

**AQUATIC PLANT DIVERSITY OF GÖLKÖY AND YUMRUKAYA
(BOLU, TURKEY)**

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**AQUATIC PLANT DIVERSITY OF GÖLKÖY AND YUMRUKAYA
(BOLU, TURKEY)**

by

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Approval of the Graduate School of Natural and Applied Sciences

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ABSTRACT

AQUATIC PLANT DIVERSITY OF GÖLKÖY AND YUMRUKAYA (BOLU, TURKEY)

Bayındır, Necati

MSc, Department of Biology

Supervisor: Asst. Prof. Nursel İkinci

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In this thesis vascular aquatic macrophyte flora of Lake Gök  y and Yumrukaya wetland (Bolu, Turkey) were studied. Field studies were done between July and November for 2011, between April and October for 2012. After identification of the collected specimens 80 taxa belonging to 30 families and 50 genera were found. 8 taxa are new records for the Bolu province.

The largest 5 families according to their species number in the two study areas are: Cyperaceae (11 sp.), Lamiaceae (8 sp.), Potamogetonaceae (6 sp.), Asteraceae (5 sp.) and Ranunculaceae (5 sp.).

The largest 5 genera according to their species number in the two study areas are: *Carex* (5 sp.), *Potamogeton* (5 sp.), *Salix* (5 sp.), *Juncus* (4 sp.) and *Polygonum* (4 sp.).

Identified aquatic plants were also classified according to their life forms, as being submerged, free floating, attached floating or as emergent.

The study sites were compared with 5 other wetland of Bolu according to their species compositions. TWINSpan two-way indicator species analyze resulted in four groups. Non-metric multidimensional scaling (NMDS) analysis separated Gölçük, Sülüklügöl and Lake Sünnet from the cluster formed by Lake Gölköy, Yumrukaya, Abant and Yeniçağa.

Keywords: Bolu, Gölköy, Macrophyte, NMDS, TWINSpan, Yumrukaya.

ÖZET

GÖLKÖY VE YUMRUKAYA' NIN SUCUL BİTKİ ÇEŞİTLİLİĞİ (BOLU, TÜRKİYE)

Bayındır, Necati

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Bu tezde Gölköy ve Yumrukaya'nın (Bolu, Türkiye) sucul makrofit florası çalışılmıştır. Arazi çalışmaları 2011 yılı içerisinde Temmuz ve Kasım, 2012 yılı içerisinde de Nisan ve Ekim ayları arasında yapılmıştır. Toplanmış olan örneklerin teşhisleri sonucunda 30 familya ve 50 cinse ait 80 takson bulunmuştur. 8 takson Bolu ili için yeni kayıt olarak değerlendirilmiştir.

Ayrıca teşhisleri yapılmış sucul bitkiler yaşam formları açısından: tüm bitki suya batık olan bitkiler, su yüzeyinde serbest olarak yüzen bitkiler, kökleri zemine bağlı su yüzeyinde yüzen bitkiler ve sadece dip kısımları ve kökleri su içinde olan bitkiler olarak sınıflandırılmıştır.

İki çalışma alanında, tür sayılarına göre en büyük 5 famiya: Cyperaceae (11 sp.), Lamiaceae (8 sp.), Potamogetonaceae (6 sp.), Asteraceae (5 sp.) ve Ranunculaceae (5 sp.) olmuştur.

İki çalışma alanında, tür sayılarına göre en büyük 5 cins ise: *Carex* (5 sp.), *Potamogeton* (5 sp.), *Salix* (5 sp.), *Juncus* (4 sp.) ve *Polygonum* (4 sp.)'dur.

İki çalışma alanımız Bolu'daki farklı 5 sucul alanla birlikte tür kompozisyonlarına göre analiz edilmiştir. TWINSpan tür analizi dört grupta sonuçlanmıştır. Non-metric multidimensional scaling (NMDS) analizi Gölcük, Sülüklügöl ve Sünnet Gölü'nü Gölköy, Yumrukaya, Abant and Yeniçağa'dan oluşan diğer kümeden ayırmıştır.

Anahtar kelimeler: Bolu, Gölköy, Makrofit, NMDS, TWINSpan, Yumrukaya.

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1. INTRODUCTION

Areas that are covered with water, either permanently or periodically are called wetlands. This term includes marsh area, fens, peatland or water bodies, whether natural or artificial with water that is static or flowing. Water could be fresh, brackish or salty [1, 2].

Wetlands or aquatic areas play a critical role in the environments. Wetlands have a great amount of annual productivity. With this feature, wetlands feed many insects, shellfish and fish species. Also, wetlands provide shelter for many bird and fish species which are nesting in the aquatic areas [1, 2, 3,].

Macrophytes are important issue in aquatic environments, and were mentioned in the Water Frame Directive (WFD) to determine water quality of aquatic areas as biological indicators [4, 5, 6, 7, 8, 9].

Macrophytes are classified into two groups: Hydrophytes and helophytes [1, 10].

Hydrophytes are plants that grow only in water or in very saturated soil. Hydrophytes can be divided into three groups according to their life forms:

The free floating hydrophytes: These plants float freely on water surface, but their roots or any parts do not reach to the soil. They usually live in stagnant water.

Typical examples are *Lemna* (water duckweed) and *Eichhornia* (water hyacinth) species.

The attached or fixed floating hydrophytes: In the floating-leaved plants, roots reach to soil and in water depths up to 3 meters or more. Floating leaves or aerial flowers either float on the surface of water or just emerge out of water. Examples are *Nymphaea* (water lilies) and some species of *Potamogeton* (pondweeds).

Submersed macrophytes: The submersed macrophytes complete their life cycle under the water surface and those not contact with the atmosphere. Flowers of some species can ascend from water level in anthesis. Leaves are mostly dissected. Examples: *Myriophyllum* (water milfoil), *Utricularia* (bladderworts) and *Ceratophyllum* (hornwort).

Helophytes or emergent hydrophytes: Emergent aquatic macrophytes are defined as plants that are rooted in shallow water or muddy soil and vegetative parts of the plant protruding above the water surface. Examples: *Typha* (Bulrush) and *Phragmites* (common reed).

Especially in submerged macrophytes gas exchange is the main problem. Water limits the capacity of gas exchange because of the density and viscosity character. Despite that, plants develop physiological strategies to cope with negative effects. The use of the ion bicarbonate (HCO_3) is the most common strategy. Exploitation of bicarbonate ion provides the synthesis of a complex of enzymes, like carbonic anhydrase that facilitates photosynthesis. Also highly dissected leaves increase leaf

surface and thereby increase gas exchange. Second main problem is light limitation that decrease photosynthesis rate. But, most of submerged macrophyte species elongate their organs to water surface. Floating leaved macrophytes overcome with aerial parts [10, 11].

In addition to anemophily (wind pollination) or entomophily (*pollination by insects*), hydrophily (pollination in water) and epihydrophily (pollination on water surface) take place in some groups of macrophytes. Approximately, 5% of the all hydrophytes are hydrophilous. This feature distinguishes the hydrophilous plants from terrestrial plants. Moreover, insects use pollens or nectar of the terrestrial plants. On the other hand, some group of insects use macrophytes for mating, nesting and shelter like mosquitoes [12, 13].

1.1. Investigation Related With Research Area

The Flora of Abant Izzet Baysal University Campus was studied (Turgut, 1996). However, the study area of this thesis did not include these two wetlands. In this thesis, some aquatic and marshy plants were found in the little ponds and seasonal marshy areas belonging to Typhaceae, Polygonaceae, Onagraceae and Lamiaceae [14].

1.2. Previous Aquatic Flora Studies in Turkey

Seçmen and Leblebici (1984) studied from the Western Anatolian (B1, B2, B3, C1, C2, C3 squares) 48 lakes and swamps. They identified 164 taxa belonging to 42 families [15].

Seçmen and Leblebici (1991) studied the aquatic flora of Thrace and they found 180 taxa belonging to 48 families [16].

Seçmen and Leblebici (1996) investigated the aquatic flora of Marmara region. 16 lakes and marshy habitats were studied and 161 taxa were found belonging to 45 families [17].

Seçmen et al. (1996) identified 32 macrophyte taxa in Lake Eber and they evaluated pollution level of the lake water according to Macrophyte Index . However, results were not supported with environmental data [7].

Kesici E. and Kesici C. (2005) investigated Titreyengöl (Antalya) macrophyte diversity and 46 macrohydrophyte taxa were identified [18].

Kesici et al. (2006) studied effect of the fishing on the aquatic plants in the Lake Akşehir, Beyşehir, Eğirdir and Kovada. They found that wrong fishing activities cause increasing of macrophyte biomass [3].

Karaömerlioğlu (2007) investigated the vegetation of Göksu Delta. Study area separated into three habitat groups and 475 taxa belonging to 76 families, 286 genera [19].

Kesici E. and Kesici C. (2007) studied hydromacrophytes of Lake Yarıklı (Burdur). At the end of study, 37 taxa belonging to 19 families were found [20].

Uğran (2008) evaluated macrophyte diversity in high-altitude Çalı Lake (2265 m.). In this study, 6 submerged, 1 free-floating, 13 emergent macrophytes were found [21].

Kırkağaç et al. (2011) investigated relationship between macrophytes and pollution. As a result of the research, decrease in macrophyte biomass was observed in the blur regions of Porsuk River [22].

2. GENERAL INFORMATIONS

2.1. Lake Glky

Lake Glky was built between 1965 and 1970 in old Glky village for irrigation and fishing activities. Additionally, the lake has been used for drinking water of city of Bolu since 2011. The maximum surface area of the lake is 180 ha. This area decreases to half of its size because the water is used for irrigation purposes in summer months. (Figure 5)

Mainly, there are two water sources: Mudurnu Creek and Abant Creek. In addition to these two sources, one underground and three fountains feed the lake in spring and autumn seasons. These water sources provide the habitat for plants that grow in the slow flowing water.

Glky village is located to the west of the lake. Villagers use the lake area for irrigation and a cattle grazing with *Mentha pulegium* L. pollution around the lake is caused by picnickers chicken farms and agricultural areas.

Klkylođlu (2005) studied ecology and phenology of Ostracoda of Lake Glky between January 2000 and December 2001. According to the results of this study Lake Glky was classified as mesotrophic [23].



Figure 1: Lake Gökçöy from north side



Figure 2: Lake Gökçöy from west side

2.2. Yumrukaya Reservoir

Yumrukaya reedbed is a wetland that is located on northern side next to the Yumrukaya Village, east of the reservoir. Also, Hamidiye district of Glky Village is on southern side of the wetland. Before 1965, this area was marshland. With the start of construction of Glky, Abant Creek that is main source of Yumrukaya was cut by damn and water accumulated. (Figure 5)

The vegetation of the wetland is dominated by *Typha latifolia* L. and *Salix amplexicaulis* Bory et Chaub species.

Sewage of Abant Izzet Baysal University and construction remnants are serious polluters in these areas.

Klkylođlu (2005) studied the factors affecting the presence of Ostracoda in Yumrukaya. In this study, physico-chemical data and Ostracoda diversity showed that the reservoir water have meso to eutrophic character [24].

Yumrukaya wetland and Lake Glky are connected through a concrete canal to transfer water from Yumrukaya to Glky in spring and summer months.



Figure 3: Yumrukaya wetland from the village side.



Figure 4: Yumrukaya wetland from the Campus side.

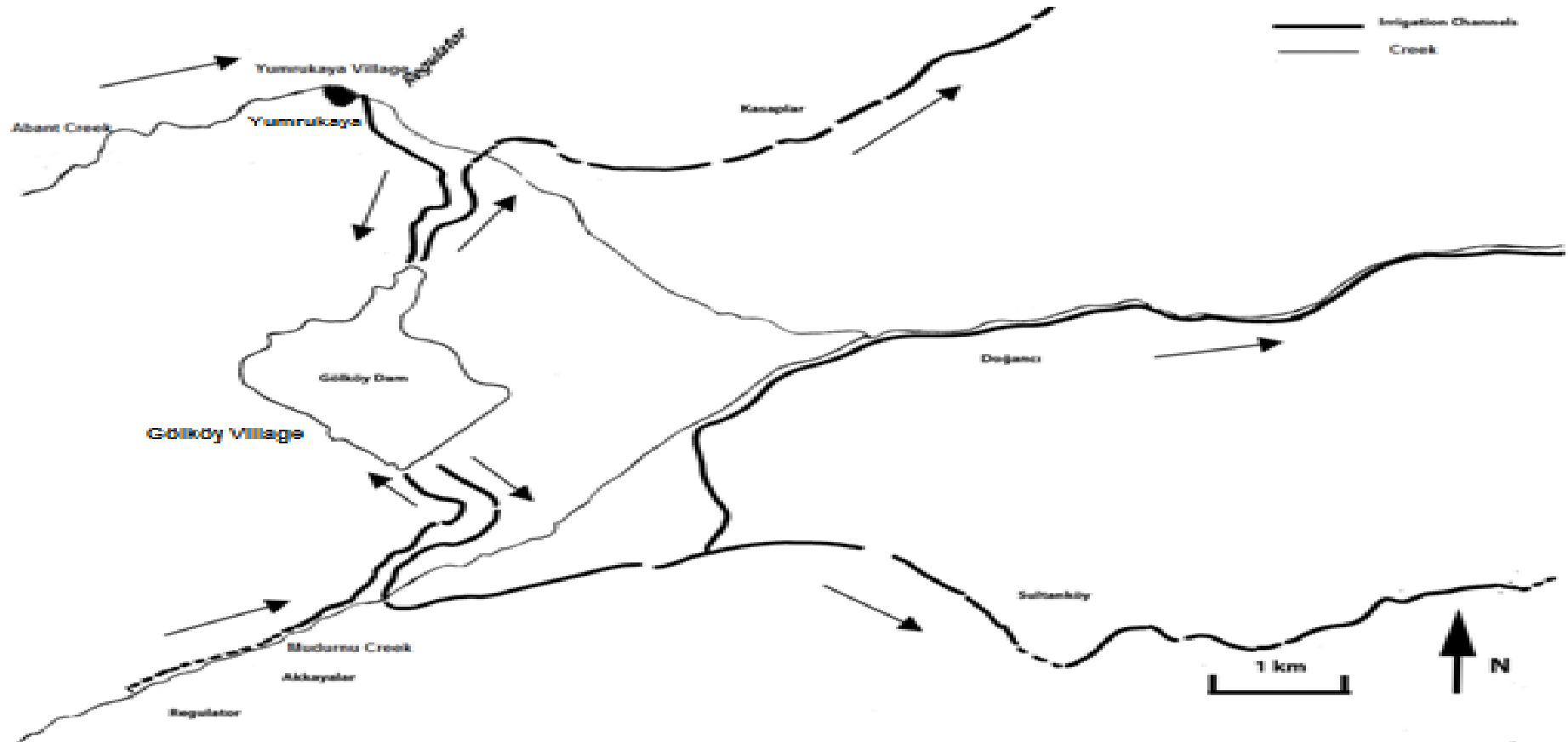


Figure 5: Map shows the two study areas (Lake Gököy and Yumrukaya).

2.3. Soil Type of the Study areas

Lake Gök  y and Yumrukaya wetland areas are formed by calcareous rocks [24].

Structure of soil gives whitish color to lake ground.



Figure 6: Calcareous soils in the Lake area

2.3. Climate

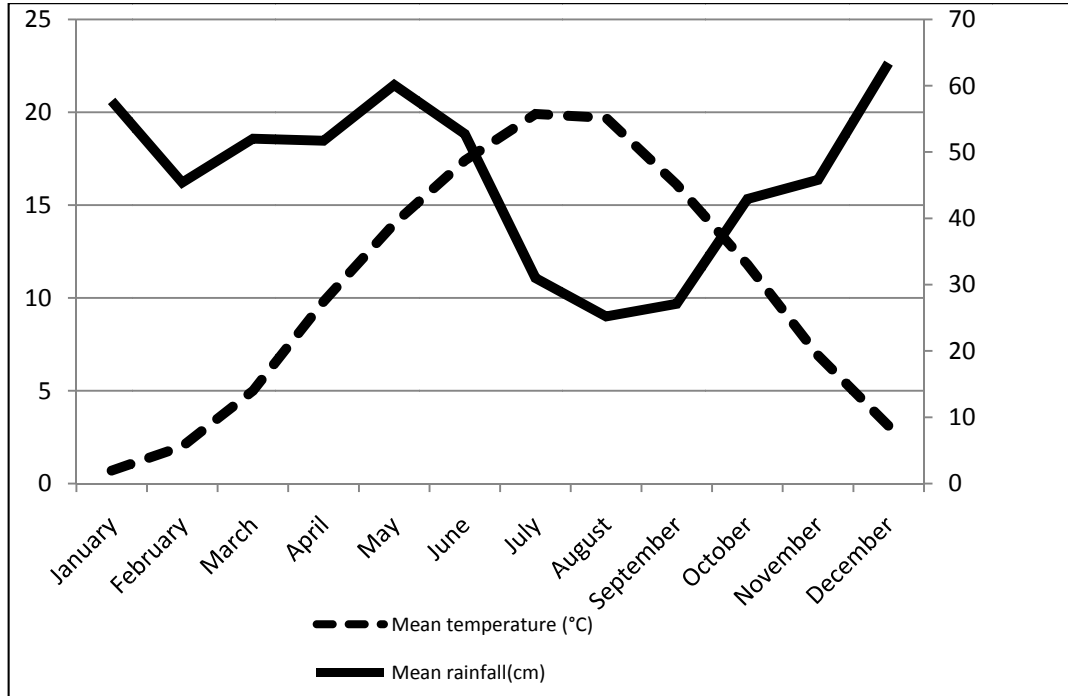


Figure 7: Climatic Diagram of Bolu, (Turkey) data obtained between 1970 and 2012.

Meteorological data obtained from General Directorate of Meteorology website. According to meteorological data, between 1970 and 2012 (42 years) mean annual precipitation for Bolu is 558 mm and annual temperature is 9,8 °C. Highest rainfall is received in December and the lowest rainfall is in August. (Figure 7) In 2011, annual rainfall was above the mean level. On the contrary, annual precipitation was over in 2012. The surface of the lake freezes during January and February.

3. MATERIALS AND METHODS

3.1. Sample Collection and Identification

In order to collect aquatic macrophytes field studies were carried out between July and November for 2011, between April and October for 2012 in Gök  y and Yumrukaya wetlands. In these dates, 25 field works were done in each area and 238 herbarium specimens were collected. Photographs of plants and habitats were taken in each visit. Dried and sterilized herbarium specimens are stored in the herbarium of Abant İzzet Baysal University (AIBU).

In plant identification, Flora of Turkey and the East Aegean Islands [26, 28], Flora of Turkey and East Aegean Islands volume 10 (Supplement I) [27] and Plants and Vegetation of Wetlands of Turkey [1] were used.

3.2. Data analysis

The floristic compositions of the two regions (G  lk  y and Yumrukaya) were compared with that of five other regions from Bolu (Table 1). Absence (0) / presence (1) matrix was prepared for the seven regions according to presence/absence of species in each region.

Species found in all areas and species found only in one area were excluded from the analysis. After excluding these taxa, the number of species decreased from 171 to 99. Two-way indicator species analysis (TWINSpan, Hill, 1979) [29] and non-metric multidimensional scaling (NMDS) is applied by using Community Analysis Package Version 4.0 (Henderson, 2007) program. [30] These analysis methods help us to understand the similarities or dissimilarities between the wetlands according to species compositions.

4. RESULTS

4.1. List of Species Found in Yumrukaya and Lake Gölköy

PTERIDOPHYTA

EQUISETACEAE

Equisetum L.

1- Stem with 20-40 grooves, cone 4-8 cm

E. telmateia

1- Stem at most 19 grooves, cone 2-4 cm

2- The first internode of the lower branches clearly longer than the adjacent sheath of the stem

E. arvense

2- The first internode of the lower branches shorter than the adjacent sheath of the stem

E. palustre

1) *E. arvense* L.

A3 Bolu; Yumrukaya , east of reservoir, N. BAYINDIR 265, 27/07/2011

40°42'946'' N - 031° 29'946'' E, 756 m.

Open marshy places.

Helophyte.

2) *E. palustre* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 318, 08/09.2011.

40°42'946'' N - 031° 29'946'' E 756, m.

A3 Bolu; Yumrukaya, east of reservoir, N. BAYINDIR 227, 05/07/2011. Hamidiye

District side of the reservoir, N. BAYINDIR 390, 17/05/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Open marshy places.

Helophyte.

3) *E. telmateia* Ehrh.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 405, 29/06/2012.

40°42'134'' N - 031° 30'948'' E, 781 m.

A3 Bolu; Yumrukaya, east of reservoir, N. BAYINDIR 46, 29/06/2012, H.

Hekimoğlu.

40°42'946'' N - 031° 29'946'' E, 756 m.

Open marshy places.

Helophyte.



Figure 8: *Equisetum telmateia* Ehrh.

SPERMATOPHYTA

ALISMATACEAE

Alisma L.

1- Leaves lanceolate to elliptic

A. lanceolatum

1- Leaves ovate to elliptic

A. plantago-aquatica

4) *A. lanceolatum* With.

A3 Bolu; Lake Gölköy, north of the lake, N. BAYINDIR 235, 07/07/2011. West of the lake, N. BAYINDIR 250, 14/07/2011.

40°42'137'' N - 031° 30'982'' E, 783 m.

A3 Bolu; Yumrukaya, east of reservoir, N. BAYINDIR 290, 02/08/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Water margins, marshy places.

Helophyte.

5) *A. plantago-aquatica* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 339, 20/09/2011.

40°41'714'' N - 031° 31'351'' E, 778 m.

A3 Bolu; Yumrukaya, east of reservoir, N. BAYINDIR 220, 05/07/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Water margins, marshy places.

Helophyte.



Figure 9: *Alisma plantago-aquatica* L.



Figure 10: *Alisma lanceolatum* With.

APIACEAE

1- Plant didymous

Berula

1- Plant not didymous

Oenanthe

***Berula* W.D.J.Koch**

6) *B. erecta* (Huds.) Coville

A3 Bolu; Yumrukaya, Hamidiye District side of reservoir, N. BAYINDIR 350, 25/10/2011. Same places, N. BAYINDIR 389, 17/05/2012, N. BAYINDIR 449, 10/08/2012.

40°42'835'' N - 031° 29'537'' E, 756 m.

In the slow flowing water.

Helophyte.

***Oenanthe* L.**

1- Fruiting umbellules globose, stem fistulosa

O. fistulosa

1- Fruiting umbellules not globose, stem not fistulosa, basal leaves lanceolate or linear lanceolate

O. silaifolia

7) *O. fistulosa* L.

A3 Bolu; Lake Gölköy, northwest of lake, N. BAYINDIR 210b, 05/07/2011. Same places N. BAYINDIR 257, 21/07/2011.

40°42'258'' N - 031° 31'088'' E, 780 m.

A3 Bolu; Yumrukaya, of the reservoir, N. BAYINDIR 293, 02/08/2011, N. BAYINDIR 307, 16/08/2011.

In the lake water and marshy places.

40°42'946'' N - 031° 29'946'' E, 756 m.

Helophyte.

8) *O. silaifolia* Bieb.

A3 Bolu; Yumrukaya, back side of the transformer, N. BAYINDIR 395, 18/06/2012.

40°42'828'' N - 031° 29'509'' E, 758 m.

Marshy places.

Helophyte.



Figure 11: *Oenanthe fistulosa* L.

ASTERACEAE

- 1- Leaves or phyllaries spiny, flowers pink ***Cirsium***
- 1- Leaves or phyllaries not spiny, flowers yellow or cream
 - 2- Leaves tripartite ***Bidens***
 - 2- Leaves not tripartite
 - 3- Leaves radical, orbicular, cordate, usually developed after flowering. ***Petasites***
 - 3- Leaves developed before flowering
 - 4- Pappus with an outer series of minute scales at base of hairs ***Pulicaria***
 - 4- Pappus consisting entirely of hairs ***Inula***

***Bidens* L.**

9) *B. tripartita* L.

A3 Bolu; Lake Gölköy, west of the lake, around underground water N. BAYINDIR 314, 08/09/2011, same places N. BAYINDIR 345, 25/10/2011.

40°41'847'' N - 031° 31'159'' E, 787 m.

A3 Bolu; Yumrukaya, near of the dam, N. BAYINDIR 451, 10/08/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy places.

Helophyte.



Figure 12: *Bidens tripartita* L.

***Cirsium* Mill.**

10) *C. canum* (L.) All.

A3 Bolu; Lake Gölköy, northwest of the lake, N. BAYINDIR 232, 07/07/2011.

40°42'258'' N - 031° 31'088'' E, 780 m.

A3 Bolu; Yumrukaya, Hamidiye District side of reservoir, N. BAYINDIR 260, 27/07/2011.

40°42'835'' N - 031° 29'537'' E, 756 m.

Marshy places.

Helophyte.

***Inula* L.**

11) *I. britannica* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 305, 09/08/2011, near the dam, N. BAYINDIR 471, 24/08/2012.

40°42'020'' N - 031° 30'962'' E, 778 m.

A3 Bolu; Yumrukaya, Hamidiye District side of reservoir, N. BAYINDIR 273, 27/07/2011.

40°42'852'' N - 031° 29'755'' E, 755 m.

Marshy places, shade of *Salix* sp.

Helophyte.

***Petasites* Mill.**

12) *P. hybridus* (L.) Gaertner, Mey. & Scherb.

A3 Bolu; Yumrukaya, *Salix* area, N. BAYINDIR 51, 04/05/2009.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy places, water shores.

Helophyte.

***Pulicaria* Gaertn.**

13) *P. dysenterica* (L.) Bernh.

A3 Bolu; Yumrukaya, campus sides, N. BAYINDIR 264, 27/07/2011.

40°42'852'' N - 031° 29'755'' E, 755 m.

Marshy places.

Helophyte.

BORAGINACEAE

***Myosotis* L.**

14) *Myosotis laxa* subsp. *caespitosa* (C.F.Schultz) Hyl. ex Nordh.

A3 Bolu; Lake Gököy, west of the lake, near of cistern, N. BAYINDIR 421,
20/07/2012.

40°42'020'' N - 031° 30'962'' E, 778 m.

A3 Bolu; Yumrukaya, Hamidiye District side of reservoir, N. BAYINDIR 415,
13/07/2012.

40°42'852'' N - 031° 29'755'' E, 755 m.

In the slow flowing water, shade of *Typha latifolia* L.

Helophyte.

BETULACEAE

***Alnus* Mill.**

15) *A. glutinosa* (L.) Gaertner subsp. *glutinosa*

A3 Bolu; Yumrukaya, N. BAYINDIR 428, 10/08/2012.

40°42'852'' N - 031° 29'755'' E, 755 m.

Water shores.

Helophyte.

BRASSICACEAE

1- Flowers yellow

Rorippa

1- Flowers white

Nasturtium

***Nasturtium* Mill.**

16) *N. officinale* R.BR.

A3 Bolu; Lake Gölköy, northwest of the lake, N. BAYINDIR 404, 29/06/2012.

40°42'134'' N - 031° 30'948'' E, 781 m.

In the slow flowing fountain water.

Helophyte.



Figure 13: *Nasturtium officinale* R.BR.

***Rorippa* Scop.**

17) *R. sylvestris* (L.) Besser

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 313, 08/09/2011.

40°41'847'' N - 031° 31'159'' E, 787 m.

A3 Bolu; Yumrukaya, east and south of reservoir, N. BAYINDIR 219, 07/07/2011.

40°42'946'' N - 031° 29'946'' E 756 m.

In the lake water and marshy places.

Helophyte.

CALLITRICHACEAE

Callitriche L.

18) *C. intermedia* subsp. *pedunculata* (DC.) Clapham

A3 Bolu; Yumrukaya, east and south of reservoir, N. BAYINDIR 253, 19/07/2011.

Same places, N. BAYINDIR 512, 24/08/2012.

40°42'946'' N - 031° 29'946'' E 756, m.

In standing water, shade of *Typha latifolia* L.



Figure 14: *Callitriche intermedia* Hoffm. subsp. *pedunculata* (DC.) Clapham

CARYOPHYLLACEAE

Myosoton Moench

19) *M. aquaticum* (L.) Moench

A3 Bolu; Yumrukaya, campus side of the reservoir, on the isle, N. BAYINDIR 269, 27/07/2011. Same places, N. BAYINDIR 292, 02/08/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Moist soils, in the middle of marshy area.

CONVOLVULACEAE

Calystegia R.BR.

20) *C. sepium* subsp. *sepium* R.BR.

A3 Bolu; Yumrukaya, in the whole area, N. BAYINDIR 459, 10/08/2012.

40°42'835'' N - 031° 29'537'' E, 756 m.

Marshy places, as climber on *Typha latifolia*.

Helophyte.

CYPERACEAE

1- Leaves reduced

2- Spikelet clearly terminal

Eleocharis

2- Inflorescence 2 or more spikelets

Schoenoplectus

1- Leaves with well developed lamina

3- Perianth present

4- Leaves ligulate

Scirpus

4- Leaves aligulate

Bolboschoenus

3- Perianth absent

5- Flowers unisexual

Carex

5- Flowers hermaphrodite

Cyperus

***Bolboschoenus* Palla**

***Bolboschoenus maritimus* (L.) Palla**

1- Nuts more than 4 cm

var. *maritimus*

1- Nuts less than 2 cm

var. *cymosus*

21) *B. maritimus* (L.) Palla var. *cymosus* (Reich.) Kit Tan & Oteng-Yeb.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 284, 27/07/2011.

40°41'714'' N - 031° 31'351'' E, 778 m.

Marshy place, shade of *Salix* sp.

Helophyte.

22) *B. maritimus* (L.) Palla var. *maritimus*

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 277, 27/07/2011.

40°41'714'' N - 031° 31'351'' E 778 m.

Marshy place, shade of *Salix* sp.

Helophyte.

Carex L.

1- Spikes sessile

2- Inflorescence brown

C. diandra

2- Inflorescence pale yellow

C. otrubae

1- Spikes pedunculate

3- Stigma 2

C. acuta

3- Stigma 3

4- Utricles densely hairy

C. hirta

4- Utricles glabrous

C. pseudocyperus

23) *C. acuta* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 422, 20/07/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

A3 Bolu; Yumrukaya, near of the dam, N. BAYINDIR 399, 18/06/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Water shores, marshy soil.

Helophyte.

24) *C. diandra* Schrank

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 327, 20/09/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy places.

Helophyte.

25) *C. hirta* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 407, 04/07/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy place.

Helophyte.



Figure 15: *Carex hirta* L.

26) *C. otrubae* Podp.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 251, 19/07/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy place.

Helophyte.

27) *C. pseudocyperus* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 242, 14/07/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy place.

Helophyte.

***Cyperus* L.**

28) *C. longus* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 401, 29/06/2012.

40°42'020'' N - 031° 30'962'' E, 778 m.

A3 Bolu; Yumrukaya, Hamidiye District side of reservoir, near of substation N.

BAYINDIR 328, 20/09/2011.

40°42'835'' N - 031° 29'537'' E, 756 m.

Slow flowing water, marshy place.

Helophyte.

***Eleocharis* R.BR.**

29) *E. palustris* (L.) Roem. & Schult.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 249, 14/07/2011. Same places, N. BAYINDIR 296, 02/08/2011

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 222, 05/07/2011. Same place, N. BAYINDIR 276, 27/07/2011.

40°42'270'' N - 031° 31'152'' E, 780 m. - 40°42'134'' N - 031° 30'948'' E, 780 m.

Partially in the water, marshy places.



Figure 16: *Eleocharis palustris* (L.) Roem. & Schult.

***Scirpus* L.**

30) *Scirpus sylvaticus* L.

A3 Bolu; Yumrukaya, N. BAYINDIR 546, 17/05/2013

40°42'946'' N - 031° 29'946'' E 756 m.

Marshy places.

Helophyte.

***Schoenoplectus* (Rchb.) Palla**

31) *S. lacustris* (L.) Palla subsp. *lacustris*

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 239, 14/07/2011.

Same places, N. BAYINDIR 326, 14/09/2011.

40°42'852'' N - 031° 29'755'' E, 755 m.

Partially in the water, marshy places.

Helophyte.

HALORAGACEAE

***Myriophyllum* L.**

1- Bracts exceeding flowers

M. verticillatum

1- Bracts as long as flowers

M. spicatum

32) *M. spicatum* L.

A3 Bolu; Lake Gök  , west of the lake, N. BAYINDIR 304, 08/09/2011.

40  42'137'' N - 031   30'982'' E, 783 m.

A3 Bolu; Yumrukaya, campus side of the reservoir and near of the dam, N.

BAYINDIR 252, 19/07/2011. Same places, N. BAYINDIR 532, 23/09/2012.

40  42'946'' N - 031   29'946'' E, 756 m.

In the water.

Submerged.



Figure 17: *Myriophyllum spicatum* L.

33) *M. verticillatum* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 453, 10/08/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

In the water.

Submerged.



Figure 18: *Myriophyllum verticillatum* L.

HIPPURIDACEAE

Hippuris L.

34) *H. vulgaris* L.

A3 Bolu; Lake Gölköy, west of the lake, around underground water, N. BAYINDIR 523, 01/10/2012.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 217, 05/07/2011.
40°42'946'' N - 031° 29'946'' E, 756 m.

In the water, marshy places.

Helophyte.



Figure 19: *Hippuris vulgaris* L.

IRIDACEAE

Iris L.

35) *I. pseudacorus* L.

A3 Bolu; Yumrukaya, between *Typha* sp. N. BAYINDIR 394, 18/06/2012. Same places, N. BAYINDIR 408, 04/07/2012.

40°42'852'' N - 031° 29'755'' E, 755 m. - 40°42'828'' N - 031° 29'509'' E 758 m.

Marshy places.

Helophyte.



Figure 20: *Iris pseudacorus* L.

JUNCACEAE

Juncus L.

- | | |
|--|-------------------------|
| 1- Flower lacking bracteoles | <i>J. articulatus</i> |
| 1- Flowers with two involucre bracteoles | |
| 2- Leaves flat | <i>J. compressus</i> |
| 2- Leaves terete | |
| 3- Pith interrupt | <i>J. inflexus</i> |
| 3- Pith continuous | <i>J. conglomeratus</i> |

36) *J. articulatus* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 211, 05/07/2011.

40°42'134'' N - 031° 30'948'' E, 781 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 223, 05/07/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Water shores, marshy places.

Helophyte.

37) *J. compressus* Jacq.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 285, 27/07/2011. Same places, N. BAYINDIR 343, 20/09/2011.

40°42'258'' N - 031° 31'088'' E, 780 m.

Drawn lake areas, marshy places.

Helophyte.

38) *J. conglomeratus* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 324, 14/09/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Water shores.

Helophyte.



Figure 21: *Juncus conglomeratus* L.

39) *J. inflexus* L.

A3 Bolu; Lake Gölköy, west of the lake, around the fountain water, N. BAYINDIR
323, 13/09/2011.

40°42'258'' N - 031° 31'088'' E, 780 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 287, 02/08/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Slow flowing water, marshy places.

Helophyte.

LAMIACEAE

1- Fertile stamen 2 or 3

Lycopus

1- Fertile stamen 4

2-Upper lip of corolla reduced

3- Lower lip 5 lobed

Teucrium

3- Lower lip 3 lobed

Ajuga

2- Upper lip of corolla well-developed

4- Corolla tube long and slender

Scutellaria

4- Corolla not as above

5- Calyx clearly bilabiate

Prunella

5- Calyx lobes similar

Mentha

***Ajuga* L.**

40) *A. reptans* L.

A3 Bolu; Lake Gölköy, west of the lake, near of cistern, N. BAYINDIR 387,

07/05/2012.

40°42'020'' N - 031° 30'962'' E, 778 m.

Marshy places.

Helophyte.



Figure 22: *Ajuga reptans* L.

***Lycopus* L.**

41) *L. europaeus* L.

A3 Bolu; Yumrukaya, south of reservoir, N. BAYINDIR 452, 10/08/2012.

40°42'852'' N - 031° 29'755'' E, 755 m.

Moist soil.

Helophyte.

***Mentha* L.**

1- Calyx throat hairy

M. pulegium

1- Calyx throat glabrous

2- Stem leaves petiolate

M. aquatica

2- Stem leaves sessile

M. longifolia

42) *M. aquatica* L.

A3 Bolu; Lake Gököy, west of the lake, around the cistern, N. BAYINDIR 321,

13/09/2011.

40°41'847'' N - 031° 31'159'' E, 787 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 288, 02/08/2011.

Same place, N. BAYINDIR 319, 09/09/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy place.

Helophyte.

43) *M. longifolia* (L.) Hudson subsp. *typhoides* (Briq.) Harley var. *typhoides*

A3 Bolu; Lake Gököy, west of the lake, around the fountain, N. BAYINDIR 258,

21/07/2011. Same place, N. BAYINDIR 521, 01/10/2011.

40°41'847'' N - 031° 31'159'' E, 787 m.

Slow flowing water shores, marshy place.

Helophyte.

44) *M. pulegium* L.

A3 Bolu; Lake Gököy, west of the lake, N. BAYINDIR 317, 08/09/2011.

40°42'258'' N - 031° 31'088'' E, 780 m. 40°41'714'' N - 031° 31'351'' E, 778 m.

Dried lake shores, swampy soil.

Helophyte.

***Prunella* L.**

45) *P. vulgaris* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 261, 21/07/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Water shores, moist soil.

Helophyte.

***Scutellaria* L.**

46) *S. galericulata* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, on the isles, N. BAYINDIR 244,

14/07/2011. Same places, N. BAYINDIR 414, 13/07/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Moist soil.

Helophyte.

***Teucrium* L.**

47) *T. scordium* L. subsp. *scordium*

A3 Bolu; Lake Gököy, west of the lake, N. BAYINDIR 315, 08/09/2011.

40°42'258'' N - 031° 31'088'' E, 780 m. - 40°41'714'' N - 031° 31'351'' E, 778 m.

Drying lake shores, moist soil.

Helophyte.

LEMNACEAE

***Lemna* L.**

48) *L. gibba* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, in the small pond, N.

BAYINDIR 246, 14/07/2011.

40°42'852'' N - 031°29'755'' E, 755 m.

In the standing water.

Free-floating.



Figure 23: *Lemna gibba* L.

LYTHRACEAE

Lythrum L.

49) *L. salicaria* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 283, 27/07/2011.

40°42'255'' N - 031° 31'080'' E, 783 m.

A3 Bolu; Yumrukaya, Yumrukaya Village side, N. BAYINDIR 238, 14/07/2011

40°42'946'' N - 031°29'946'' E, 756, m.

Marshy places, partially under water.

Helophyte.

ONAGRACEAE

Epilobium L.

1- Stem covered with long spreading hairs

E. hirsutum

1- Stem crisped-hairy or glabrous

E. montanum

50) *E. hirsutum* L.

A3 Bolu; Yumrukaya, between the *Salix* sp., N. BAYINDIR 407, 04/07/2012.

40°42'828'' N - 031°29'509'' E, 758 m.

Shade of *Salix* sp., marshy place.

Helophyte.

51) *E. montanum* L.

A3 Bolu; Lake Gököy, west of the lake, near of cistern, N. BAYINDIR 472,

24/08/2012.

Water shores.

40°42'020'' N - 031° 30'962'' E, 778 m.

Helophyte.

POACEAE

1- Inflorescence a plumose panicle

Phragmites

1- Inflorescence a non-plumose panicle

Echinochloa

***Echinochloa* P.Beauv.**

52) *E. crus-galli* (L.) P.Beauv.

A3 Bolu; Lake Gölköy, shore of water that is coming from Mudurnu Creek, N.

BAYINDIR 470, 24/08/2012.

40°42'561'' N - 031° 31'700'' E, 776 m.

A3 Bolu; Yumrukaya, Yumrukaya Village side of reservoir, N. BAYINDIR 457,

10/08/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Moist lake area.

Helophyte.

***Phragmites* Adans.**

53) *P. australis* (Cav.) Steud.

A3 Bolu; Lake Gölköy, west of the lake, under *Salix* sp., N. BAYINDIR 360,

01/11/2011.

40°41'714'' N - 031° 31'351'' E, 778 m.

A3 Bolu; Yumrukaya, N. BAYINDIR 339, 20/09/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy places, partially in the lake water.

Helophyte.



Figure 24: *Phragmites australis* (Cav.) Steud.

POLYGONACEAE

Polygonum L.

1- Plant perennial

P. amphibium

1- Plant annual

2- Inflorescence lax

P. hydropiper

2- Inflorescence dense

3- Peduncle with yellow glands

P. lapathifolium

3- Peduncle eglandular

P. persicaria

54) *P. amphibium* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 281, 27/07/2011. Same places, N. BAYINDIR 299, 02/08/2011.

40°42'137'' N - 031° 30'982'' E, 783 m.

A3 Bolu; Yumrukaya, N. BAYINDIR 340, 02/08/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

In the lake water.

Attached-floating.



Figure 25: *Polygonum amphibium* L.

55) *P. lapathifolium* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 530, 03/09/2012.

40°41'507'' N - 031° 31'700'' E, 776 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 527, 05/10/2012.

40°42'852'' N - 031° 29'755'' E, 755 m.

Marshy places, dried lake shores.

Helophyte.

56) *P. persicaria* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 456, 10/08/2012.

40°42'134'' N - 031° 30'948'' E, 781 m.

A3 Bolu; Yumrukaya, around the dam, N. BAYINDIR 291, 02/08/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Partially in the lake water, marshy place.

Helophyte.



Figure 26: *Polygonum persicaria* L. with flower and submerged leaves.

57) *P. hydropiper* L.

A3 Bolu; Yumrukaya, campus side of the reservoir, on the isle, N. BAYINDIR 466,
03/09/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Marshy place.

Helophyte.

POTAMOGETONACEAE

1- Leaves opposite

Groenlandia

1- Leaves alternate

Potamogeton

***Groenlandia* J.Gay**

58) *G. densa* Fourr.

A3 Bolu; Gölköy, canal that is coming from Mudurnu Creek, N. BAYINDIR 519,
01/10/2011.

40°41'507'' N - 031° 31'700'' E, 776 m.

In the slow flowing water.

Submerged.



Figure 27: *Groenlandia densa* (L.) Fourr.

***Potamogeton* L.**

- | | |
|--|------------------------------|
| 1- Floating leaves present | <i>P. natans</i> |
| 1- All leaves submerged | |
| 2- Leaves serrate, undulate | <i>P. crispus</i> |
| 2- Leaves entire or weakly serrate | |
| 3- Leaves linear and less than 3 mm broad | <i>P. berchtoldii</i> |
| 3- Leaves convex sided and more than 20 mm | |
| 4- Leaves sessile | <i>P. perfoliatus</i> |
| 4- Leaves petiolate | <i>P. gramineus</i> |

59) *P. berchtoldii* Fieber

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 297, 02/08/2011.

40°41'847'' N - 031° 31'159'' E, 787 m.

In the lake water with other *Potamogeton* sp. and *Chara* sp.

Submerged.

60) *P. crispus* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 344, 25/10/2011.

40°41'714'' N - 031° 31'351'' E, 778 m.

A3 Bolu; Yumrukaya, east of the reservoir, N. BAYINDIR 254 19/07/2011. Same places N. BAYINDIR 275, 27/07/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

In the lake water.

Submerged.



Figure 28: *Potamogeton crispus* L.



Figure 29: *Potamogeton crispus* L.

61) *P. gramineus* L.

A3 Bolu; Lake Gölköy, west of the lake, in little pond, N. BAYINDIR 278, 27/07/2011.

40°41'714'' N - 031° 31'351'' E, 778 m.

In the lake water with other *Potamogeton* sp. and *Chara* sp.

Submerged.

62) *P. natans* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 279, 27/07/2011. Same places N. BAYINDIR 300, 02/08/2011.

40°42'137'' N - 031° 30'982'' E, 783 m.

In the lake water with other *Potamogeton* sp. and *Chara* sp.

Attached-floating.

63) *P. perfoliatus* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 298, 02/08/2011.

40°42'020'' N - 031° 30'962'' E, 778 m.

In the lake water with other *Potamogeton* sp. and *Chara* sp.

Submerged.



Figure 30: *Potamogeton natans* L. in the water.



Figure 31: *Potamogeton natans* L. in marshy condition.



Figure 32: *Potamogeton gramineus* L.



Figure 33: *Potamogeton perfoliatus* L.

PRIMULACEAE

Lysimachia L.

64) *L. vulgaris* L.

A3 Bolu; Lake Gölköy, canal that is coming from Mudurnu Creek, N. BAYINDIR
468, 24/08/2012.

40°41'507'' N - 031° 31'700'' E, 776 m.

A3 Bolu; Yumrukaya, between *Salix* sp., N. BAYINDIR 416, 13/07/2012.

40°42'828'' N - 031° 29'509'' E, 758 m.

Moist soil, stream shore.

Helophyte.

RANUNCULACEAE

1- Perianth uniseriate

Thalictrum

1- Perianth biseriate

Ranunculus

Ranunculus L.

1- Petals white with yellow base

R. trichophyllus

1- Petals yellow

2-Sepals 3, petals 9

R. ficaria

2-Sepals 5, petals 5

3- Plant perennial, petal longer than the torus

R. repens

3- Plant annual, petal shorter than the torus

R. sceleratus

RANUNCULACEAE

Ranunculus L.

65) *R. ficaria* subsp. *calthifolius* (L.)B.R.

A3 Bolu; Lake Gököy, west of lake, NB372, 05/04/2012.

40°42'137'' N - 031° 30'982'' E, 783 m.

Marshy places.

Helophyte.

66) *R. repens* L.

A3 Bolu; Yumrukaya, south and east shore of reservuar, NB388, 17/05/2012. Same places, NB396, 18/06/2012.

40°42'946'' N - 031° 29'946'' E 756, m.

Marshy places.

Helophyte.

67) *R. sceleratus* L.

A3 Bolu; Lake Gököy, in the creek that is coming from village, NB361, 01/11/2011.

Same place, NB393, 18/05/2012.

40°42'134'' N - 031° 30'948'' E, 781m.

In the slow flowing water.

Helophyte.

68) *R. trichophyllus* Chaix

A3 Bolu; Lake Gököy, west of the lake, NB386, 07/05/2012. Same places, NB476, 24/08/2012.

40°42'137'' N - 031° 30'982'' E, 783 m.

In the lake water.

Helophyte.



Figure 34: *Ranunculus sceleratus* L.



Figure 35: *Ranunculus trichophyllus* Chaix

***Thalictrum* L.**

69) *T. lucidum* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 248, 14/07/2011.

40°42'258'' N - 031° 31'088'' E, 780 m.

A3 Bolu; Yumrukaya, in the *Salix* area, N. BAYINDIR 224, 05/07/211.

40°42'828'' N - 031° 29'509'' E, 758 m.

Water shore, marshy places.

Helophyte.

ROSACEAE

***Potentilla* L.**

70) *P. reptans* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 306, 09/08/2011.

40°42'134'' N - 031° 30'948'' E, 781m. - 40°41'714'' N - 031° 31'351'' E, 778 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 268, 27/07/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Moist soil.

Helophyte.

RUBIACEAE

Galium L.

71) *G. palustre* L.

A3 Bolu; Yumrukaya, campus side of reservoir, with *Typha* sp., N. BAYINDIR 218, 05/07/2011. Same places, N. BAYINDIR 303, 02/08/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Partially in the water.

Helophyte.

SALICACEAE

Salix L.

1- Stamens 3

2- Catkins 4-8 cm, curved

S. triandra

2- Catkins 2-4 cm, straight

S. pentandroides

1- Stamens 2

3- Filaments united for whole their length,
leaves opposite or subopposite

S. amplexicaulis

3- Filaments free

4- Stipule cordate

S. fragilis

4- Stipule lanceolate

S. alba

72) *S. alba* L.

A3 Bolu; Lake Gölköy, north of the lake, near the dam, N. BAYINDIR 387, 27/04/2012.

40°42'561'' N - 031° 31'700'' E 776, m., 40°41'714'' N - 031° 31'351'' E 778, m.

A3 Bolu; Yumrukaya, N. BAYINDIR 352, 25/10/2011.

40°42'828'' N - 031° 29'509'' E, 758 m.

Water shore.

Helophyte.

73) *S. amplexicaulis* Bory et Chaub.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 375, 12/04/2012.

40°41'714'' N - 031° 31'351'' E, 778 m.

A3 Bolu; Yumrukaya, N. BAYINDIR 373, 03/04/2012.

40°42'828'' N - 031° 29'509'' E, 758 m.

In the lake water, water shore.

Helophyte.



Figure 36: *Salix amplexicaulis* Bory et Chaub.

74) *S. fragilis* L.

A3 Bolu; Yumrukaya, *Salix* dominated area, N. BAYINDIR 412, 04/07/2012.

40°42'828'' N - 031° 29'509'' E, 758 m.

Marshy area.

Helophyte.

75) *S. pentandroides* A. Skv.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 379, 26/04/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Seasonally in the water, marshy places.

Helophyte.

76) *S. triandra* L. subsp. *triandra*

A3 Bolu; Lake Gököy, west of the lake, N. BAYINDIR 383, 27/04/2012.

40°41'714'' N - 031° 31'351'' E, 778 m.

Partially in the lake water, marshy place.

Helophyte.



Figure 37: *Salix triandra* L. subsp. *triandra*

SCROPHULARIACEAE

Veronica L.

77) *V. anagallis-aquatica* L.

A3 Bolu; Lake Gölköy, west of the lake, N. BAYINDIR 230, 07/07/2011. Same place, N. BAYINDIR 359, 01/11/2011.

40°42'255'' N - 031° 31'080'' E, 783 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 216, 05/07/2011.

40°42'946'' N - 031° 29'946'' E, 756 m.

Partially in the water, marshy places.

Helophyte.

TYPHACEAE

1- Leaf triangular in transverse section

Sparganium

1- Leaves flat to little convex shape

Typha

Sparganium L.

78) *S. erectum* subsp. *microcarpum* (Neuman) Domin

A3 Bolu; Lake Gölköy, west of the lake, under *Salix* sp., N. BAYINDIR 351, 25/10/2011.

40°41'714'' N - 031° 31'351'' E, 778 m.

A3 Bolu; Yumrukaya, campus side of the reservoir, N. BAYINDIR 259, 27/07/2011.

40°42'852'' N - 031° 29'755'' E, 755 m.

Slow flowing water, marshy places.

Helophyte.



Figure 38 : *Sparganium erectum* L. subsp. *microcarpum* (Neuman) Domin

***Typha* L.**

1- Leaves more than 10 mm broad

T. latifolia

1- Leaves less than 8 mm broad

T. angustifolia

79) *T. angustifolia* L.

A3 Bolu; Yumrukaya, campus side of reservoir, N. BAYINDIR 337, 28/09/2011.

Near of the dam, N. BAYINDIR 462, 03/09/2012.

40°42'946'' N - 031° 29'946'' E, 756 m.

Partially in the water.

Helophyte.

80) *T. latifolia* L.

A3 Bolu; Lake Gölköy, canal that are coming from Mudurnu Water, N. BAYINDIR 531, 01/10/2012.

A3 Bolu; Yumrukaya, in all area, N. BAYINDIR 335, 20/09/2011.

Partially in the water.

Helophyte.



Figure 39: *Typha latifolia* L.

4.2. List of New Records for Bolu Province

ASTERACEAE

Bidens tripartita L.

CALLITRICHACEAE

Callitriche intermedia Hoffm. subsp. *pedunculata* (DC.) Clapham

CYPERACEAE

Bolboschoenus maritimus (L.) Palla var. *maritimus*

Bolboschoenus maritimus (L.) Palla var. *cymosus* (Reichb.) Kit Tan & Oteng-Yeb.

JUNCACEAE

Juncus conglomeratus L.

POLYGONACEAE

Polygonum hydropiper L.

SALICACEAE

Salix triandra L. subsp. *triandra*

Salix pentandroides A.Skv.

4.3. General Results and Observations

As a result of our studies, in Yumrukaya and Glky wetlands, 80 aquatic vascular taxa were found (Result 4.1). In Glky and Yumrukaya, largest families are Cyperaceae (11 sp.), Lamiaceae (8 sp.), Potamogetonaceae (6 sp.), and Ranunculaceae (5 sp.). The largest genera are *Carex* (5 sp.), *Potamogeton* (5 sp.), *Salix* (5 sp.), *Juncus* (4 sp.) and *Polygonum* (4 sp.). In Glky totally 51 species were found, of these 42 species are emergent, 7 species are submerged and 2 species have attached-floating life forms (Figure 44). In Yumrukaya totally 62 species were found, among these 56 species are emergent, 3 species are submerged, 2 species are attached-floating and one species have free-floating life form. (Figure 44)

In the field surveys, changes were observed in macrophyte sizes because of the frequent water level fluctuations. Typical examples are *Potamogeton natans* L. and *Ranunculus trichophyllus* Chaix (Figure 40,41) . Also, decrease in the vegetation of *Polygonum persicaria* L. was in substantial extent. In two areas, *Potamogeton crispus* L. that is an invasive species covers a large area of the water. Where this species is dominant it does not let other macrophyte species to grow.



Figure 40: *Ranunculus trichophyllus* Chaix in the water, in Lake Gölköy



Figure 41: *Ranunculus trichophyllus* Chaix in mud.



Figure 42: *Myriophyllum* sp. in muddy condition.



Figure 43: *Mentha pulegium* L. in wet (A) and in dry season (B)

Area	Source	Altitude (m)	Coordinates	Depth (max.)	Surface area (ha)
Yumrukaya	This study	756	40°42' N, 31° 29'E	1,6 m	2,5
Gölköy	This study	780	40°42' N, 31° 31'E	20 m	180
Sünnet	İkinci, 2011 [32]	1050	40°25' N, 30° 57'E	22 m	18
Abant	Türker & Güner, 2003 [33]	1345	40°37' -40°42'N 31°29' -31° 38'E	13 m	128
Gölcük	İkinci & Güner, 2007 [31]	1230	40°47' N-31° 37'E	18 m	20
Yeniçağa	Sümer, 2002 [35].	970	40°47' N-32° 20'E	5 m	500
Sülüklügöl	Kanoğlu. 2010 [34]	1050	40°31' 19.7"N 30°52' 37.0"E	0,5 m	100

Table 1: Details of compared areas.

We also analyzed aquatic plants of five other regions in Bolu (Table 1). When we add the species from these studies to our results, totally there are 171 macrophyte taxa, belonging to 44 families and 88 genera in Bolu. The largest families are Cyperaceae (23 sp.), Poaceae (15 sp.) Lamiaceae (12 sp.) and Potamogetonaceae (8 sp.). The largest genera are *Carex* (12 sp.) *Potamogeton* (7 sp.), *Juncus* (7 sp.), *Mentha* (6 sp.), *Equisetum* (5 sp.) and *Ranunculus* (5 sp.). *Lythrum salicaria* L. (Lythraceae) and *Lysimachia vulgaris* L. (Primulaceae) are found in all wetlands. In Bolu, 3 species are free-floating, 5 species are attached-floating, 12 species are submerged and 151 species have emergent life form (Figure 47).

Generally, in seven areas, Cyperaceae, Lamiaceae, Potamogetonaceae, Asteraceae, Juncaceae, Poaceae, Equisetaceae families take place in first 5 order according to species number (Table 2).

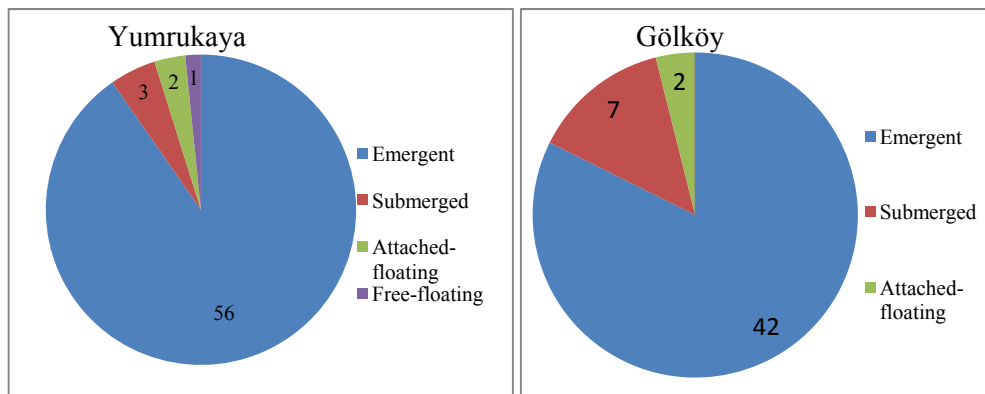


Figure 44 : Graph of species numbers in Yumrukaya and Gököy according to life forms

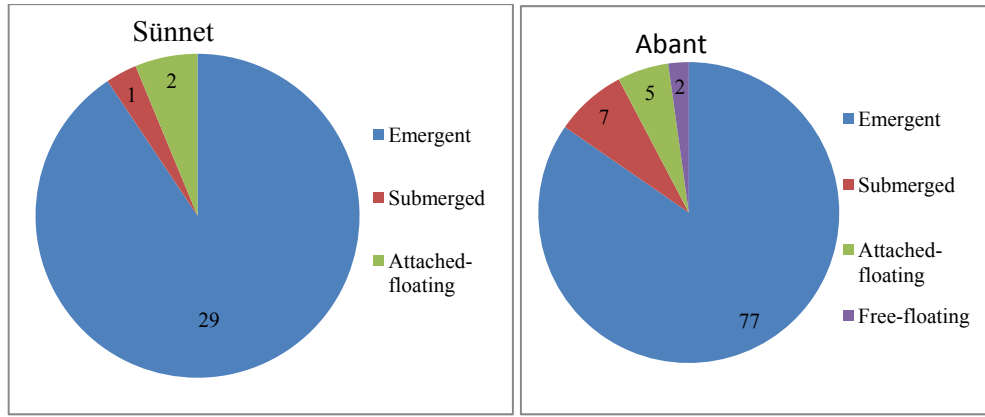


Figure 45: Graph of species numbers in Sünnet and Abant according to life forms

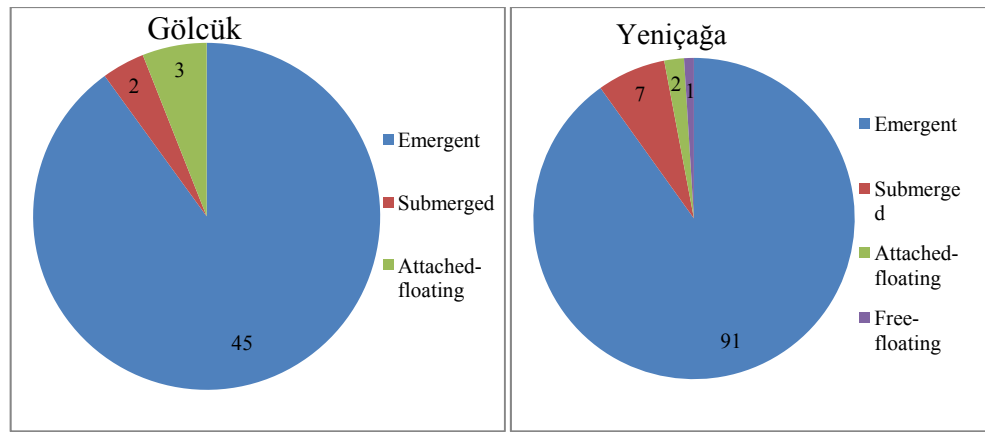


Figure 46: Graph of species number in Sünnet and Abant according to life forms

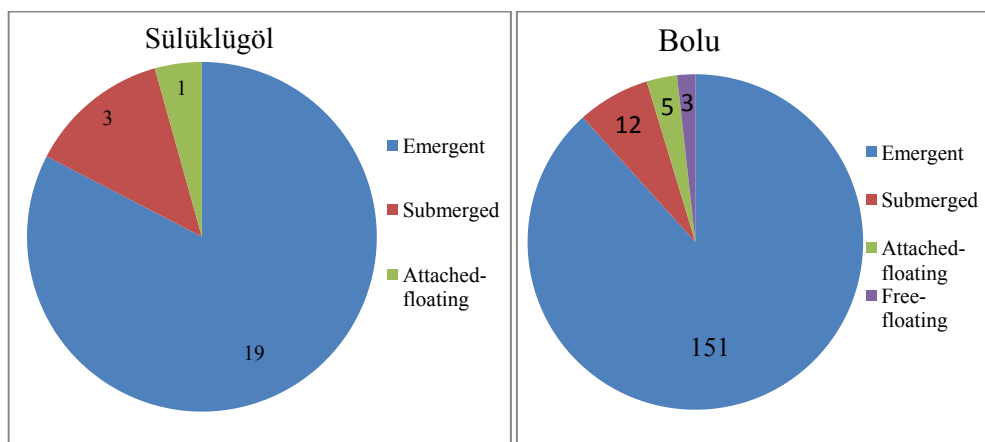


Figure 47: Graph of species number in Sülüklügöl and Bolu according to life forms

Yumrukaya	Gölköy	Sünnet	Abant	Gölcük	Yeniçağa	Sülüklügöl
Cyperaceae 9	Potamogetonaceae 6	Lamiaceae 5	Cyperaceae 12	Lamiaceae 8	Cyperaceae 10	Lamiaceae 4
Lamiaceae 5	Cyperaceae 5	Cyperaceae 4	Poaceae 7	Cyperaceae 8	Poaceae 8	Onagraceae 3
Asteraceae 5	Lamiaceae 5	Equisetaceae 3	Potamogetonaceae 7	Salicaceae 3	Lamiaceae 7	Potamogetonaceae 3
Polygonaceae 4	Asteraceae 3	Asteraceae 2	Juncaceae 6	Orchidaceae 2	Asteraceae 6	Brassicaceae 2
Equisetaceae 3	Juncaceae 3	Onagraceae 2	Ranunculaceae 6	Primulaceae 2	Juncaceae 6	Ranunculaceae 2

Table 2: Largest five families and their species numbers in 7 studied areas

4.4. Analysis Results

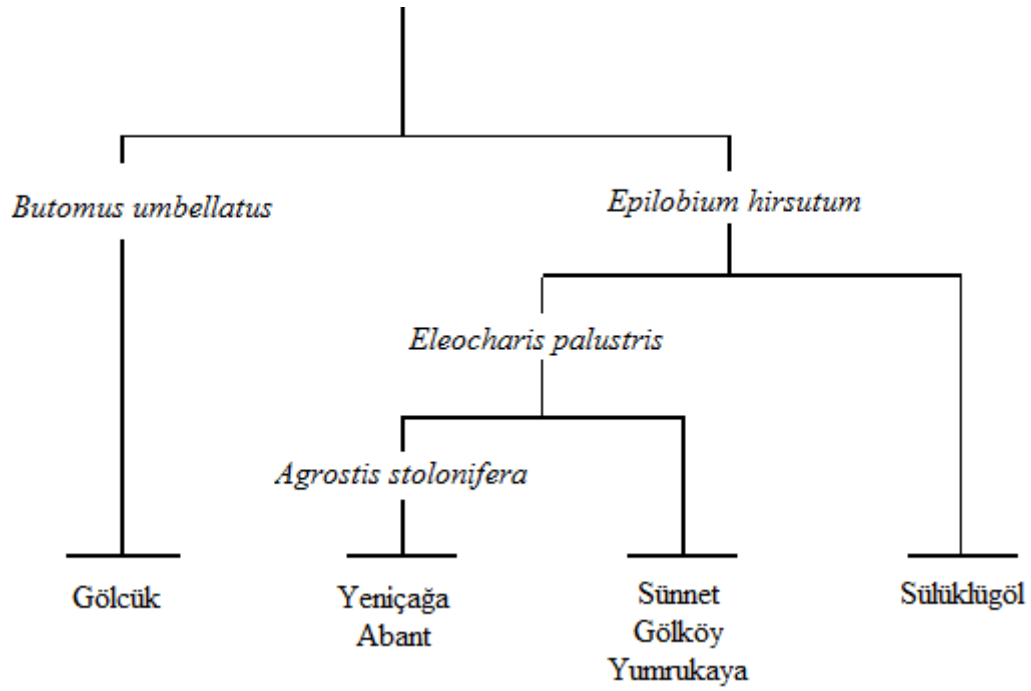


Figure 48: TWINSpan tree for seven sites and indicator species of each group

In the results of the TWINSpan analysis, 7 different areas were classified into 4 groups (Figure 48). First group comprises Gölçük. *Butomus umbellatus* L. is the indicator species for this group. Furthermore, *Epilobium hirsutum* L. was not found in Gölçük area. Second group encompasses Sülüklügöl. Third group contains Abant and Yeniçağa. The characteristic species is *Agrostis stolonifera* L. that was found in Abant and Yeniçağa. Also *Agrostis stolonifera* L separates another group that is consist of Sünnet, Gölköy and Yumrukaya.

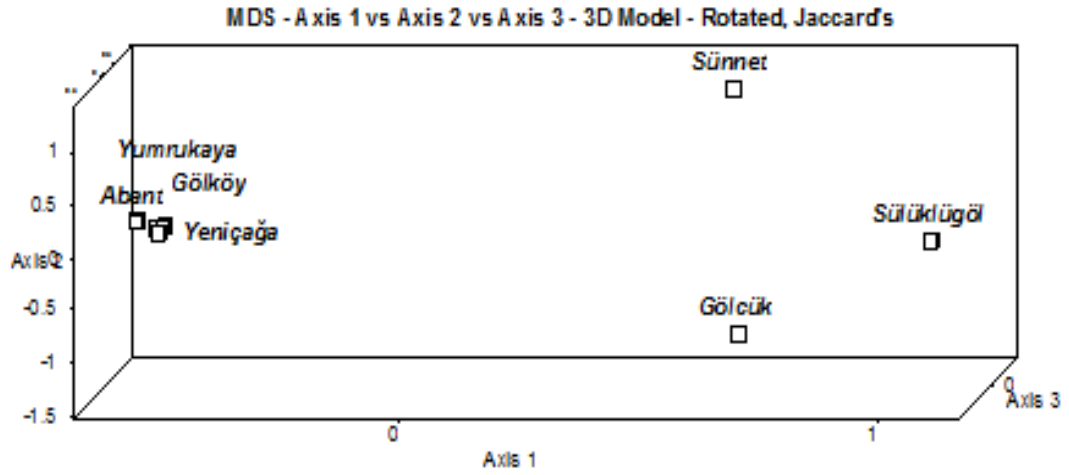


Figure 49: NMDS ordination plot (3D).

NMDS (Non-metric multidimensional scaling) ordination plot analysis for 7 sites resulted in four groups (Figure 49). First groups on the left sides of the figure consist of four sites. (Gölköy, Yumrukaya, Yeniçağa and Abant). These sites are geographically closer to each other except Yeniçağa. Also Gölköy, Yumrukaya and Abant wetlands were connected by waterways. The other three groups are on the right side of the figure those separated from the others. Lake Sünnet, Sülüklügöl and Gölçük areas were separated from each other according to species composition.

5. DISCUSSION AND CONCLUSIONS

TWINSPAN analysis separated Gölcük area from other regions by absence of *Epilobium hirsutum* L. and presence of *Butomus umbellatus* L. species respectively. *Eleocharis palustris* (L.) Roem. & Schult (common spikerush) is a critical species in the remaining areas. The absence of this species in the Sülüklügöl is an interesting result. Because *Eleocharis palustris* (L.) Roem. & Schult is a widespread species that can be found in most aquatic areas. *Agrostis stolonifera* L. was found in Yeniçağa and Abant and separate Sünnet, Gölköy and Yumrukaya. NMDS analysis shows similar results to TWINSPAN. In NMDS, Lake Sünnet separated from Yumrukaya and Gölköy clearly. Also Yumrukaya, Gölköy, Abant and Yeniçağa areas were clustered in the same group.

When we examine both TWINSPAN and NMDS analyses, the similarity of Abant, Yumrukaya and Gölköy is revealed. Direct water connections among these sites may be the main reason responsible for this result.

Except our study for Gölköy and Yumrukaya, the other studies included in analysis did not concentrate on aquatic plants. But they were general floristic studies. If these sites are to be analyzed especially for aquatic plants, it is possible that more species will be discovered. This fact should be kept in mind while interpreting the analysis results. Because of this reason, new and accurate surveys must be done on wetlands

In my study, Cyperaceae is the first largest family. But Poaceae does not take place among the largest five families. Possible reason is pressure of the highly adapted and invasive macrophytes. Best example is *Potamogeton crispus* which limits growth of other plants [36].

Gölcük, Sünnet and Sülüklügöl have the lowest number of macrophyte species (Figure 44, 45, 46). Although Yumrukaya have the smallest surface area, species number is in the third order. Vegetation type plays an important role on species number. At this point, *Typha latifolia* L. provide stable water conditions for indurable plants.

Water level fluctuations affect flowering time and vegetation of aquatic plants and also growth of insect or other organisms on their leaves. In 2012, the vegetation of *Polygonum persicaria* L. decreased. Also number of mosquitoes those are nesting on leaves decreased rapidly with water reflux.

Finally, when we examine the studies in Turkey on aquatic macrophyte distribution, it is clear that researches in this field are not sufficient. Because of this reason, long term studies must be done to understand the importance of macrophyte diversity and ecology.

REFERENCES

- [1]. SEÇMEN Ö. & LEBLEBİCİ E., Türkiye Sulak Alan Bitkileri ve Bitki Örtüsü. Ege Üniv. Fen Fak. Yay. No: 158 Bornova-İzmir (1997).
- [2]. The Convention on Wetlands. Ramsar (1971).
- [3]. KESİCİ E., ÖZVAROL A., İKİZ R., KESİCİ C., Doğal Göllerin Balıklandırılmasının Doğal Göllerdeki Su Bitkilerine Etkileri. I. Balıklandırma Ve Rezervuar Yönetimi Sempozyumu, Antalya. (2006).
- [4]. EU Water Framework Directive (2000).
- [5]. MELZER A., Aquatic Macrophytes as Tools for Lake Management. *Hydrobiologia* 395/396: 181–190, (1999).
- [6]. MAGGIONI L. A., FONTANETO D., BOCCHI S. and GOMARASCA S., Evaluation of Water Quality and Ecological System Conditions through Macrophytes. *Desalination* 247, 191–202, (2009).
- [7]. ÖZTÜRK M., SEÇMEN Ö. and LEBLEBİCİ E. Eber Gölü (AFYON) Bitki Örtüsü ve Kirlenme İlişkileri. *Ekoloji* Issue 20, 14-16, (1996).
- [8]. THIEBAUT G., Macrophyte as a Indicators of the Quality and Ecological Status of Waterbodies and for Use in Removing Nutrients and Metals. *Aquatic. Ecosystem Research Trends*, (2009).
- [9]. THOMAZ S.M., ESTEVES F.A., MURPHY K.J., et al., Aquatic Macrophytes in the Trophics: Ecology of Populations and Communities, Impacts of Invasions and Use by man. *Tropical Biology and Coservation Management - Vol. IV*, (2008).
- [10]. CURIEL D., FALACE A., BANDELJ V. and RISMONDO A., Applicability and Intercalibration of Macrophyte Quality Indices to Characterise the Ecological Status of Mediterranean Transitional Waters: the Case of the Venice Lagoon. *Marine Ecology Volume 33, Issue 4*, 437–459, (2012).
- [11]. MURPHY K. J., Plant Communities and Plant Diversity in Softwater Lakes of Northern Europe. *Aquatic Botany* 73, 287–324 (2002).

- [12]. PHILBRICK T. & LES D., Evolution of Aquatic Angiosperm Reproductive Systems. BioScience vol. 46, (1996).
- [13]. ACKERMANN J. D., Abiotic pollen and pollination: Ecological, functional, and evolutionary perspectives. Plant Systematics and Evolution. Volume 222, Issue 1-4, pp 167-185.
- [14]. TURGUT T., Flora of Abant İzzet Baysal University, Abant İzzet Baysal University, Graduate School of Natural Science, (MCs), (1996).
- [15]. SEÇMEN Ö. & LEBLEBİCİ, E. Aquatic flora of Western Anatolia. Willdenowia 14: 165-178, (1984).
- [16]. SEÇMEN Ö. & LEBLEBİCİ, E., Aquatic Flora of Thrace (Turkey). Willdenowia, Bd. 20, H. 1/2 pp. 53-66 (1991).
- [17]. SEÇMEN Ö. & LEBLEBİCİ, E., Aquatic flora of the Marmara region, NW Turkey. Willdenowia 25 (1996).
- [18]. KESİCİ E. & KESİCİ C., TitreyenGöl (Side- Antalya) Yüksek Su Bitkileri. Ulusal Su Günleri, Trabzon (2005).
- [19]. KARAÖMERLİOĞLU D., Göksu Deltasındaki (Silifke) Doğal Ekosistemlerin Bitki Ekoloji Yönünden Araştırılması. Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Biyoloji Anabilim Dalı, (Doktora tezi.) Adana (2007).
- [20]. KESİCİ E. & KESİCİ C., Yarıklı Gölü (Yeşilova-Burdur) Makrohidrofitleri. Ulusal Su Günleri, Antalya (2007).
- [21]. UĞRAN R., Çalı Gölü (Kars) Florası. Kafkas Üniversitesi Fen Bilimleri Enstitüsü Biyoloji AnaBilim Dalı.(Y. Lisans Tezi), (2008).
- [22]. KIRKAĞAÇ M., DEMİR N., TOPÇU A, FAKIOĞLU Ö., ZENCİR Ö., Porsuk Çayı'nda (Eskişehir) Sucul Makrofitler, Zooplankton ve Bentik Makroomurgasızların İncelenmesi. Ankara Üniversitesi ÇevreBilimleri Dergisi Cilt: 3, Sayı: 1, 65-72 (2011).
- [23]. KÜLKÖYLÜOĞLU O., Ecology and Phenology of Freshwater Ostracods in Lake Gököy (Bolu, Turkey). Aquatic Ecology, 39:295–304, (2005).
- [24]. KÜLKÖYLÜOĞLU O., Factors Affecting the Occurrence of Ostracoda (Crustacea) in the Yumrukaya Reedbeds (Bolu, Turkey). Wetlands Volume 25, Issue 1, pp 224-227 (2005). Volume 39, Issue 3, pp 295-304 (2005).

- [25]. DSİ Sakarya Planlama Amirliği, Bolu Büyüksu Projesi, Göl Rezervuarı Malzeme Sahaları Haritası ve Kuyu Profilleri Paftası (1965).
- [26]. P.H. DAVIS, Flora of Turkey and East Aegean Islands, Volume 1-9. (1965-1985).
- [27]. P.H.DAVIS et al., Flora of Turkey and East Aegean Islands, Volume 10 (Supplement I). (1988).
- [28]. GÜNER A., Flora of Turkey and East Aegean Islands, Volume 11 (Supplement II). (2000).
- [29]. HILL, M.O., TWINSpan - a Fortran program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell University, Ithaca, New York. (1979).
- [30]. HENDERSON, P.A. & SEABY, R. M. H., , Community Analysis Package 4.0 Pisces Conservation Ltd, Lymington, UK. (2007).
- [31]. İKİNCİ N. & GÜNER A., The Flora of Gölcük Area. Turkish Journal of Botany, 31, 87-107. (2007).
- [32]. İKİNCİ N., Gamma-diversity of vascular plant taxa of the surrounding of Lake Sünnet (Bolu, NW Turkey) compared with other regions in Bolu. Biological Diversity and Conservation, 4/1-107-121, (2011).
- [33]. TÜRKER A.U. & GÜNER A., Plant Diversity in Abant Nature Park (Bolu), Turkey. Turk. J. Bot., 27, 185-222. (2003).
- [34]. KANOĞLU S. S., The Flora of Sülüklügöl, Düzce University, Institute of Science and Technology, (MCs), (2011).
- [35]. SÜMER N., Flora of Lake Yeniçağa. Abant İzzet Baysal University, Graduate School of Natural Science, (MCs), (2002).
- [36]. BUGBEE G., J. Control of *Potamogeton crispus* and *Myriophyllum spicatum* in Crystal Lake. Connecticut Department of Environmental Protection, (2009).

APPENDIX 1.

1. List of macrophyte species occurring in 7 regions in Bolu and their presence (1), absence (0) matrix.

	Abant	Sünnet	Yeniçağa	Gölcük	Gölköy	Yumrukaya	Sülüklügöl
<i>Acorus calamus</i> L.	0	0	1	0	0	0	0
<i>Agrostis gigantea</i> Roth.	1	0	0	0	0	0	0
<i>Agrostis gigantea</i> Roth.	0	0	1	0	0	0	0
<i>Agrostis stolonifera</i> L.	1	0	1	0	0	0	0
<i>Ajuga reptans</i> L.	1	0	1	1	1	0	1
<i>Alisma lanceolatum</i> With.	0	1	1	0	1	1	0
<i>Alisma plantago-aquatica</i> L.	1	0	1	1	1	1	0
<i>Alopecurus aequalis</i> Sobol.	0	1	0	0	0	0	0
<i>Alopecurus arundinaceus</i> Poir.	1	0	1	0	0	0	0
<i>Angelica sylvestris</i> L. subsp. <i>sylvestris</i>	0	0	1	0	0	0	0
<i>Apium nodiflorum</i> (L.) Lag.	0	0	1	0	0	0	0
<i>Barbarea vulgaris</i> W.T.Aiton	1	0	1	0	0	0	0
<i>Berula erecta</i> (Huds.) Coville	0	0	1	0	0	1	0
<i>Bidens tripartita</i> L.	0	0	0	0	1	1	0
<i>Blysmus compressus</i> (L.) Panz. ex Link	1	0	0	0	0	0	0
<i>Bolboschoenus maritimus</i> (L.) Palla var. <i>cymosus</i> (Rchb.) Kit Tan & Oteng-Yeb.	0	0	0	0	1	0	0
<i>Bolboschoenus maritimus</i> (L.) Palla var. <i>maritimus</i>	0	0	0	0	1	0	0
<i>Butomus umbellatus</i> L.	0	0	1	1	0	0	0
<i>Calamagrostis epigejos</i> (L.) Roth	1	0	0	0	0	0	0
<i>Callitriche intermedia</i> Hoffm. subsp. <i>pedunculata</i> (DC.) Clapham	0	0	0	0	0	1	0
<i>Calystegia sepium</i> R.BR. subsp. <i>sepium</i>	0	0	0	0	0	1	0
<i>Carex acuta</i> L.	1	0	0	0	1	1	0
<i>Carex diandra</i> Roth	1	0	0	0	0	1	0
<i>Carex distans</i> L.	1	0	1	0	0	0	0
<i>Carex flacca</i> Schreb. subsp. <i>serrulata</i> (Biv.) Greuter	1	0	0	1	0	0	1
<i>Carex nigra</i> (L.) Reichard subsp. <i>nigra</i>	1	0	0	0	0	0	0
<i>Carex nigra</i> (L.) Reichard subsp. <i>dacica</i> (Heuff.) Soó	1	0	0	0	0	0	0
<i>Carex otrubae</i> Podp.	1	1	1	1	0	1	0
<i>Carex panicea</i> L.	1	1	0	0	0	0	0
<i>Carex paniculata</i> L. subsp. <i>paniculata</i>	0	0	1	0	0	0	0
<i>Carex pendula</i> Huds.	0	0	0	1	0	0	0
<i>Carex pseudocyperus</i> L.	0	0	1	1	0	1	0

	Abant	Sünnet	Yeniçağa	Gölcük	Gölköy	Yumrukaya	Sülüklügöl
<i>Carex riparia</i> Curtis	0	0	1	0	0	0	0
<i>Catabrosa aquatica</i> P.Beauv.	1	0	1	0	0	0	0
<i>Ceratophyllum demersum</i> L.	0	0	1	0	0	0	0
<i>Cirsium canum</i> (L.) All.	0	0	1	0	1	1	0
<i>Cirsium creticum</i> d'Urv. subsp. <i>creticum</i>	0	0	1	0	0	0	0
<i>Crypsis schoenoides</i> (L.) Lam.	0	0	0	1	0	0	0
<i>Cyperus longus</i> L.	0	0	0	0	1	1	0
<i>Dactylorhiza iberica</i> (M.Bieb. ex Willd.) Soó	1	0	1	0	0	0	0
<i>Dactylorhiza incarnata</i> (L.) Soó	1	0	1	1	0	0	0
<i>Dactylorhiza nieschalkiorum</i> H.Baumann & Künkele	0	0	0	1	0	0	0
<i>Danthonia alpina</i> Vest	1	0	0	0	0	0	0
<i>Deschampsia caespitosa</i> P.Beauv.	1	0	1	0	0	0	0
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	0	0	1	0	1	1	0
<i>Eleocharis mitracarpa</i> Steud.	0	0	1	1	0	0	0
<i>Eleocharis palustris</i> Steud..	1	1	1	1	1	1	0
<i>Epilobium hirsutum</i> L.	1	1	1	0	1	1	1
<i>Epilobium montanum</i> L.	1	0	0	0	1	0	1
<i>Epilobium palustre</i> L.	0	1	0	0	0	0	0
<i>Epilobium parviflorum</i> Schreb.	1	0	0	0	0	0	1
<i>Equisetum arvense</i> L.	1	1	0	0	0	1	0
<i>Equisetum hyemale</i> L.	1	0	1	0	0	0	0
<i>Equisetum palustre</i> L.	1	1	1	1	1	1	0
<i>Equisetum ramosissimum</i> Desf.	1	0	0	0	0	0	0
<i>Equisetum telmateia</i> Ehrh.	1	1	0	1	1	1	0
<i>Euphorbia palustris</i> L.	0	0	1	0	0	0	0
<i>Euphorbia pubescens</i> Vahl	0	0	1	0	0	0	0
<i>Filipendula ulmaria</i> (L.) Maxim.	1	0	0	0	0	0	0
<i>Galium debile</i> Desv.	0	0	1	0	0	0	0
<i>Galium palustre</i> L.	0	0	0	1	0	1	0
<i>Galium rivale</i> Griseb.	0	0	1	0	0	0	0
<i>Geum rivale</i> L.	0	0	0	1	0	0	0
<i>Glyceria fluitans</i> (L.) R.Br.	1	0	1	0	0	0	0
<i>Glyceria plicata</i> Fr.	0	0	1	0	0	0	0
<i>Groenlandia densa</i> Fourr.	1	0	0	0	1	0	0
<i>Hippuris vulgaris</i> L.	0	0	1	0	1	1	0
<i>Hordeum marinum</i> Huds. subsp. <i>marinum</i>	0	1	1	0	0	0	0
<i>Inula britannica</i> L.	0	1	1	1	1	1	0
<i>Iris pseudacorus</i> L.	0	0	1	0	0	1	0
<i>Isolepis setacea</i> (L.) R.Br.	0	0	1	0	0	0	0
<i>Juncus articulatus</i> L.	1	0	1	0	1	1	0
<i>Juncus bufonius</i> L.	1	0	1	0	0	0	0
<i>Juncus conglomeratus</i> L.	0	0	0	0	0	1	0
<i>Juncus compressus</i> Jacq.	1	0	1	0	1	0	0

	Abant	Sünnet	Yeniçağa	Gölcük	Gölköy	Yumrukaya	Sülüklügöl
<i>Juncus effusus</i> L.	1	0	0	1	0	0	0
<i>Juncus gerardi</i> subsp. <i>libanoticus</i>	1	0	1	0	0	0	0
<i>Juncus gerardi</i> Loisel. subsp. <i>gerardi</i>	1	0	0	0	0	0	0
<i>Juncus inflexus</i> L.	1	0	1	0	1	1	0
<i>Juncus maritimus</i> Lam.	0	0	0	0	0	0	1
<i>Juncus sphaerocarpus</i> Nees	0	0	1	0	0	0	0
<i>Lathyrus palustris</i> L. subsp. <i>palustris</i>	0	0	1	0	0	0	0
<i>Lathyrus pratensis</i> L.	1	0	1	0	0	0	1
<i>Lemna gibba</i> L.	1	0	0	0	0	1	0
<i>Lemna minor</i> L.	0	0	1	0	0	0	0
<i>Lemna trisulca</i> L.	1	0	0	0	0	0	0
<i>Lepidium latifolium</i> L.	0	0	1	0	0	0	0
<i>Leucojum aestivum</i> L. subsp. <i>aestivum</i>	0	0	1	1	0	0	0
<i>Lycopus europaeus</i> L.	1	1	1	1	0	1	0
<i>Lysimachia verticillaris</i> Spreng.	0	0	1	1	0	0	0
<i>Lysimachia vulgaris</i> L.	1	1	1	1	1	1	1
<i>Lythrum hyssopifolia</i> L.	0	0	0	1	0	0	0
<i>Lythrum salicaria</i> L.	1	1	1	1	1	1	1
<i>Melissa officinalis</i> L. subsp. <i>officinalis</i>	0	1	0	0	0	0	0
<i>Mentha longifolia</i> subsp. (L.) Huds. <i>typhoides</i> (Briq.) Harley var. <i>typhoides</i>	0	0	1	1	1	1	1
<i>Mentha aquatica</i> L.	1	0	1	0	1	1	0
<i>Mentha piperita</i> L.	0	0	1	0	0	1	0
<i>Mentha pulegium</i> L.	0	1	0	1	1	0	1
<i>Mentha spicata</i> L. subsp. <i>spicata</i>	0	0	0	1	0	0	0
<i>Mentha spicata</i> L. subsp. <i>tomentosa</i> Harley	0	0	0	1	0	0	0
<i>Menyanthes trifoliata</i> L.	1	0	0	0	0	0	0
<i>Myosotis laxa</i> Lehm. subsp. <i>caespitosa</i> (C. F. Schultz) Hyl. ex Nord.	1	0	0	0	1	1	0
<i>Myosoton aquaticum</i> Moench	0	0	0	1	0	1	0
<i>Myriophyllum spicatum</i> L.	1	1	0	1	0	0	1
<i>Myriophyllum verticillatum</i> L.	0	0	1	0	1	1	0
<i>Najas marina</i> L.	0	0	1	0	0	0	0
<i>Nasturtium officinale</i> R.Br.	0	1	1	0	1	0	1
<i>Nuphar lutea</i> (L.) Sm.	1	0	0	1	0	0	0
<i>Nymphaea alba</i> L.	1	0	1	0	0	0	0
<i>Oenanthe aquatica</i> (L.) Poir.	0	0	1	0	0	0	0
<i>Oenanthe fistulosa</i> L.	0	0	1	1	1	1	0
<i>Oenanthe silaifolia</i> M.Bieb.	1	0	0	1	0	1	0
<i>Ornithogalum platyphyllum</i> Boiss.	0	0	1	0	0	0	0
<i>Parnassia palustris</i> L.	1	0	0	0	0	0	0
<i>Petasites hybridus</i> (L.) G.Gaertn., B.Mey. & Scherb.	1	1	1	1	0	1	0
<i>Phragmites australis</i> (Cav.) Steud.	1	0	1	1	1	1	1
<i>Polygonum amphibium</i> L.	1	1	0	1	1	1	0
<i>Polygonum lapathifolium</i> L.	1	0	1	0	1	1	0

	Abant	Sünnet	Yeniçağa	Gölcük	Gölköy	Yumrukaya	Sülüklügöl
<i>Polygonum persicaria</i> L.	0	0	0	1	0	0	0
<i>Potamogeton berchtoldii</i> Fieber	1	0	0	0	1	0	0
<i>Potamogeton crispus</i> L.	0	0	1	0	1	1	0
<i>Potamogeton gramineus</i> L.	1	0	0	1	1	0	1
<i>Potamogeton natans</i> L.	1	1	1	1	1	0	1
<i>Potamogeton nodosus</i> Poir.	1	0	0	0	0	0	0
<i>Potamogeton pectinatus</i> L.	1	0	0	0	0	0	0
<i>Potamogeton perfoliatus</i> L.	1	0	1	0	1	0	1
<i>Potentilla anserina</i> L. subsp. <i>anserina</i>	0	0	1	0	0	0	0
<i>Potentilla reptans</i> L.	1	1	1	1	1	1	0
<i>Potentilla supina</i> L.	0	1	0	0	0	0	0
<i>Prunella vulgaris</i> L.	0	0	0	1	0	1	1
<i>Pulicaria dysenterica</i> (L.) Bernh.	1	0	1	0	0	1	0
<i>Ranunculus ficaria</i> L. subsp. <i>calthifolius</i> (Rchb.) Arcang.	1	0	0	0	1	0	0
<i>Ranunculus lingua</i> L.	1	0	1	0	0	0	0
<i>Ranunculus repens</i> L.	1	1	1	1	0	1	1
<i>Ranunculus sceleratus</i> L.	1	0	1	0	1	0	0
<i>Ranunculus trichophyllus</i> Chaix	1	0	1	0	1	0	1
<i>Rorippa amphibia</i> Besser	0	0	1	0	0	0	0
<i>Rorippa sylvestris</i> (L.) Besser	1	0	1	1	1	1	1
<i>Rumex hydrolapathum</i> Huds.	1	0	0	0	0	0	0
<i>Sagittaria sagittifolia</i> L.	1	0	0	0	0	0	0
<i>Salix alba</i> L.	1	1	0	0	1	1	1
<i>Salix amplexicaulis</i> Bory & Chaub.	1	0	0	1	1	1	0
<i>Salix caprea</i> L.	0	0	1	1	0	0	0
<i>Salix fragilis</i> L.	1	0	0	0	0	1	0
<i>Salix elaeagnos</i> Scop.	0	0	1	1	0	0	1
<i>Salix pentandra</i> L.	1	1	0	0	0	0	0
<i>Salix pentandroides</i> A.K.Skv.	0	0	0	0	0	1	0
<i>Salix triandra</i> L. subsp. <i>triandra</i>	0	0	0	0	1	0	0
<i>Saxifraga cymbalaria</i> L. subsp. <i>cymbalaria</i>	1	0	0	1	0	0	0
<i>Schoenoplectus lacustris</i> (L.) Palla subsp. <i>lacustris</i>	1	0	0	0	0	1	0
<i>Schoenoplectus lacustris</i> (L.) Palla subsp. <i>tabernaemontani</i> (C.C.Gmel.) Á.Löve & D.Löve	1	0	1	0	0	0	0
<i>Scirpus sylvaticus</i> L.	0	1	1	1	0	1	0
<i>Scutellaria galericulata</i> L.	0	0	1	1	0	1	0
<i>Senecio mollis</i> Willd.	0	0	1	0	0	0	0
<i>Sium sisarum</i> L.	1	0	0	0	0	0	0
<i>Sparganium erectum</i> L. subsp. <i>erectum</i>	1	0	0	0	0	0	0
<i>Sparganium erectum</i> subsp. <i>microcarpum</i> (Neuman) Domin	1	0	1	0	1	1	0
<i>Tetragonolobus maritimus</i> Roth	1	0	1	0	0	0	0
<i>Teucrium scordium</i> L. subsp. <i>scordium</i>	1	1	1	0	1	0	0
<i>Thalictrum flavum</i> L.	0	0	1	0	0	0	0

	Abant	Sünnet	Yeniçağ	Gölcük	Gölköy	Yumrukaya	Sülüklügöl
<i>Thalictrum lucidum</i> L.	1	0	1	0	1	1	0
<i>Triglochin palustris</i> L.	0	0	1	0	0	0	0
<i>Typha angustifolia</i> L.	1	0	0	0	0	1	0
<i>Typha domingensis</i> Pers.	1	0	1	0	0	0	0
<i>Typha latifolia</i> L.	1	0	1	1	1	1	0
<i>Typha shuttleworthii</i> Koch & Sond.	1	1	1	0	0	0	0
<i>Utricularia australis</i> R.Br.	0	0	1	0	0	0	0
<i>Utricularia vulgaris</i> L.	1	0	0	0	0	0	0
<i>Veronica anagallis-aquatica</i> L.	1	0	1	1	1	1	0
<i>Veronica scutellata</i> L.	0	0	0	0	0	0	0
<i>Zingeria pisdica</i> (Boiss.) Tutin	1	0	1	0	0	0	0