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# Macrophytic flora of the lakes Balikli and Kayi in Gulagac District, Aksaray, Turkey

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**ABSTRACT**

*The research was conducted through the summer period of the 2009 and 2010 in the lakes Kayı and Balıklı (Gülağaç, Aksaray). During this study, eighteen macrophyte species belonging to fourteen genera in the Lake Balıklı, sixteen macrophyte species belonging to thirteen genera in the Lake Kayı were identified.The total 20 aquatic macrophyte species found in two wetlands were classified under 3 morphological groups: free floating (2 species), submerged (5 species), and emergent (13 species). Emergent vegetation dominated by reed (Typha angustifolia L.) belt in littoral zone of two lakes. Lake waters are dominated by two hydrophytes, Ceratophyllum submersum L. and Ceratophyllum demersum L.*

**Key words:** Macrophyte, Lake, Aksaray, Turkey

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## INTRODUCTION

The European Water Framework Directive human impact on the composition and abundance of biotic communities in fresh waters were described and commented by The European Water Framework Directive[1].That is an undeniable fact that, there are enormous contribution of macrophyte species on the primary productivity in the aquatic habitats, such as rivers, lakes, dams, ponds and wetlands. Aquatic plants are abundant of the littoral zones in these lakes. Macrophytes are an important component of lakes, because they provide food and habitat for invertebrates, fish and wild life. Macrophytes as a component of aquatic ecosystems have been recognized as an indicator of trophic state and water quality of lakes[2]. In wetland ecosystems, aquatic macrophytes play important roles on the production processes of the lakes[3,4], on the determining of nutrient status levels of lakes[2, 5], on the shaping of lakes [4]and on the oxygen budgets on water bodies[2]. Karasu Creek are fed by spring waters located in the north of the county. Karasu Creek is the most important side-arm of the Melendiz Creek, and waters of Karasu Creek flow to Melendiz Creek. Consisting brook after the confluence with the Karasu Brook and Melendiz Brook is called Uluırmak. Mamasın Dam was built on Uluırmak Brook. Uluırmak Brook is one of the most important sources of life in Salt Lake Basin. Lake Kayı and Balıklı are located in the important water source zone (former name of Avların Önü). Two lakes are important habitat for migratory birds and other aquatic animals. Gülağaç is located at the crossroads of ancient and old highways, and due to this reason there are large number historical ruins within the boundaries of Gülağaç District. Four macrophyte species belonging to reeds and rushes where collected from of the Lakes Kayı and Balıklı which arebeing used for the making baskets and wicker by local people [6]. Today, Ministry of Education is trying reviving again to handicrafts as making baskets and wicker in Gülağaç District. Historically, distribution of aquatic macrophytes was firstly reported bySeçmen and Leblebici [7].The flora and vegetation of lakes and swamps, occurring in Thrace, west Black Sea, Marmara, Inner Anatolia and Mediterranean regions were investigated [7, 8, 9, 10]. In all 422 taxa belonging to the families were recorded and 65 plant groups from 58 lakes established [7, 8, 9, 10].At present, there are several published scientific papers on macrophytic flora of lakes where found in adjacent area [10].Species composition and distribution of macrophytes that located at four lakes in Karasu District (Sakarya Province, Marmara Region, Turkey) was given by Altınsaçlı *et al.*[11]. Anthropogenic activities

have been degrading the biodiversity of wetlands in the Turkey. In spite of known all threats and ecological hazards, lakes have not been still declared a protected area by the related government agencies. This papers presents biodiversity and spatial distribution of the macrophyte vegetation from Lakes Kayı and Balıklı. Results of this research will also be used for the conservation plan for these lakes. Because, conservation and restoration proposals for this ecologically significant wetland are made in the framework of a sustainable management plan.

## MATERIALS AND METHODS

### Site Description

Lake Kayıis situated 2.5 km northeast part of the district of Gülağaç (Aksaray Province) (38º 24' 16.2'' K 34º 22' 45.6''D) at an altitude of 1180 m above sea level (Figure 1)and surrounded by a willow (*Salix)*trees. It is a mesotrophic with a mean depth of 2 m, maximum depth 5 m and a surface area of 15.9 ha (Figure 1). Lake is a freshwater water lake. The lake primarily fed by few springs, groundwater and rain water. It has an outlet in the west. Lake is connected with a short canal (outlet) to the Karasu Creek at its west. Karasu Creek waters directly flow into the Mamasın Dam Lake. Lake Balıklı is situated(38º 23' 50.6''K 34º 21' 55.0''D) 1.5 km northeast of the Gülağaç District (Aksaray Province) at an altitude of 1173 m above sea level (Figure 1)and surrounded by a willow (*Salix*)trees. It is a eutrophic lake and with a mean depth of 2 m, maximum depth 5 m and a surface area of 21.6ha (Figure 1). The lake primarily fed by few springs, groundwater, rain water and waters of the Kayı Lake.

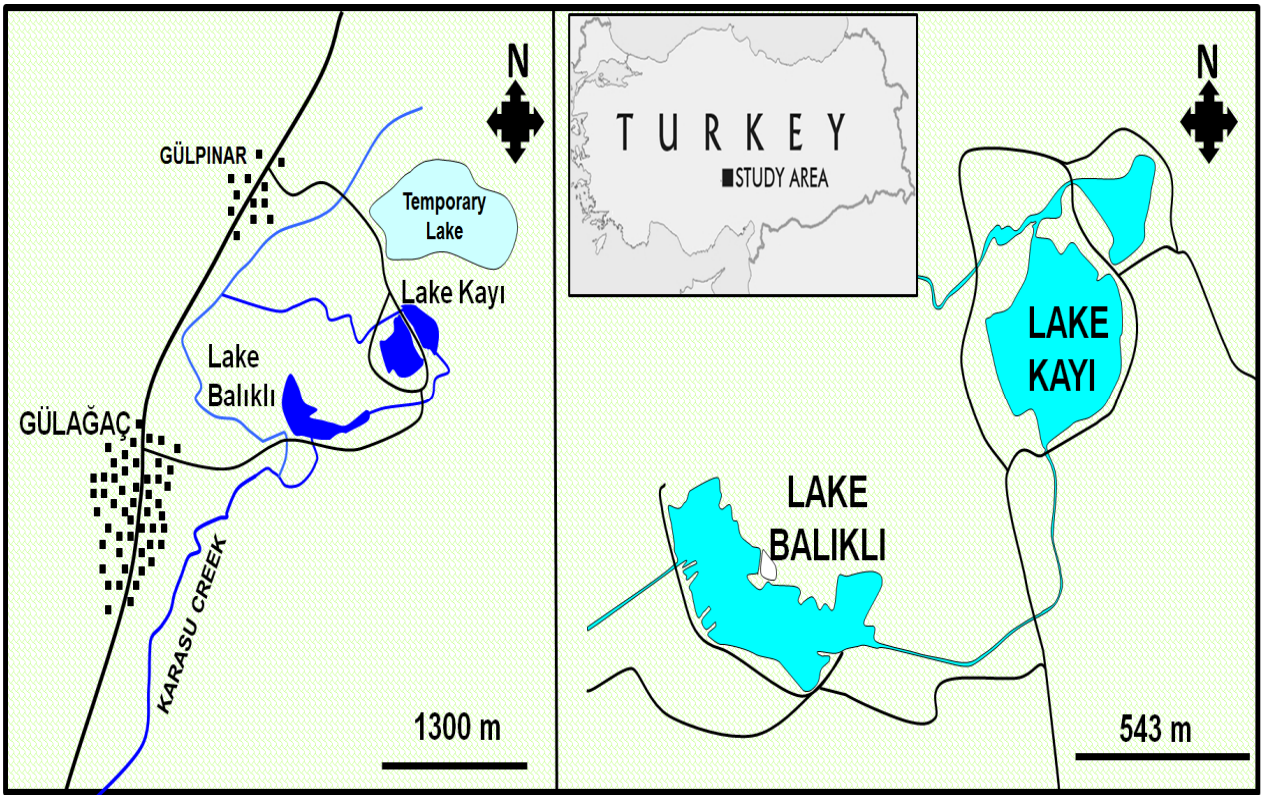


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**Figure 1: Location of lakes Kayı and Balıklı**

Previously there was large wetland at the location of these lakes. Both lakes have occurred after construction of levee on Karasu Creek by DSİ. Climatic conditions in the study area are mainly continental. Water loss of these lakes is consisting by evaporation

According to records of DMİ [12], due to its inland location and high altitude, Province of Aksaray has a markedly continental climate(mean annual temperature of 15.1◦C and annual rainfall of 28,8 kg/m$^2$ between 1960-2012), with hot dry summers and cold snowy winters. Aksaray has a semi-arid continental climate with of cold and snowy winters and long, hot and dry summers. Spring has the most rainfall. Therefore, study area has to a typical climate is semi-arid with high fluctuations in relative humidity between day and night and pronounced temperature fluctuations between summer and winter months.

This study was carried out during summer 2009/2010 in the lakes Kayı and Balıklı located in Gülağaç District in Aksaray Province, Turkey. The distribution and abundance of macrophytes in the two lakes were assessed on foot

along the lake shore or by boat. The macrophytes were collected by rake with hooks[11]. The distribution and abundance of macrophytes in the two lakes are shown on the map of each lake (Fig. 2).

The methodology followed the European Standard EN 14184 recommended for the assessment of aquatic macrophyte vegetation in running waters, and the principles of Kohler [13]; Kohler and Janauer[14] andKohler *et al*. [15] . The method is based on assessment of aquatic macrophytes in contiguous survey units. In all survey units the abundance of each species was estimated on a five-level descriptor scale (1– rare, 2– occasional, 3– frequent, 4– abundant and 5– very abundant). For each species, the growth form (acro-pleustophytes, submerged pleustophytes, submerged anchored, floating leaf rooted plants, amphiphytes and helophytes) was identified in the survey unit.

Various important reviews on the subject were used for identification of the species [10, 16, 17, 18, 19, 20]. Coordinates of the lakes were obtained with a Garmin Etrex 12-channel GPS. Physico-chemical variables (dissolved oxygen, oxygen saturation, pH, salinity and electrical conductivity) and were measured in situ using with a WTW 340i multimeter. Light penetration (Water transparency)was measured using a25cmdiameterSecchidisk.

According to the Davis grid system [17], the research area is located in the B5 square.

**Statistical analysis**

Sorensen's Similarity Quotient (QS) was used for determining similarity of the macrophyte flora in the two lakes. Sorensen's Similarity Quotient (QS) [21], i.e. species similarity based on the presence or absence of species, was used to determine the degree of similarity of macrophyte species collected from the two lakes: QS = 2C/ (A+B), where A and B are the number of species from each sample, and C is the number of common species. Bray-Curtis similarity analysis of the macrophyte species in the two lakes was conducted using the Multivariate Statistical Package[22].

**Table 1: List of macrophyte species and their life form were determined in two lakes**

*(Abbrevations: LK: Lake Kayı, LB: Lake Balıklı, SM: Submerged, FF: Free floating, E: Emergent)*

| | TAXA | LAKES | | MACROPYTE TYPES | | |
|---|---|---|---|---|---|---|
| | | LK | LB | FF | E | SM |
| **BRYOPHYTA** | | | | | | |
| Fontinalaceae | *Fontinalis antipyretica* L. ex Hedw. | ● | ● | | | ■ |
| **SPERMATOPHYTA** | | | | | | |
| Lamiaceae | *Mentha aquatica* L. | ● | ● | | ■ | |
| Cyperaceae | *Eleocharis palustris* (L.) Roem. & Schult. | ● | | | ■ | |
| Cyperaceae | *Cyperus longus* L. | ● | | | ■ | |
| Cyperaceae | *Schoenoplectus lacustris* (L.) Palla | | ● | | ■ | |
| Alismataceae | *Alisma plantago-aquatica L.* | ● | ● | | ■ | |
| Brassicaceae | *Nasturtium officinale* R. Br. | ● | ● | | ■ | |
| Ceratophyllaceae | *Ceratophyllum demersum* L. | ● | ● | | | ■ |
| Ceratophyllaceae | *Ceratophyllum submersum* L. | ● | ● | | | ■ |
| Haloragidaceae | *Myriophyllum spicatum* L. | ● | ● | | | ■ |
| Butomaceae | *Butomus umbellatus* L. | | ● | | ■ | |
| Juncaceae | *Juncus effesus* L. | ● | ● | | ■ | |
| Lemnaceae | *Lemna minor* L. | ● | ● | ■ | | |
| Lemnaceae | *Lemna trisulca* L. | ● | ● | ■ | | |
| Potamogetonaceae | *Potamogeton nodosus* L. | ● | ● | | | ■ |
| Poaceae | *Phragmites australis* (Cav.) Trin. ex Steudel | ● | ● | | ■ | |
| Typhaceae | *Typha angustifolia* L. | ● | ● | | ■ | |
| Typhaceae | *Typha latifolia* L. | ● | ● | | ■ | |
| Typhaceae | *Typha laxmannii* Lepechin | | ● | | ■ | |
| Typhaceae | *Sparganium erectum* L. | | ● | | ■ | |
| **Total number of species** | | **16** | **18** | **2** | **13** | **5** |

## RESULTS AND DISCUSSION

The present study has attempted to determine the macrophytes (free-floating, emergent and submerged species) in the two lakes in Gülağaç District (Aksaray). As a result of the samplings performed in summer 2009 and 2010, 20 macrophyte species (*Fontinalis antipyretica* L. ex Hedw., *Mentha aquatica* L., *Eleocharis palustris* (L.) Roem. & Schult., *Cyperus longus* L., *Schoenoplectus lacustris* (L.) Palla.,*Alisma plantago-aquatica* L., *Nasturtium officinale* R. Br.,*Ceratophyllum demersum* L.,*Ceratophyllum submersum* L., *Myriophyllum spicatum* L., *Butomus umbellatus* L., *Juncus effesus* L., *Lemna minor* L.,*Lemna trisulca*L.,*Potamogeton nodosus* L.,*Phragmites australis* (Cav.) Trin. ex Steudel., *Typha angustifolia* L.,*Typha latifolia* L.,*Typha laxmannii* Lepechin.,*Sparganium erectum* L.) were identified. They belonged to 13 families and 16 genera in the two lakes **(**Table 1**).** In the following list, taxonomic

and systematic nomenclature largely follows Davis[17] and Seçmen & Leblebici [10]. The macrophyte species and their life form types listed in these lakes are given in Table 1.

The hydrophytes found in this study, fall into the following four categories according to growth forms: a) Plants with roots penetrating the substrate but leaves and/or stems emerging above the water surface (hyperhydates): *P. australis,B. umbellatus,M. aquatica, E. palustris, N. officinale, C. longus, J. effesus, A. plantago-aquatica,S. lacustris, T. angustifolia,T. latifolia, T. laxmannii, S. erectum*; b) Rooted in sediment, plants which except their flowers or inflorescences are submerged (hyphydates): *M. spicatum, P. nodosus*; c) Surface floating plants (acropleustophytes): *L. trisulca, L. minor;* d) Plants entirely submerged, floating at mid-depth (mesopleustophytes): *C. demersum, C. submersum, F. antipyretica.*

The invertebrate fauna living in the lakes today consists mainly of Oligochaeta (*Tubifex tubifex*(Müller, 1774), Gastropoda (*Valvata piscinalis*(O.F. Müller, 1774), *Planorbis planorbis*(Linnaeus, 1758);*Gyraulus albus*(O.F. Müller, 1774), Bivalvia (*Pisidium casertanum* (Poli, 1791), *Pisidium amnicum*(O.F. Müller, 1774), Hirudinea (*Hirudo medicinalis*Linnaeus, 1758, *Haementeria costata* Fr. Müller1864), *Glossophonia complanata*, *Erpobdellaoctoculata* Linnaeus, 1758, *Piscicola geometra* (Linnaeus, 1761) Crustacea(*Darwinulla stevensoni* (Brady & Robertson, 1870), *Cypridopsis vidua*(O.F. Müller, 1776), *Cypria ophtalmica*(Jurine, 1820), *Physocypria kraepelini*G. W. Müller 1903, *Fabaeformiscandona fabaeformis* (Fischer, 1851), *Candona neglecta*Sars, 1887, Ilyocypris bradyi Sars, 1890, *Ilyocypris biplicata*(Koch, 1838), *Heterocypris salina* (Brady, 1868), *Heterocypris incongruens*(Ramdohr, 1808), *Prionocypris zenkeri*(Chyzer and Toth, 1858), *Chydorus*sp., *Asellus aquaticus*(L.),*Daphnia* sp.*Gammarus* sp. *Astacus leptodactylus*Eschscholtz, 1823) and Insecta (*Chironomus plumosus* (L.).Four fish species in the lake: Pike (*Esox lucius*L.), tench (*Tinca tinca* L.), Common carp (*Cyprinus carpio* L.), Common bleak(*Alburnus alburnus* L.) and Common rudd (*Scardinius erythrophthalmus* L.); one amphibian species (*Rana ridibunda* (Pallas 1771) ), three reptilian species (*Emys orbicularis* L., *Natrix natrix* (Linnaeus, 1758) *Natrix tessellata*Laurenti 1768); twelve bird species (*Fulica atra, Rallus aquaticus* L., *Circus macrourus* (Gmelin, S.G., 1770), *Circus aeruginosus* (L.), *Glareola pratincola* (Linnaeus, 1766), *Ciconia nigra* (L.), *Ciconia ciconia* (L.), *Phoenicopterus rube* L., *Podiceps cristatus* (L.), *Egreta alba* L., *Motacilla cinerea* Tunstall, 1771, *Upupa epops*L.**)** and four mammalian species (*Spermophilus xanthophrymnus* (Bennett, 1835), *Rattus norvegicus*(Berkenhout, 1769), *Rattus rattus* (L.), *Allactaga williamsi*Thomas, 1897) were determined in the both lakes and adjacent area of theirs. Due to host valuable birds and reptilian species, Lake Balıklı should be placed under legal protection. As many of the water bodies in Turkey are permanent, plants and animal are tolerant to a wide variety of environmental conditions.

Sixteen taxa were registered in the Lake Kayı, of which 15 are Spermatophyta (93.75%) and one is Bryophyta (6.25 %). Nineteentaxa were reported from Lake Balıklı, of which seventeen are Spermatophyta (94.44 %) and one is Bryophyta (5.56 %).

In the research area, 20 species taxa having 13 family are; Typhaceae 4 (20 %), Cyperaceae 3 (15%), Lemnaceae 2 (10%), Ceratophyllaceae 2 (10%) Poaceae 1 (5%), Potamogetonaceae 1(5%), Juncaceae 1 (5%), Haloragidaceae 1 (5%), Alismataceae 1 (5%), Brassicaceae 1 (5%), Fontinalaceae1 (5%), Butomaceae 1 (5%), Lamiaceae1 (5%),

The genera with the largest number of species in the research area are *Typha* 3 (16 %); *Lemna* 2 (11%); *Ceratophyllum* 2 (11%), *Mentha* 1 (6%), *Butomus* 1 (6%), *Phragmites* 1 (5%), *Sparganium* 1 (5%), *Juncus* 1 (5%), *Myriophyllum* 1 (5%), *Schoenoplectus* 1 (5%), *Cyperus* 1 (5%), *Eleocharis* 1 (5%), *Alisma* 1 (5%), *Nasturtium 1* (5%), *Fontinalis* 1 (5%),

A total of 20 macrophyte taxa were identified in the two lakes (Table 1).Macrophytes identified in this study were evaluated according to the classificationcriteria of Dorotovičová [23] and Sculthorpe [24].According to macrophyte classification of the Dorotovičová(2005[23],*F.antipyretica, C. demersum, C. submersum, M. spicatum, L. minor, L. trisulca, P. nodosus* are hydrophytic species; *M. aquatica, N. officinale, A. plantago-aquatica* are amphiphytic species; *C. longus, E.palustris,B. umbellatus, S. lacustris,J. effesus,P. australis,T. angustifolia,T. latifolia,T. laxmannii,S. erectum* are helophytic species. Also, according to Sculthorpe [24], *L. minor* and *L. trisulca* are floating macrophyte species; *M. aquatica, N. officinale, A. plantago-aquatica, C. longus, E. palustris, B. umbellatus, S. lacustris, J. effesus, P. australis, T. angustifolia, T. latifolia, T. laxmannii* and *S. erectum* are emergent macrophyte species; *F. antipyretica, C. demersum, C. submersum, M. spicatum* and *P. nodosus* are submerged macrophyte species.

Aquatic plants are welladapted to lenticecosystems according to lotic ecosystems. Because lentic ecosystem can able to support a diverse range of water plants due to more light penetration. Submerged macrophytes (five) were dominated by the species of genus *Ceratophyllum* and *Myriophyllum*(*C. demersum, C. submersum, M. spicatum*).

Emergent macrophytes (13taxa) were dominated by the species of genus *Typha*(*T. angustifolia*and*T. latifolia*), floating macrophytes (2) were dominated by the species of genus*Lemna* (*L. minor* and *L. trisulca*). Spatial distribution and abundance of the macrophytes in the two lakes are shown in Table 2.According to the Bray-Curtis Similarity Index [22] and Sorensen's Similarity Coefficient [21], Lake Kayı is at 82 % similar to Lake Balıklı. Physico-chemical parameters of Lake Kayı and Balıklı are given in Table 3.

**Table 2: The spatial distribution and abundance of the macrophytes in the two lakes (1-rare (●), 2-occasional (►), 3-frequent (♦), 4-abundant (▲) and 5- very abundant (♣). Black bars indicate the abundance of macrophytes. Abbrevations: LK: Lake Kayı, LB: Lake Balıklı**

| TAXA | LAKES | |
|---|---|---|
| | LK | LB |
| **CHAROPHYTA** | | |
| *Fontinalis antipyretica* L. ex Hedw. | 3♦ | 2► |
| **SPERMATOPHYTA** | | |
| *Mentha aquatica* L. | 3♦ | 3♦ |
| *Eleocharis palustris* (L.) Roem. & Schult., | 2► | - |
| *Cyperus longus* L. | 2► | - |
| *Schoenoplectus lacustris* (L.) Palla | - | 3♦ |
| *Alisma plantago-aquatica* L. | 3▲ | 3▲ |
| *Nasturtium officinale* R. Br. | 3▲ | 3▲ |
| *Ceratophyllum demersum* L. | 4▲ | 4▲ |
| *Ceratophyllum submersum* L. | 4▲ | 4▲ |
| *Myriophyllum spicatum* L. | 3■ | 3■ |
| *Butomus umbellatus* L. | - | 3♦ |
| *Juncus effesus* L. | 3♦ | 3♦ |
| *Lemna minor* L. | 3♦ | 3♦ |
| *Lemna trisulca* L. | 4▲ | 2► |
| *Potamogeton nodosus* L. | 3♦ | 3♦ |
| *Phragmites australis* (Cav.) Trin. ex Steudel | 3♦ | 3♦ |
| *Typha angustifolia* L. | 5♣ | 5♣ |
| *Typha latifolia* L. | 2► | 2► |
| *Typha laxmannii* Lepechin | - | 2► |
| *Sparganium erectum* L. | - | 3♦ |

According to the Bray-Curtis Similarity Index [22] and Sorensen's Similarity Coefficient [21], Lake Kayı is at 82 % similar to Lake Balıklı.Physico-chemical parameters of Lake Kayı and Balıklıare given in Table 3. The physico-chemical parameters (dissolved oxygen, temperature, pH and salinity) has slightly changed during in the observed periods (Table 3). Lake Kayı is a fresh water(0.0-0.1‰), well oxygenated (8.57-8.71 mg/L) and alkaline(8.15-8.45) lake. Lake Balıklı is fresh water(0.0-0.1‰), oxygen-rich(6.1-6.45mg/L) and alkaline (7.5-7.65). In summer period, Secchi disc transparency fluctuated between 90 and 96 cm in the Lake Kayı and between 82 and 85 cm in the Lake Balıklı. The high dissolved oxygen levels measured in open waters are necessary within the life of invertebrates animals in two lakes.

Distribution of the submerged, emerged and floating-leaved macrophytes in the two lakes in Gülağaç District is shown in Figure 2.

**Table 3: Some physico-chemical parameters of Lake Kayı and Balıklıduring the summer period of the 2009 and 2010. The scientific abbreviations shown are dissolved oxygen (DO, mg/L), water temperature (Temp, °C), oxygen saturation (Sat, %), standard hydrogen electrode (SHE, mV), electrical conductivity (EC, µS/cm), pH, salinity (Sal, ‰), Secchi depth (Secchi, cm)**

| | Temp. (ºC) | pH | SHE (mV) | Sal. (‰ ) | EC (µS/cm) | DO (mg/L) | Sat. (%) | Secchi (cm) |
|---|---|---|---|---|---|---|---|---|
| **Lake Kayı (June 2009)** | 24.5 | 8.15 | -97 | 0.1 | 667 | 8.57 | 120.4 | 96 |
| **Lake Kayı (June 2010)** | 25.2 | 8.45 | -99 | 0.1 | 671 | 8.71 | 145.4 | 90 |
| **Mean** | 24.8 | 8.3 | -98 | 0.1 | 669 | 8.64 | 132.9 | 93 |
| **Lake Balıklı (June 2009)** | 27 | 7.5 | -32 | 0.1 | 691 | 6.45 | 85 | 85 |
| **Lake Balıklı (June 2010)** | 24.6 | 7.65 | -34 | 0.1 | 688 | 6.1 | 82 | 80 |
| **Mean** | 25.8 | 7.57 | -33 | 0.1 | 689.5 | 6.2 | 83.5 | 82.5 |

*T. angustifolia* (Lesser Bulrush) was the dominant emergent macrophyte species in the littoral of the Lake Kayı. Other emergent macrophyte species according to *T. angustifolia* (Lesser Bulrush) were found less abundant in the littoral zone of the Lake Kayı.Lake Kayı has a narrow macrophyte belt was formedalong the lake shore from such emergent macrophytes as *T. angustifolia*, *T. latifolia* (common bulrush), *P. australis* and *J. effusus* (soft rush). Other emergent macrophyte species *A. plantago-aquatica* (common water plantain), *N. officinale* (watercress), *M. aquatica* (water mint), *E. palustris* (common spikerush) and *C. longus* (Galingale) are found in behind and amongst

of macrophyte belt zone of Lake Kayı. *A. plantago-aquatica* (common water plantain) and *N. officinale* (watercress) were determined in wet meadow zone of Lake Kayı.

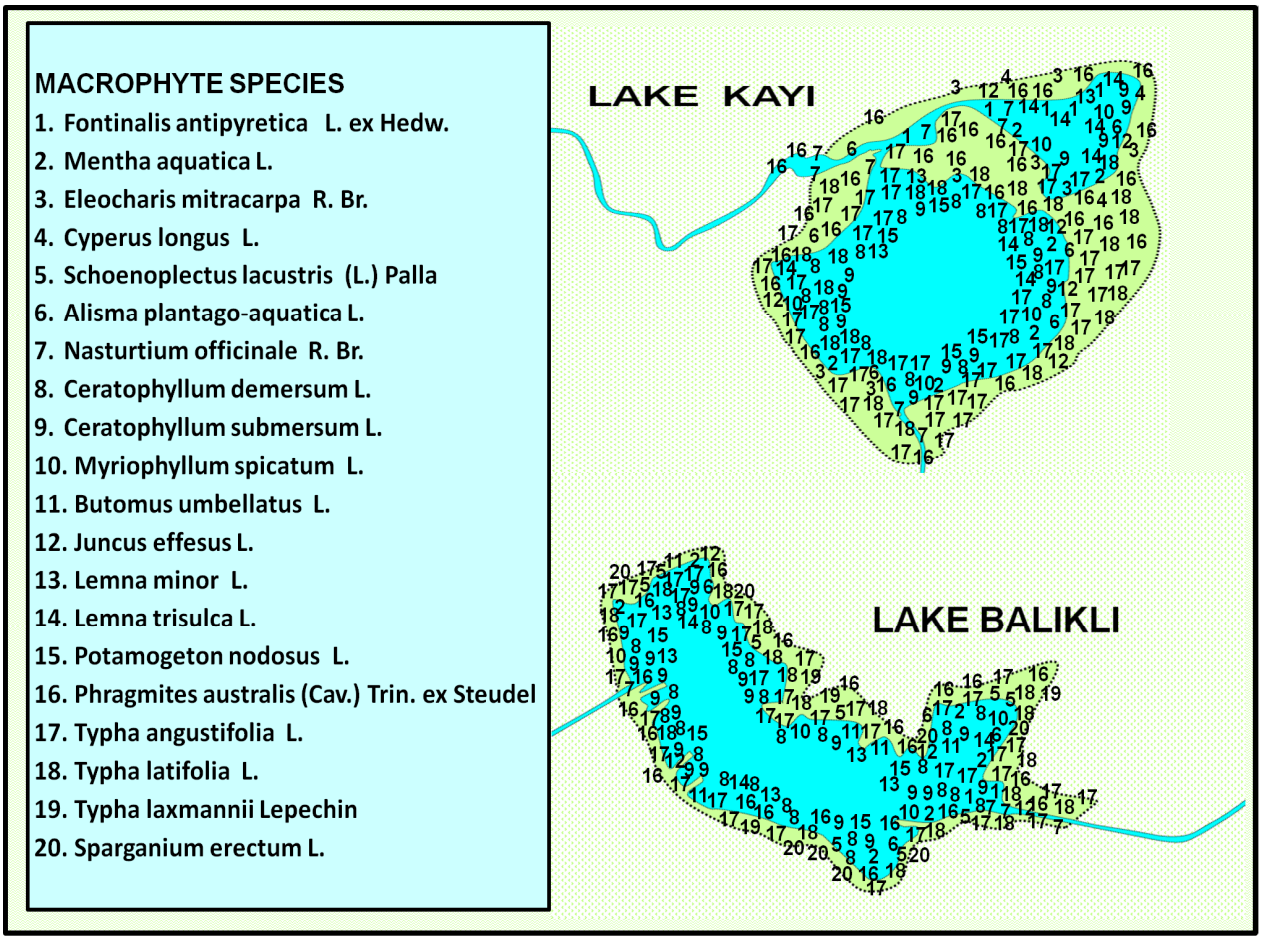


**Figure 2: Distribution map of macrophyte species of two lakes located in Gülağaç district**

It is a cosmopolitan species of every continent except Antarctica. Populations of *P. australis* behave invasively [25]. However, *Typha* species are dominant than *P. australis* in the Lake Kayı, and *P. australis* seen only in the north eastern bank of the Lake Kayı.

Submerged aquatic macrophytes are more commonly found in shallow stagnant waters. *C. demersum* (Hornwort) and *C. submersum*(soft hornwort) were the dominant submerged species in the deeper part of the lake. *M. spicatum* (Eurasian watermilfoil) were found less abundant in the deeper part of the lake according to other two submerged macrophyte species. Macrophyte species *C. demersum* and *C. submersum* formed denser stands than *M. spicatum* in Lake Kayı. Antialgal compounds are produced by *C. demersum* and *M. spicatum*[26]. Cosmopolitan species *C. demersum* and *M. spicatum* have very similar biological characteristics, and C. *demersum* and *M. spicatum* usually prefer eutrophic stagnant and flowing waters condition for colonisation[27, 28].

The Lake Kayı is fed by important underground water spring located in northern bank. Invasive free-floating macrophyte *Lemna trisulca* (star duckweed) is dominant species in this section of the Lake Kayı.Unshaded or shaded and eutrophic or less eutrophic conditions affects competition between *L. minor* and *L. trisulca*[29]. Shaded eutrophic sites were dominated by *L. minor*, whereas a less eutrophic site was dominated by *L. trisulca* [29]. Unshaded eutrophic sites *Lemna trisulca* dominance in spring and fall, and summer *L. minor* dominance [29]. The parts where found of the underground water spring in Lake Kayı are covered with willow trees. Shaded and oligotrophic conditions are dominance in throughout summer period in this section of the Lake Kayı.

*Fontinalis antipyretica* (willow moss) is attaches to rocks or substrate in flowing water, and it prefers in shaded sites and slightly acidic or slightly alkaline water. *F.antipyretica* grows in shallow faster flowing waters, and it prefers course-grained substrates(gravel and solid rocks) such as *M. spicatum* [30]. Bryophyte *F. antipyretica* largely used as a biomonitor for water quality in freshwater ecosystems [31].Submerged macrophyte *F. antipyretica* was found in

same section of Lake Kayı as *L.trisulca*. *F. antipyretica* reaches a dominant position in the shade of willow trees and slow-flowing waters of the Lake Kayı. Spring that having high flow rate and found in northern part of Lake Kayı are shallow (maximum depth 1.5 m) and are dominated by fine-grain substrates (gravel, sand and solid rock). Therefore, *F. antipyretica* was found in suitable habitat of the Lake Kaya which compatible with its biological characteristics.

*T. angustifolia* (lesser bulrush) was the dominant emergent macrophyte species in the littoral of Lake Balıklı as the Lake Kayı. However, *Typha* species are dominant than cosmopolitan species *P. australis* in the Lake Balıklı. *P. australis* is sporadically observed in the all along the coast of the Lake Balıklı. Other emergent macrophyte species according to *T. angustifolia* (Lesser Bulrush) were found less abundant in the littoral zone of the Lake Balıklı.Lake Balıklı has a narrow macrophyte belt was formed along the lake shore from such emergent macrophytes as *T. angustifolia*, *T. latifolia* (common bulrush), *T. laxmannii* (graceful cattail)*P. australis*, *J. effusus* (soft rush). *T.laxmannii* (graceful cattail**)** is still used in Gülağaç for making of basket and pillows.*T. latifolia*, *S. lacustris*, *P. australis*, *J. effusus* and *C. longus* which is used in making baskets and pillows were reported from Lake Balıklı and Kadı Creek by Gülçur *et al.*[6]. Aquatic macrophytes species were reported in Gülağaç by Gülçur et al.[6] that was identificated in 2009 by the team who wrote this article. Other emergent macrophyte species *Alisma plantago-aquatica* (common water plantain), *N. officinale* (watercress), *M. aquatica* (water mint), *B. umbellatus* (flowering-rush) and *S. lacustris* (common club-rush)are found in behind and amongst of macrophyte belt zone of Lake Balıklı as the Lake Kayı.

*A. plantago-aquatica* (common water plantain) and *N. officinale* (watercress) are common helophytic emergent species in wet meadow zone of Lake Balıklı.

Lake Balıklı is very similar to Lake Kayı in terms of types spatial distribution and abundance of submerged macrophyte species. Submerged *C. demersum* and *C. submersum* were found at all depths and in all regions in Lakes Balıklı as Lake Kayı. *C. demersum* and *C. submersum* are dominant submerged species in the deeper part of the Lake Balıklı. As in Kayı Lake,*M. spicatum* were found less abundant in the deeper part of the Lake Balıklı according to other two submerged macrophyte species.

Lake Balıklı are fed by little spring and n creek which formed by Lake Kayı. Free-floating macrophyte *L. minor* **(**common duckweed)is more dominant species than *L. trisulca* (star duckweed) inunshaded Lake Balıklı.

Generally, water mosses are attached to rocks. In Balıklı Lake, Bryophtic species *F. antipyretica* was only observed in fine-grained substrates in mouth of creek and around of the spring waters. Higher abundance of emergent macrophyte species was recorded from muddy substrates of two lakes.

Secchi disk readings can be used to determine a lake's trophic status. Low Secchi depth values were measured in the lakes Kayı (90-96 cm) and Balıklı (82-85 cm) (Table 3). Lower Secchi depth values indicate turbid or colored water. Lower Secchi depth values and greenish water observed in these lakes indicate mass abundance of phytoplanktonic organisms in the lakes Kayı and Balıklı. Secchi disk transparency value was measured at 1.5 m (maximum depth) in clean water of spring where located in front of Lake Kayı. Lakes Kayı and Balıklı are connect to each other via a little creek, and two lakes are located near distance to each other. The waters of the Lake Kayı flows into the lake Balıklı and is feeds it. Therefore, most of macrophyte species identified in Lake Kayı are available at the Lake Balıklı. According to the Sorensen Similarity Matrix [21]and Bray- Curtis similarity index [22]. Lake Kayı is similar 82.3 % to Lake Balıklı.UPGMA (unweighted pair method with arithmetic mean) dendrogram was constructed according to based on the presence or absence of macrophyte species by using clustering analysis of Bray Curtis similarity coefficient (Figure 3).

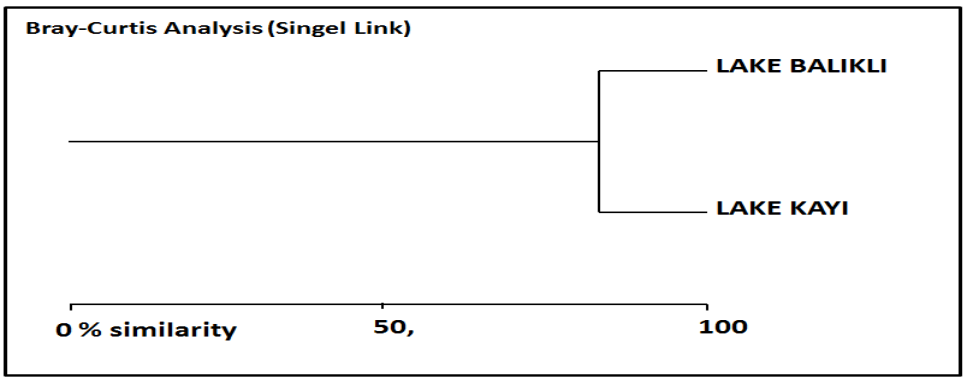


**Figure 3: Dendrogram according to Bray-Curtis similarity index for the two lakes studied**

## CONCLUSION

During this study, eighteen macrophyte species belonging to fourteen genera in the Lake Balıklı, sixteen macrophyte species belonging to thirteen genera in the Lake Kayı were identified. The present study reveals that all of the physico-chemical parameters were permissible limits for macrophyte species in two wetlands. In some water springs that feed wetland was determined low flow rate, also some of them found completely dry. In this study, expected slightly basic pH values instead were measured slightly acidic pH values (6.5) in some water springs that feed wetland. During this study, we were observed excessive irrigation water use that obtained from groundwater sources. Increases of the depth of artesian wells have been caused reduction of spring water rate. For this area, qualified data concerning of the capacity of groundwater that used in agriculture are not available. Hydrological balance will be disrupting in near future in this area due to use of sprinkler method in potato growing instead use of the drip irrigation method. Recreational purposeful facilities planned construction around of the Karasu Creek and Lakes Kayı and Balıklı by the Gülağaç Municipality should be never constructed without a scientific environmental impact assessment report. Both of wetlands must be declared "Environmental Protected Area" or "Wildlife Protection Area" for protecting existing species in these wetlands. *T. angustifolia* was the dominant emergent macrophyte species in the littoral of the Lakes Kayı and Balıklı. *C. demersum* and *C. submersum* were the dominant submerged species in the two wetlands. *L. trisulca* was the free-floating macrophyte species in the Lakes Kayı, and *L. minor* was the free-floating macrophyte species in the Lakes Balıklı.

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