committee has included this species in the Treaty on the Conservation of European Wildlife and Natural Habitats. In addition, there are animal and vegetation samples defined in the lake and park area, and there are many living things that have not yet been studied in the basin and their contribution to biological diversity has not yet been determined. Apart from these, *Panthera pardus*, known to have lived in this region for a while when it became extinct, is one of them (Külköylüoğlu, 2014). The most important forest and shrub species are *Pinus nigra*, *Pinus sylvestris* L., *Abies nordmanniana*, *Abies bornmulleriana*, *Populus tremula* L., *Fagus orientalis*, *Acer* sp., *Salix* sp., *Crataegus* sp., *Tamarix* sp., *Corylus* sp., *Ilex* sp., *Juniperus* sp., *Vaccinium* sp. and others (Çakır et al., 2016).

Figure 3. *Crocus abantensis* (Çevik, 2015).

The lake is surrounded by a protected forest, meadow, and wetland that support a variety of plant and animal life. Some of the vegetation found around the lake includes coniferous and deciduous trees such as pine, spruce, oak, and beech, as well as a variety of shrubs and wildflowers. The wetlands around the lake also support a variety of aquatic plants, such as reeds and water lilies. 50 out of 664 species in the lake are endemic: at least 5 out of 12 mammal species (mouse, rat, *Muscardinus avellanarius abanticus*), 7 fish species (*Salmo trutta abanticus*), 285 phytoplankton species are endemic; 16 of more than 150 lichen species, 1 of 13 ostracoda species, 4 of 22 new rotifera species are new records for Turkey and 3 tailed frog species (Small salamander, *Triturus vulgaris koswigii*) are type species (Külköylüoğlu, 2012). *Salmo trutta abanticus* and *Triturus vulgaris koswigii* are given in Figures 4 and 5, respectively.

Figure 4. *Salmo trutta abanticus* (Külköylüoğlu, 2012).

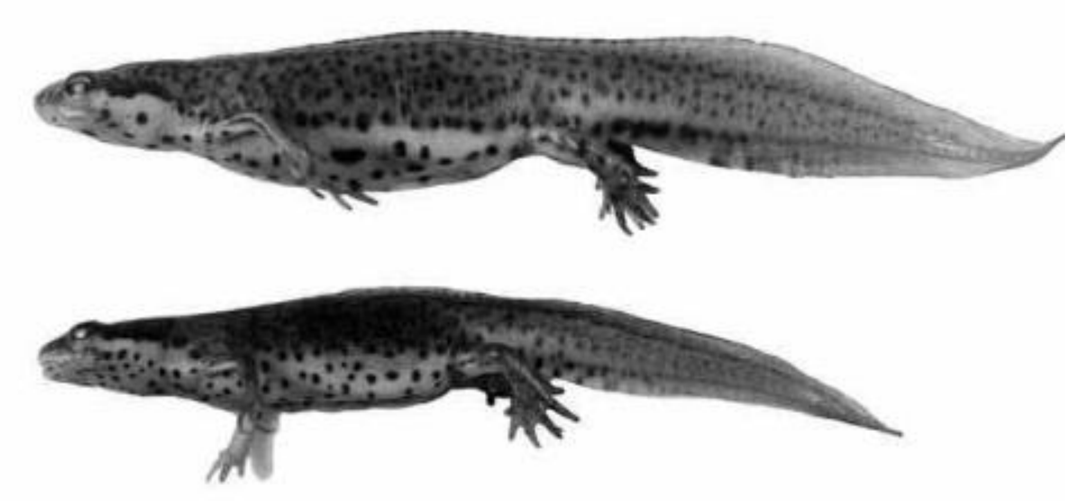

Figure 5. *Triturus vulgaris koswigii* (Taşkın & Olgun, 2003).

Phytoplankton are microscopic organisms that are the primary food source for aquatic life. They are also important for the global carbon cycle and oxygen production. Phytoplankton assemblages are among the biological components that are frequently utilised to evaluate the ecological characteristics of lentic ecosystems and provide important knowledge about ecosystem health (Çelekli and Özpınar, 2021). Phytoplankton exhibit different responses to a variety of pollution gradients, making them powerful indicators in ecosystems (Reynolds et al., 2002).

Phytoplankton as bioindicator taxa have become an integral part of water quality monitoring in the majority of the world (Reynolds et al., 2002). There is likely to be a very diverse phytoplankton population in Lake Abant, but more information will be needed to provide a specific response. In the study (Çelekli & Külköylüoğlu, 2006), 285 taxa were identified in 69 different genera between 2003 and 2005. Some taxa from the species (for example, *Chroococcus turgidus*, *Microcystis aeruginosa*, *Oscillatoria limosa*, *O. sancta*, *Spirulina maior*, *Anabaena bergii*, *A. planctonica*, *Cylindrospermum minutissimum*, *Trachelomonas volvocina*, *Cryptomonas ovata*, and *Ceratium hirundinella*) are observed at almost all sampling times (Figure 6), while others have a certain seasonality. A total of 42 phytoplankton species from Lake Abant was the first report for the algal flora of Turkey and 30 species were the first record for Lake Abant (Çelekli et al., 2007). In a previous study, Atıcı and Obalı (2002a) determined that 68 and 62 phytoplankton species were identified in Lake Abant and Lake Yedigöller, respectively. Bacillariophyta is the most abundant group with 25 species in Lake Abant, followed by Chlorophyta with 23 taxa and Cyanobacteria with 9 species. Bacillariophyta comprises the majority of phytoplankton in Lake Yedigöller, followed by Chlorophyta with 11 species and Cyanobacteria with 9 species. In Lake Abant, *Asterionella formosa, Fragilaria intermedia, Synedra ulna, Merismopedia tenuissima, Scenedesmus bijuga, Oocystis borgei, Sphaerocystis polycocca,* *Ceratium hirundinella, Staurastrum polymorphum,* and *Trachelomonas volvocina* had been observed almost throughout the studied period (Atıcı & Obalı 2002a). In another study (Atıcı & Obalı 2002b), 83 phytoplankton taxa were identified, of which 34 to Bacillariophyta, 26 belong to Chlorophyta, 10 to Cyanophyta, 4 to Euglenophyta, 6 to Dinophyta and 3 to Chrysophyta divisions. 10 of the determined taxa are new records for the algae flora of Türkiye.

A total of 138 benthic algal taxa were identified from Lake Abant (Atıcı el al., 2005). Bacillariophyta is the dominant group with 69 species, followed by Chlorophyta with 28 taxa and Cyanobacteria with 29 species. Other algal groups were represented by Euglenophyta with 7 species, Chrysophyta with 3 species, and Pyrrophyta with 2 species.

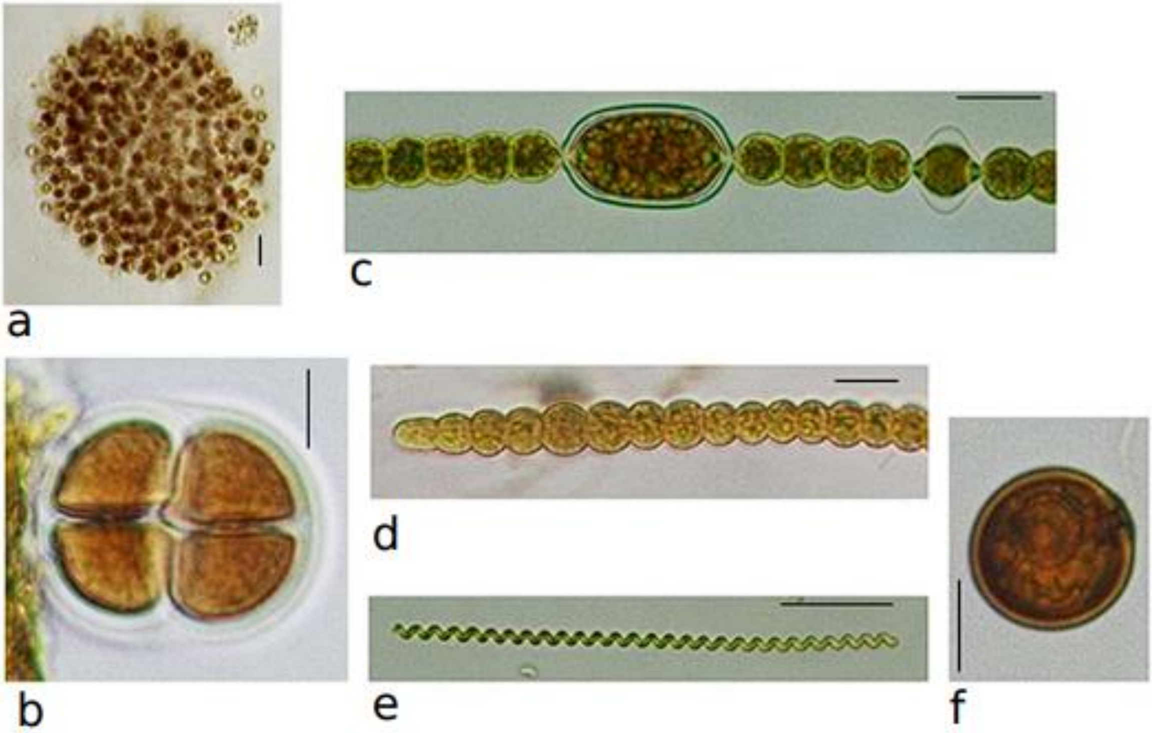

Figure 6. a) *Microcystis aeruginosa*, b) *Chroococcus turgidus*, c) *Anabaena planctonica*, d) *Anabaena bergii*, e) *Spirulina maior*, f) *Trachelomonas volvocina* (scale 10 μm) (Çelekli et al., 2007).

Atici & Tokatlı (2014) reported that the physicochemical properties and phytoplankton compositions of Lake Abant indicate that the eutrophic tendency is present. The eutrophication of the lake is primarily the result of human activities and an urbanized catchment area (Atıcı & Tokatlı, 2014). Therefore, it is imperative to take conservation measures to prevent further eutrophication of these lakes, and the relevant authorities of the municipality are firmly advised to implement their restoration programs and minimize the impacts of human activities in and around the lakes.

Diatoms are found all over the world in a variety of environments where conditions are suitable for some essential elements (such as light, temperature, and chemical components), including freshwater and marine waters (Smol & Stoermer, 2010). Diatoms are also important bioindicators of water quality and are used in a wide range of studies, including environmental monitoring and assessments (Çelekli et al., 2021). Diatoms are especially useful for detecting changes in aquatic communities because of their rapid response to changes in the aquatic environment. They are sensitive to changes in water quality, including levels of nutrients, acidity, and pollutants such as heavy metals and organic chemicals (Çelekli et al., 2021). In the previous study (Çelekli & Külköylüoğlu, 2006), a total of 123 taxa, including 4 genera and 11 taxa belonging to the Centrales and 29 genera and 112 taxa belonging to the Pennales, were identified and some species are shown in Figure 7.

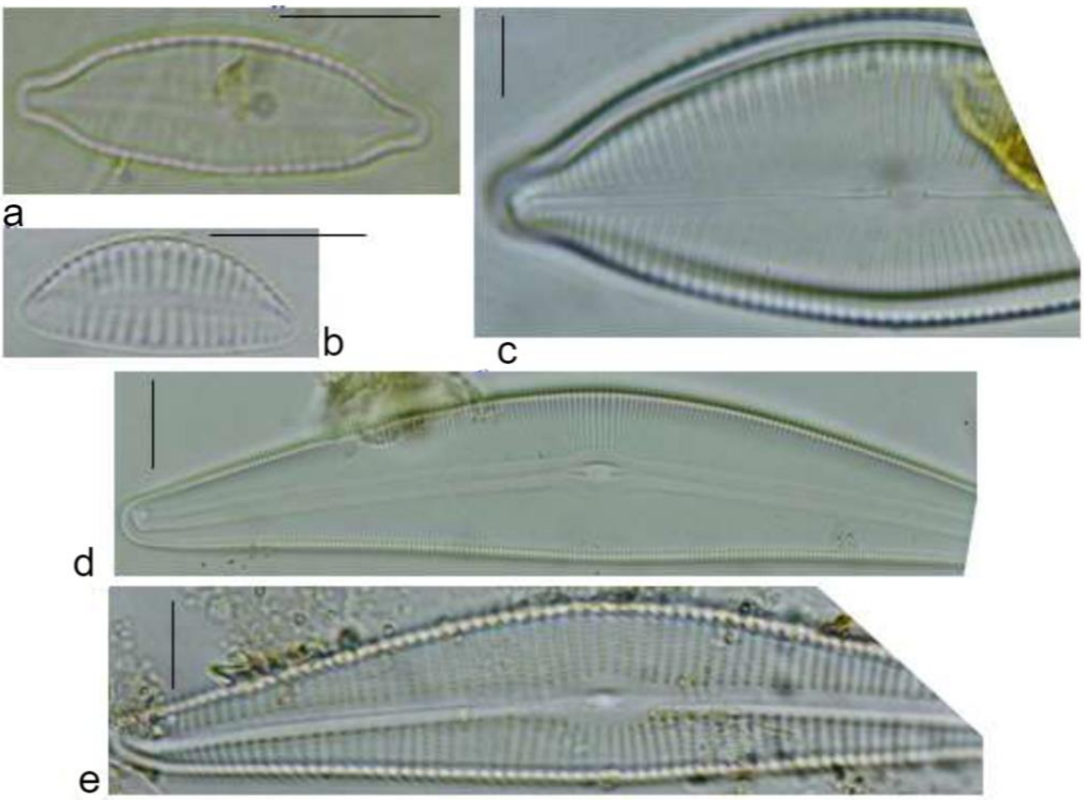

Figure 7. a) *C. amphicephala*, b) *C. leptoceros* c) *C. ehrenbergi*, d) *C. aspera*, e) *C. helvetica*, (Scale 10 µm), (Çelekli & Külköylüoğlu, 2006).

Aquatic macrophytes in rivers and lakes are used as indicators for monitoring environmental impacts and eutrophication is being developed for macrophytes in various countries (Coşkun & Demir,2019). Aquatic macrophytes in Lake Abant; *Juncus articulatus*, *Lemna minor*, *Phragmites australis, Trinex steud*, *Schoenoplectus lacustris*, *Nuphar lutea*, *Nymphaea alba*, *Potamogeton natans*, *Myriophyllum spicatum,* and *M. verticillatum* were detected (Coşkun & Demir, 2019). When the distribution of macrophyte species in the lake is examined according to the sampling periods, *P. australis*, *S. lacustris*, and *N. lutea* species proliferated in the northern, western, eastern, and southern regions of the lake, while *N. alba* multiplied only in the southern regions (Coşkun & Demir, 2019).

Benthic macroinvertebrates are bioindicator organisms that show the ecological structure and water quality of lentic and lotic systems by analyzing their characteristics, such as species composition, biomass values, numbers, life cycles, and seasonal changes (Şimşek, 2015). In the study; as a result of the examination of benthic macroinvertebrate samples collected from 7 stations selected from Lake Abant, which was carried out seasonally between November 2015 and July 2017, an average of 10085 organisms and 49 taxa were identified. About 12 species from the Oligochaeta, 21 species from the Chironomidae and one species from the Chaoboridae were identified in Lake Abant (Tereshenko, 2019).

A total of 16 ostracod species were found in and around Lake Abant (Bolu, Turkey); *Physocypria kraepelini*, *Ilyocypris bradyi*, *Heterocypris incongruens*, *Notodromas monacha*, *Pseudocandona conspressa*, *Eucypris pigra*, *Herpetocypris chevreuxi*, *Psychrus, psychrussychrus*, *Psychrodromus fontinalis*, *Cypris pubera*, and *Leucocythere* sp. (Dügel et al., 2008). While 80% of these species have a cosmopolitan distribution at least within the Holarctic region, two species (*P. fontinalis* and *E. pigra*) are new records for the region (Dügel et al., 2008).

1.4. Trophic state and Ecological status of Lake Abant

Two methods are used to monitor waters and determine their ecological status. The first of these is the use of biological quality elements (bioindicators), and the second is the use of physicochemical methods. As a result of the researches, it has been seen that besides the physical and chemical properties, the use of biological indicators in studies is much more appropriate. In the European Union, there are more than twenty directives on the protection of the earth's water reserves (Maastricht, 1991). Among these, the Water Framework Directive dated November 22, 2000, consisting of 26 articles and 11 annexes, has an important place (Directive, 2000). The basic principle of WFD is the identification, prevention, control, and maintenance of pollution sources. In the directive, biological quality elements (diatoms, phytoplankton, macrophytes, fishes, and benthic macroinvertebrates) are used to determine the ecological status of surface waters (Directive, 2000). Phytoplankton as bioindicator taxa are frequently used to evaluate the ecological characteristics of lakes and reservoirs and provide important knowledge about the ecological status of ecosystems (Reynolds et al., 2002).

Carlson (1977) and OECD (1982) methods were used to determine the trophic state of Lake Abant. Temporary changes in trophic state index (TSI) values of Sechi depth, phosphate, and chlorophyll-a measured monthly between 2003 and 2005 are given in Figure 8 (Çelekli, 2006). According to the results of Carlson (1977) and OECD (1983) based on Secchi depth, chlorophyll-a, and phosphate concentrations, Lake Abant showed mesotrophic features.

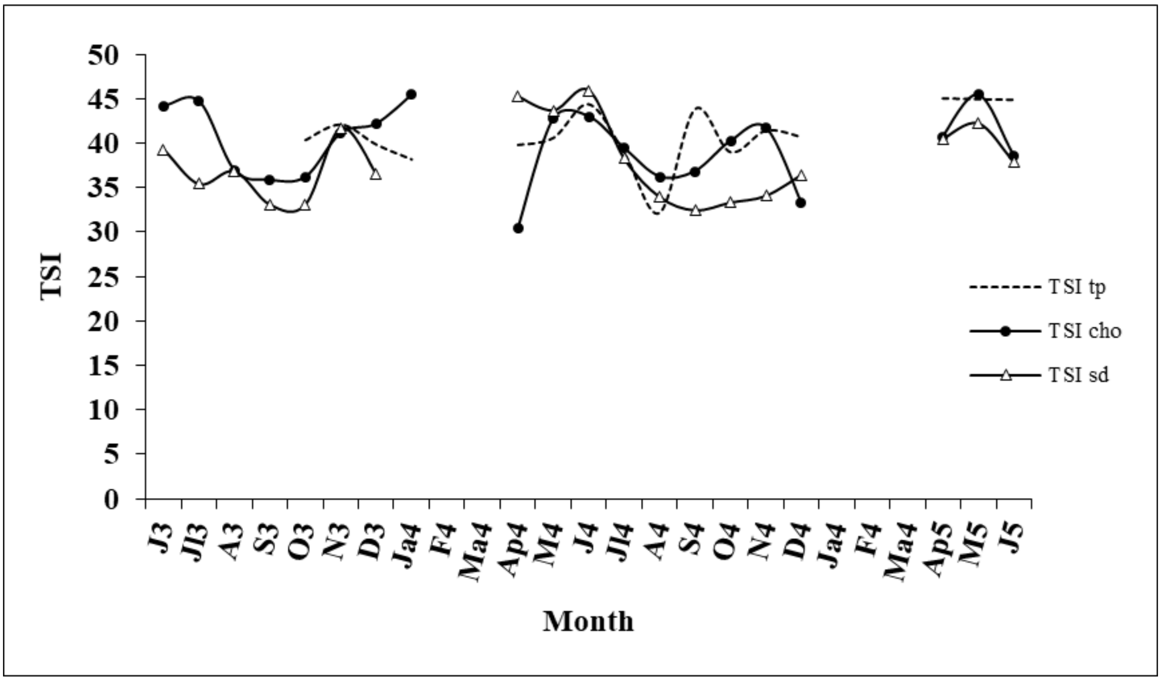

Figure 8. Temporary changes in TSI values of Secchi depth, total phosphorus, and chlorophyll-a measured monthly between 2003 and 2005. The code for each month (e.g., June 2003 (J3)) is the trophic status code (TSI_{TP}, $TSI_{Cho,}$ and TSI_{SD}) (Çelekli, 2006).

The water quality of Lake Abant was evaluated not only by chlorophyll-a, Secchi depth, and phosphorus content but also by the BOD_5 and the total number of coliform bacteria. BOD_5 values showed that this lake was in beta mesosaprobic state. The maximum total coliform bacteria were recorded as $4x10^4$ cfu/ml in this lake in the autumn and spring seasons. Also, *Escherichia coli* was found in Lake Abant, probably due to the high organic matter flow from the sewage of its surrounding settlement (Figure 9). As a result, the values suggest that Lake Abant is not suitable for swimming due to its high coliform bacteria content (Çelekli, 2006).

a b

Figure 9. a and b) Colonies of total coliform bacteria (Çelekli, 2006).

1.5. Ecotourism of Lake Abant

Bolu city center stands out in terms of tourism with its historical and cultural sites, thermal springs, health tourism, and sports tourism. Lake Abant, one of Bolu's natural beauties, and its route are a center of attraction for ecotourism in all seasons (Figure 10). In this way, people benefit from the blessings of tourism through hotels, motels, restaurants, and businesses selling local products along the way. In addition, there are activities such as bird watching, paragliding, cycling and trekking, and horseback and carriage tours in and around Lake Abant, and the number of visitors for the last 10 years is given in Figure 11 (Genç et al., 2017). In the last 20 years, the highest number of tourists was in 2019.

Figure 10. Water outflow from Lake Abant (Çelekli, 2006).

Vegetation and soil compaction are the most frequently evaluated ecosystem features. Effects on vegetation are typically clear, but significant data collection is re quired to determine effects on soil. Plants, riverbanks, and water resources are damaged by visitor activities around the lake and human interventions such as roadworks. Reduced riparian vegetation has the potential to affect fish species and populations, resulting in changes in water temperatures and reduced uptake of organic matter (Cole & Landres, 1995).

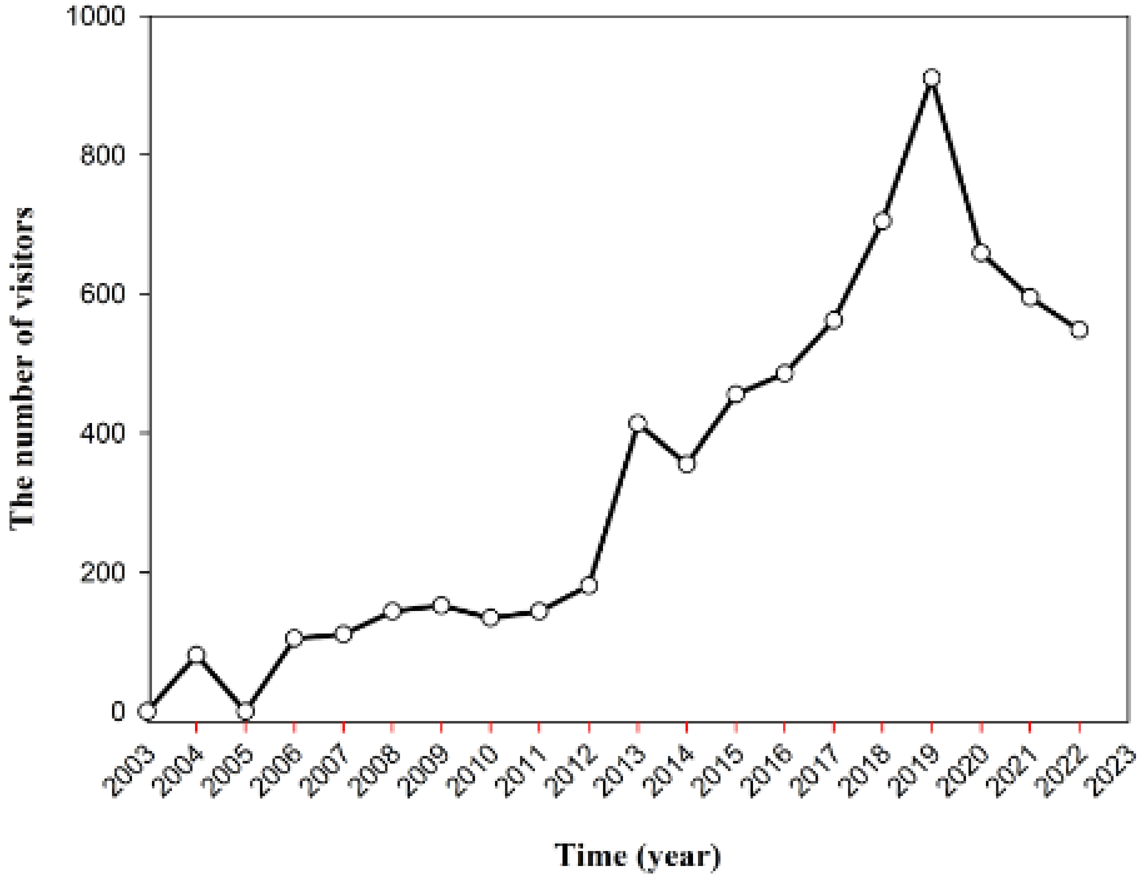

Figure 11. Number of visitors in Lake Abant

1.6. Challenges in Lake Abant

A report (Tuncer, 2013) incited environmental destruction in Lake Abant Nature Park (Figure 12). The report focused on:

i. As can be observed, there is a conflict between the 1/10 000 scale of Long-Term Nature Conservation and National Parks, and the actions carried out in the Lake Abant Nature Park between 2009 and 2010 (Tuncer, 2013).

ii. To maintain this width, excavations were constructed on the forest side of the lake while filling the lakeside, and the existing soil structure and vegetation in these regions were modified. The road surrounding the lake was widened to 15–16 m in some locations, (Tuncer, 2013).

iii. Sections of the flora and fauna, which are living things with living spaces, were "destroyed" recklessly and carelessly on the filled-in lakeside, where the lake shore-side line was altered, and on the filled parts (Figure 12) (Tuncer, 2013).

iiii. Additionally, excavations are done on steep slopes where erosion could carry the soil cover into the lake; these excavations are not reinforced with vegetation or machinery and are vulnerable to erosion (Tuncer, 2013).

iiiii. The width of the road and the fact that things are quite steep in some places prevent animals like otters, turtles, and small mammals (Rodentia and Insectivora) from passing. It has been reported that this is contrary to the provision that "new roads cannot be opened and existing ones cannot be expanded". The trees near the water were submerged by the increasing water level in the lake (Tuncer, 2013).

Figure 12. Destruction in the Nature Park and road widening and shore filling (Tuncer, 2013).

AUTHOR CONTRIBUTION STATEMENT

Abuzer Çelekli, Sidar Yaygir, and Özgür Eren Zariç designed the overall review work.

ETHICAL APPROVAL

No need to ethical approval for this study.

FUNDING STATEMENT

The authors don’t declare any fund.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

Data used in this study are available from the corresponding author upon reasonable request.

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