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# SPECIES DIVERSITY IN LENTIC, LOTIC, MARINE AND TERRESTRIAL BIOTOPES OF GOKCEADA SALT LAKE WETLAND (CANAKKALE, TURKEY)

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## ABSTRACT

This study was carried out to provide detailed information on species diversity and community structure of Gökçeada Salt Lake Wetland (brook feeding the lake, neighboring sea and terrestrial area around the wetland). Aquatic species diversity (algae, invertebrates, and fish) at 9 different stations in freshwater, brackish water and marine ecosystems, and terrestrial species diversity (plants, amphibians, reptiles, birds and mammals) in the surrounding wetland were studied seasonally in 2016. A total of 195 taxa of terrestrial vascular flora and 134 species of aquatic flora (97 species of phytoplankton, 37 species of benthic algae); a total of 23 macrobenthic invertebrate taxa from the lake and 131 invertebrate species from the sea were identified. Also, 4 fish, 14 reptiles, 3 amphibians and 71 bird species were observed in the study area. While one species of phytoplankton was determined as a new record for the Turkish aquatic flora, a total of 71 marine invertebrate species were reported for the first time in the marine fauna of Gökçeada. The obtained data will not only provide a solid basis to expand the understanding of the island's ecosystem, but also will serve as an important tool in the action plans for wetland conservation.

**KEYWORDS:**
Salt Lake, Gökçeada, diversity, Imbros, wetlands

## INTRODUCTION

Wetlands are one of the most important ecosystems on Earth because of their rich biodiversity, natural value and economic benefits. To be able to ensure the sustainability of these ecosystems, it is essential to investigate and learn more about their ecological balance. Wetlands have a rich and specialized biodiversity due to their structures and locations between the terrestrial and aquatic areas; therefore, they serve as rich ecosystems for the inhabitants living in these areas and also provide multiple ecosystem services to humans [1]. Several previous studies have determined the biological diversity in wetlands [2-9].

Coastal lagoons have special hydrodynamic perspective and very sensitive structures [10]. They are particularly important aquatic ecosystems, usually located near a sea and relatively isolated from the sea by coastal barriers [11]. Coastal lagoons range from nearly fresh to hypersaline waters, and can be fed by freshwater from a stream or salt water from the sea. Therefore, their species diversity may change seasonally within an ecological balance. Also, any artificial influence to these sensitive areas may cause the destruction of the natural balance within those areas [10]. Incidentally, lagoons and their surrounding areas may also serve the tourism sector. Therefore, it is very hard to maintain their sustainability. For this reason, it is necessary to know their hydrobiological structures to protect their ecological balance.

In Turkey, wetlands cover more than 60,000 ha and almost 50% of those areas are located in the Mediterranean Region, followed by the Aegean Region (35%) [12]. Lagoons are targeted as marine protected areas due to the remarkable biodiversity they hold in the ecosystems as a result of the influence of both marine and terrestrial factors [13]. Many species can be ecologically and/or commercially important [14, 15]. They provide goods and services for humans besides their ecological role [16]. Thus, monitoring of these ecosystems is essential for the spatio-temporal changes in organisms and the sustainability of these areas. Determining the changes in organisms living in the aquatic system is the best method for identifying threats. The persistence of the local species and biodiversity are directly related to the protection of the wetland. In this study, the wetland system of Gökçeada Salt Lake including the reptiles, amphibians and bird

species from the surrounding terrestrial area was monitored seasonally in 2016 to determine the aquatic species diversity from the lake and the neighboring.

Gökçeada is the biggest island of Turkey, covering an area of 290 km$^2$, with a 95 km coastline situated on the north Aegean Sea (40°05 – 40°14 N 25°39 – 26°00 E). The southwesterly and northeasterly winds are prevalent on the island. The Gökçeada Salt Lake is also called Gökçeada Lagoon, which is on the list of Wetlands of International Importance of Turkey and a suitable habitat for bird species under conservation protection [17].

Previous studies were conducted on terrestrial vegetation, fresh and marine fauna, ornithofauna and herpetological features of Gökçeada including the Salt Lake [17-32]. But, except one study [17], none of these studies focused on determining the diversity of the species in Gökçeada Salt Lake Wetland. The Gökçeada Salt Lake Wetland has not been sufficiently protected. It is close to the settlement areas with considerable tourism pressure especially in summer months. And ecological shifts have not been explained scientifically.

This study aims to improve the overall knowledge of the species diversity of the Gökçeada Salt Lake Wetland and to provide information on spatiotemporal variation of the species in lentic, lotic, marine and terrestrial biotopes. As such, algae, plants, invertebrates (except terrestrial and semi-aquatic insects) and vertebrates were investigated. At the end of this paper, we offer some suggestions for the sustainable use and ecological management of the Gökçeada Salt Lake Wetland.

## MATERIALS AND METHODS

**Studied Area and Sampling Locations.** The Salt Lake Wetland is located in the southeast of Gökçeada Island, in the Aydıncık region (Figure 1). The surface area of the lake is approximately 2 km$^2$ with an average depth of 1-2 m. The lake is connected with the sea when the southwesterly winds are strong. Overall, nine sampling stations to determine aquatic flora and fauna in the study area were selected. While one of them was chosen as lotic biotope in the stream feeding of the Salt Lake (TK1), the other four stations, located on the lake, were chosen as lentic biotope (TG2, TG3, TG4 and TG5). Four farther stations were chosen from the sea as marine biotope (TD6, TD7, TD8, and TD9) (Figure 1, Table 1). The sampling for fish was made at the same time as the sampling of marine macrozoobenthos. Terrestial plants, amphibians, reptiles and mammal specimens were observed in the wetland with an area of 6.883 hectares. While all these samplings and observations were made at the selected stations at seasonal intervals between January 2016 and December 2016, only the bird observations were conducted monthly from three regions (TB10, TB11 and TB12).

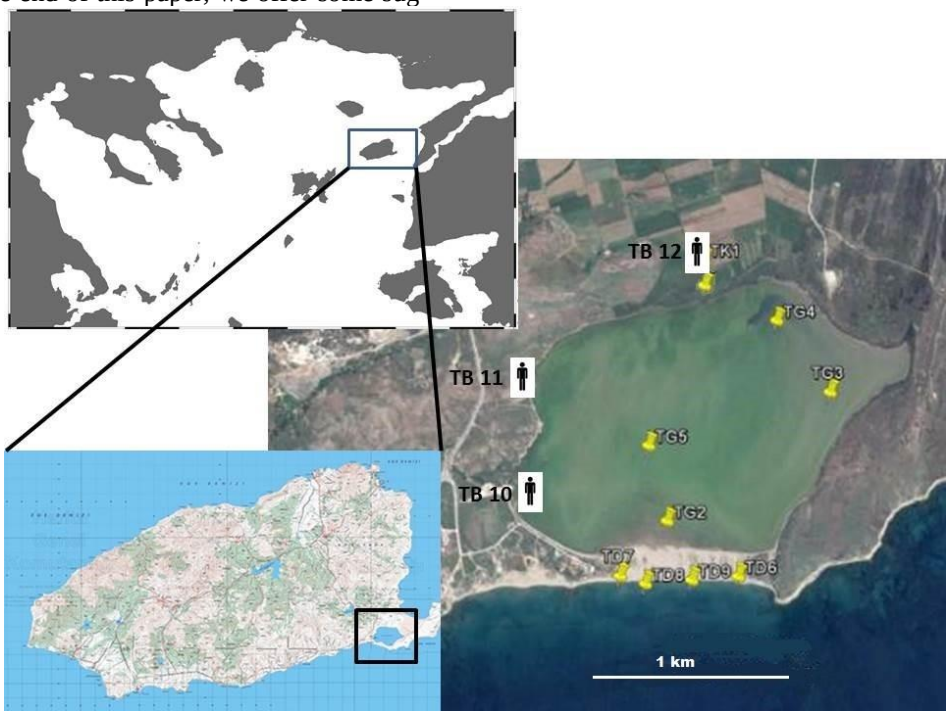


**FIGURE 1**
**The map of sampling area**

**TABLE 1**
**Information of sampling stations (van Veen grab: VG, Plankton net: PN, Sampling bottle: SB, Beam trawl: BT, Binocular: B, Camera: C)**

| Station No | Biotope | Coordinate | Date | Sampling tool | Depth (m) | Station No | Biotope | Coordinate | Date | Sampling tool | Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **TK1** | Stream | 40 08 254<br>25 57 087 | 09.01.2016<br>08.05.2016<br>09.08.2016<br>13.11.2016 | VG,<br>PN, SB | 0.1 | **TD6** | Sea | 40 07 522<br>25 57 171 | 29.02.2016<br>28.05.2016<br>02.08.2016<br>17.11.2016 | BT,<br>PN | 1.5 |
| **TG2** | Salt lake | 40 07 481<br>25 57 231 | 08.01.2016<br>08.05.2016<br>09.08.2016<br>13.11.2016 | VG,<br>PN, SB | 0.3 | **TD7** | Sea | 40 07 501<br>25 57 162 | 29.02.2016<br>28.05.2016<br>02.08.2016<br>17.11.2016 | VG,<br>PN | 8.0 |
| **TG3** | Salt lake | 40 07 587<br>25 57 498 | 08.01.2016<br>08.05.2016<br>09.08.2016<br>13.11.2016 | VG,<br>PN, SB | 0.3 | **TD8** | Sea | 40 07 433<br>25 57 251 | 29.02.2016<br>28.05.2016<br>02.08.2016<br>17.11.2016 | BT,<br>PN | 5.0 |
| **TG4** | Salt lake | 40 07 652<br>25 57 041 | 08.01.2016<br>08.05.2016<br>09.08.2016<br>13.11.2016 | VG,<br>PN, SB | 0.3 | **TD9** | Sea | 40 07 464<br>25 57 325 | 29.02.2016<br>28.05.2016<br>02.08.2016<br>17.11.2016 | VG,<br>PN | 7.0 |
| **TG5** | Salt lake | 40 08 013<br>25 57 143 | 09.01.2016<br>08.05.2016<br>09.08.2016<br>13.11.2016 | VG,<br>PN, SB | 1.2 | **TB10** | Wetland | 40 07 342<br>25 57 125 | Every Month | B, C | - |
| | | | | | | **TB11** | Wetland | 40 07 421<br>25 57 110 | Every Month | B, C | - |
| | | | | | | **TB12** | Wetland | 40 08 178<br>25 56 145 | Every Month | B, C | - |

**Algal samplings.** Water samples were taken from nine stations at depths of 0.1-8 m using a Hydro-Bios Free Flow Water Sampler (2.5 liters) to obtain the phytoplankton samples. Also, a plankton net with a 20 µm mesh size was used to evaluate the phytoplankton qualitatively, and a glass tube with a diameter of 0.8 cm and a length of 1 m was used to collect the epipelic algal samples from lentic and lotic biotopes. All phytoplankton samples were transferred into plastic bottles and fixed with 5% formalin. Before the phytoplanktonic organisms were counted, the water samples were homogenized at a low speed until the sediment was thoroughly mixed and were of uniform consistency. Three water-mounted slides for each sample were examined and living diatoms were collected at each station to obtain an estimate of the algal relative abundance [33, 34]. At least 500 algal cells were counted at 600x magnification. Permanent slides for the identification of diatoms were prepared from the same sample after boiling in a 1:1 mixture of concentrated $H_2SO_4$ and $HNO_3$. The acid-cleaned diatoms were mounted in Naphrax high refractive index medium [4]. Microscopic observations were conducted under a Prior phase-contrast inverted microscope and a Prior phase-contrast. The Lugol-fixed water samples were concentrated to 1-3 ml and then counted in the Sedgewick-Rafter chamber for the marine samples and utermohl counting chambers for the lotic and lentic phytoplankton samples under an inverted microscope [35]. New records of taxa from the Turkish Algal Flora were checked according to Aysel [36]. Furthermore, valid taxa names and arrangement of taxonomic groups were determined according to the website of [37].

**Macroinvertebrates and Fish Samples.** Sediment samples were taken from a total of five different sampling stations (TK1, TG2, TG3, TG4, and TG5) by van Veen Grap (15 x 15 $cm^2$) twice at each station. However, the sampling could not be done at the sampling station TG4 in autumn because of the drying. The obtained material was put into the plastic bottles including 70% ethanol after using a sieve. The specimens were identified from papers by [38-44]. All samples were preserved in 70% ethanol.

For the marine macrozoobenthic community sampling, we made three replicates by using a 0.1 $m^2$ van Veen Grab in two sampling stations (TD7 & TD9) and by using a beam trawl in the other two stations (TD6 & TD8). All sediment samples were sieved on deck through 0.5 mm size mesh and preserved in a formaldehyde seawater solution (4-5%) for further analyses. The samples were evaluated with ÇOMÜ-3 R/V and I.U Fırtına R/V. The macrozoobenthic samples were sorted and identified to the lowest possible taxonomic level (typically species level) with Olympus SZX-16 stereomicroscope and light microscope, preserved in 70% ethanol. Also, the fish species were obtained by means of the beam trawl in the marine sampling locations. WoRMS is followed here for the nomenclature of the species [45].

.**TABLE 2**
**Literatures and field studies are the result of species and subtaxa list of vascular plants**

**APIACEAE**

*Apium nodiflorum* (L.) Lag.

*Lagoecia cuminoides* L.
*Oenanthe silaifolia* M.Bieb.
*Scandix pecten-veneris* L.
*Torilis arvensis* (Huds.) Link subsp. *neglecta* (Spreng.) Thell.
*Torilis nodosa* (L.) Gaertn.

**ARACEAE**

*Lemna minor* L.

**AMARYLLIDACEAE**

*Allium sphaerocephalon* L.

**ASPARAGACEAE**

*Ornithogalum pyrenaicum* L.

**ASPLENIACEAE**

*Asplenium obovatum* Viv.

**ASTERACEAE**

*Achillea maritima* (L.) Ehrend. & Y.P.Guo

*Anthemis auriculata* Boiss.

*Anthemis cotula* L.

*Anthemis tomentosa* L.

*Bellis perennis* L.

*Carduus nutans* L.
*Centaurea spinosa* L.
*Conyza bonariensis* (L.) Cronquist
*Cota tinctoria* (L.) J.Gay ex Guss.
*Crepis commutate* (Spreng.) Greuter
*Crepis zacintha* (L.) Babc.
*Filago eriocephala* Guss.
*Filago pygmaea* L.
*Filago pyramidata* L.
*Hedypnois rhagadioloides* (L.) F.W.Schmidt subsp. *cretica* (L.) Hayek
*Inula viscosa* (L.) Aiton
*Picnomon acarna* (L.) Cass.
*Scolymus hispanicus* L.
*Senecio vernalis* Waldst. & Kit.
*Sonchus oleraceus* L.
*Tragopogon porrifolius* L. subsp. *longirostris* (Sch.Bip.) Greuter

**BORAGINACEAE**

*Anchusa hybrida* Ten.
*Echium italicum* L.
*Heliotropium europaeum* L.

**BRASSICACEAE**

*Alyssum umbellatum* Desv.

*Capsella rubella* Reut.

*Clypeola jonthlaspi* L.
*Diplotaxis viminea* (L.) DC.
*Draba verna* L.

*Hirschfeldia incana* (L.) Lagr.-Foss.

*Nasturtium officinale* R.Br.
*Raphanus raphanistrum* L.

**CAMPANULACEAE**

*Legousia pentagonia* (L.) Thell.

**CAPRIFOLIACEAE**

*Valerianella discoidea* (L.) Loisel.

**CARYOPHYLLACEAE**

*Arenaria serpyllifolia* L. subsp. *leptoclados* (Rchb.) Nyman
*Cerastium brachypetalum* Pers. subsp. *roeseri* (Boiss. & Heldr.) Nyman

*Polycarpon tetraphyllum* (L) L.

*Silene colorata* Poir.
*Silene gallica* L.
*Spergula pentandra* L.
*Spergularia marina* (L.) Besser
*Stellaria media* (L.) Vill.
*Velezia quadridentata* Sibth. & Sm.

**CISTACEAE**

*Cistus creticus* L.

*Fumana thymifolia* (L.) Spach

**CONVOLVULACEAE**

*Calystegia sepium* (L.) R.Br.

*Convolvulus arvensis* L.
*Convolvulus elegantissimum* Mill.

**CRASSULACEAE**

*Umbilicus horizontali* (Salisb.) Dandy

**CYPERACEAE**

*Bolboschoenus maritimus* (L.) Palla

*Carex divisa* Huds.

*Carex divulsa* Stokes
*Cyperus capitatus* Vand.

*Isolepis cernua* (Vahl) Roem. & Schult.

*Scirpoides holoschoenus* (L.) Soják

**DENNSTAEDTIACEAE**

*Pteridium aquilinum* (L.) Kuhn

**EQUISETACEAE**

*Equisetum ramosissimum* Desf.

**EUPHORBIACEAE**

*Euphorbia chamaesyce* L.
*Euphorbia helioscopia* L.
*Euphorbia paralias* L.

**FABACEAE**

*Lathyrus annuus* L.
*Medicago constricta* Dur.

*Medicago coronata* (L.) Bart.

*Medicago falcata* L.
*Medicago marina* L.
*Medicago orbicularis* (L.) Bartal.
*Medicago polymorpha* L.
*Medicago rigidula* (L.) All.

*Melilotus albus* Desr.

*Ononis serrata* Forssk.
*Ononis viscosa* L. subsp. *brevifolia* (DC.)
*Trifolium angustifolium* L.
*Trifolium arvense* L.
*Trifolium campestre* Schreb.
*Trifolium fragiferum* L. var. *pulchellum* Lange

*Trifolium purpureum* Lois.

*Trifolium scabrum* L.
*Vicia hirsuta* (L.) Gray
*Vicia lathyroides* L.
*Vicia villosa* Roth subsp. *eriocarpa* (Hausskn.) P.W.Ball

**FAGACEAE**

*Quercus coccifera* L.

**GENTIANACEAE**

*Centaurium maritimum* (L.) Fritsch
*Centaurium tenuifolium* (Hoffmanns. & Link) Fritsch

**GERANIACEAE**

*Erodium acaule* (L.) Becherer & Thell.

*Erodium cicutarium* (L.) L Hér.

*Geranium molle* L.

**HYPERICAEAE**

*Hypericum perforatum* L.

**IRIDACEAE**

*Crocus pulchellus* Herb.
*Iris suaveolens* Boiss. & Reut.

*Romulea linaresii* Parl.

**JUNCACEAE**

*Juncus acutus* L.
*Juncus gerardii* Loisel.

*Juncus hybridus* Brot.

*Juncus maritimus* Lam.

**LAMIACEAE**

*Ballota acetabulosa* (L.) Benth.
*Lamium amplexicaule* L.
*Marrubium peregrinum* L.
*Micromeria graeca* (L.) Benth. ex Reicbh.
*Origanum vulgare* L. subsp. *hirtum* (Link) Ietsw.
*Salvia viridis* L.
*Stachys cretica* L. subsp. *lesbiaca* Rech.f.
*Teucrium chamaedrys* L.
*Teucrium polium* L.
*Teucrium scordium* L. *subsp. scordioides* (Schreb.) Arcang.
*Thymbra capitate* (L.) Cav.

*Vitex agnus-castus* L.

**LINACEAE**

*Linum bienne* Mill.
*Linum trigynum* L.

**MALVACEAE**

*Alcea biennis* Winterl
*Malva sylvestris* L.

**OLEACEAE**

*Olea europaea* L.
*Phillyrea latifolia* L.

**ORCHIDACEAE**

*Orchis laxiflora* Lam.

**OROBANCHACEAE**

*Bartsia trixago* L.
*Parentucellia latifolia* (L.) Caruel
*Parentucellia viscosa* (L.) Caruel

**PAPAVERACEAE**

*Fumaria kralikii* Jord.

*Hypecoum pendulum* L.
*Papaver argemone* L.
*Papaver rhoeas* L.

**PLANTAGINACEAE**

*Plantago coronopus* L.

*Plantago lagopus* L.

*Plantago major* L. subsp. *intermedia* (Gilib.) Lange
*Veronica cymbalaria* Bodard
*Veronica polita* Fr.

**POACEAE**

*Aegilops biuncialis* Vis.

*Aegilops caudata* L.
*Aeluropus littoralis* (Gouan) Parl.
*Aira elegantissima* Schur subsp. *ambigua* (Arcang.) Doğan
*Anthoxanthum aristatum* Boiss.

*Avena barbata* Pott ex Link

*Brachypodium distachyon* (L.)
*Briza maxima* L.

*Briza minor* L.

*Bromus arvensis* L.

*Bromus diandrus* Roth

*Bromus fasciculatus* C.Presl
*Bromus madritensis* L.
*Bromus tectorum* L.
*Catapodium rigidum* (L.) C.E.Hubb.
*Crypsis aculeata* (L.) Aiton
*Cynosurus echinatus* L.
*Dactylis glomerata* L.
*Elymus elongatus* (Host) Runemark
*Hordeum bulbosum* L.
*Hordeum murinum* L. subsp. *leporinum* (Link) Arcang.
*Imperata cylindrica* (L.)
*Koeleria pyramidata* (Lam.)
*Lagurus ovatus* L.

*Lolium perenne* L.

*Lolium rigidum* Gaudich

*Oryzopsis miliacea* (L.)
*Phragmites australis* (Cav.) Trin. ex Steud.
*Poa annua* L.
*Poa bulbosa* L.

*Poa trivialis* L.

*Polypogon maritimus* Willd.
*Polypogon monspeliensis* (L.) Desf.
*Puccinellia distans* (Jacq.) Parl.
*Rostraria cristata* (L.)
*Vulpia ciliate* Dumort.

**POLYGONACEAE**

*Polygonum patulum*
*Rumex acetosella* L.
*Rumex pulcher* L.
*Rumex tuberosus* L.

**PRIMULACEAE**

*Anagallis arvensis* L.
*Anagallis arvensis* L. *var. caerulea* (L.) Gouan

**PTERIDACEAE**

*Anogramma leptophylla* (L.)

**RANUNCULACEAE**

*Anemone coronaria* L.
*Ranunculus ficaria* L

*Ranunculus muricatus* L.

*Ranunculus neapolitanus*
*Ranunculus peltatus*

**ROSACEAE**

*Potentilla reptans* L.
*Rubus sanctus Schreb.*
*Sarcopoterium spinosum* (L.) Spach

**RUBIACEAE**

*Galium debile* Dev.
*Valantia muralis* L.

**SALICACEAE**

*Salix alba* L.

**SCROPHULARIACEAE**

*Verbascum sinuatum* L.

**TAMARICACEAE**

*Tamarix smyrnensis* Bunge

**TYPHACEAE**

*Typha angustifolia* L.

**VERBENACEAE**

*Verbena officinalis* L.

**VIOLACEAE**

*Viola kitaibeliana* Roem. & Schult.

**XANTHORRHOEACEAE**

*Asphodelus aestivus* Brot.

**TABLE 3**
**Phytoplankton species list in the water samples from Gökçeada Salt Lake. New record algal flora for the Turkey were marked with *.**

**MARINE SPECIES**

**CYANOBACTERIA**

*Phormidium limosum* (Dillwyn) P.C. Silva

**BACILLARIOPHYTA**

*Achnanthes longipes* C. Agardh
*Actinocyclus normanii* (Gregory) Hustedt
*Amphora ocellata* Donkin
*Bacteriastrum hyalinum* Lauder
*Cerataulina pelagica* (Cleve) Hendey
*Coscinodiscus perforatus* Ehrenberg
*Diploneis chersonensis* (Grunov) Cleve
*Gyrosigma acuminatum* (Kützing) Rabenhorst
*Hannaea arcus* (Ehrenberg) R.M. Patrick
*Hemiaulus hauckii* Grunow ex Van Heurck
*Leptocylindrus minimus* Gran
*Lyrella lyroides* (Hendey) D.G. Mann in Round
*Navicula cryptocephala* Kützing
*Navicula salinarum* Grunow
*Nitzschia longissima* (Brébisson) Ralfs
*Nitzschia sigma* (Kützing) W. Smith
*Podosira hormoide*s (Mont.) Kutzing
*Proboscia alata* (Brightwell) Sündstrom
*Pseudo-nitzschia delicatissima* (Cleve) Heiden
*Pseudosolenia calcar-avis* (Schultze) Sundström
*Thalassionema nitzschioides* (Grunow)
*Thalassiothrix mediterranea* Pavillard

**OCHROPHYTA**

*Heterosigma akashiwo* (Y. Hada)

**BIGYRA**

*Bicosoeca mediterranea* Pavillard

**CHLOROPHYTA**

*Halosphaera viridis* F. Schmitz
*Pyramimonas adriaticus* J. Schiller

**CRYPTOPHYTA**

*Rhodomonas marina* (P.A. Dangeard) Lemmermann

**DINOFLAGELLATA**

*Amphidinium sphenoides* WüIff
*Ceratium hirundinella* (O.F. Müller) Dujardin
*Cochlodinium archimedes* (Pouchet) Lemmermann
*Gonyaulax scrippsae* Kofoid
*Gyrodinium pingue* (Schütt) Kofoid & Swezy
*Gyrodinium spirale* (Bergh) Kofoid & Swezy
*Karenia brevis* (C.C. Davis) Gert Hansen & Ø. Moestrup
*Katodinium fungiforme* (Anissimova) A.R. Loeblich III
*Neoceratium fusus* (Ehrenberg) F. Gomez,
*Noctiluca scintillans* (Macartney) Kofoid
*Polykrikos kofoidii* Chatton
*Prorocentrum compressum* (Bailey) Abé ex
*Prorocentrum cordatum* (Ostenfeld) Dodge
*Protoperidinium mediterraneum* (Kofoid) Balech
*Protoperidinium oceanicum* (VanHöffen) Balech
*Protoperidinium pallidum* (Ostenfeld) Balech
*Protoperidinium pellucidum* Bergh exLoeblich
*Protoperidinium steinii* (Jorgensen) Balech
*Torodinium teredo* (Pouchet) Kofoid & Swezy
*Tripos furca (*Ehrenberg) F. Gómez
*Tripos macrocer-os* (Ehrenberg) F. Gómez

**LAKE SPECIES**

**CYANOBACTERIA**

*Leptolyngbya fragilis* (Gomont)

**BACILLARIOPHYTA**

*Amphora ovalis* (Kützing) Kützing
*Caloneis limosa* (Kützing) R.M. Patrick in Patrick
*Cocconeis pediculus* Ehrenberg
*Coronia decora* (Brébisson) Ruck & Guiry
*Cyclotella meneghiniana* Kützing
*Cymatopleura elliptica* (Brébisson) W.Smith
*Encyonema minutum* (Hilse) D.G. Mann
*Entomoneis alata* (Ehrenberg) Ehrenberg
*Fragilaria capucina* Desmazières
*Fragilaria crotonensis* Kitton
*Gomphonema minutum* (C. Agardh) C. Agardh
*Gomphonema olivaceum* (Hornemann) Brébisson
*Gyrosigma attenuatum* (Kützing) Rabenhors
*Gyrosigma acuminatum* (Kützing) Rabenhorst
*Gyrosigma distortum* (W. Smith) Griffith & Henfrey
*Licmophora ehrenbergii* (Kützing) Grunow
*Melosira varians* C. Agardh
*Navicula cincta* (Ehrenberg) Ralfs in Pritchard
*Navicula cryptocephala* Kützing
*Navicula salinarum* Grunow
*Nitzschia acicularioides* Hustedt
*Nitzschia communis* Rabenhorst
*Nitzschia dissipata* (Kützing) Rabenhorst
*Nitzschia nana* Grunow in Van Heurck
*Nitzschia ovalis* H.J. Arnott in Cleve & Grunow
*Nitzschia sigmoidea* (Nitzsch) W. Smith
*Plagiotropis lepidoptera* (W. Gregory) Kuntze
*Rhoicosphenia abbreviata* (C. Agardh) Lange-Bertalot
*Surirella brebissonii* Krammer & Lange-Bertalot
***Surirella notabilis* G. Leuduger-Fortmorel***
*Tryblionella acuta* (Cleve) D.G. Mann in Round
*Tryblionella navicularis* (Brébisson) Ralfs in Pritchard
*Ulnaria danica* (Kützing) Compère & Bukhtiyarova
*Ulnaria ulna* (Nitzsch) Compère in Jahn et al.

**CHAROPHYTA**

*Spirogyra crassa* (Kützing) Kützing

**CRYPTOPHYTA**

*Cryptomonas ovata* Ehrenberg
*Plagioselmis nannoplanctica* (H. Skuja) G. Novarino
*Rhodomonas marina* (P.A. Dangeard) Lemmermann
*Teleaulax acuta* (Butcher) D.R.A. Hill

**CHLOROPHYTA**

*Aegagropila linnaei* Kützing
*Ankistrodesmus spiralis* (W.B. Turner)
*Chlamydomonas reinhardtii* P.A. Dangeard
*Cladophora glomerata* (Linnaeus) Kützing
*Closterium ehrenbergii Meneghini ex Ralfs*
*Closterium moniliferum Ehrenberg ex Ralfs*
*Dunaliella tertiolecta* Butcher
*Oocystis elliptica* West

**DINOFLAGELLATA**

*Karenia brevis* (C.C. Davis) Gert Hansen
*Prorocentrum cordatum* (Ostenfeld) Dodge

**HAPTOPHYTA**

*Phaeocystis globosa* Scherffel

**OCHROPHYTA**

*Heterosigma akashiwo* (Y. Hada)

**Terrestrial Plant Samples.**The terrestrial vascular plants around the Salt Lake were collected at spring vegetation periods. The samples were collected, photographed and identified. The specimens were kept in the Çanakkale Onsekiz Mart University, Çanakkale Botanic Garden Herbarium (CBB). In addition, herbarium samples previously collected from the site were examined in CBB and

Herbarium of Ege University Botanic Garden (EGE).

**Birds, Amphibians, Reptilians and Mammals Observations.** The birds in and around the lake were observed in detail under the transect work. Three binoculars (8x40, 8,20 wide angle, Meade telescope (EXT 70), Garmin GPS Etrex navigation device (Vista-HCX), and a camera (Canon 60D, Canon 7D Mark II body, Canon 300mm f2.8L IS USM super telephoto lens) were used during the observations. In the study area, species of fixed birds primarily were counted and photographed.

Amphibian, reptile and mammal specimens were captured during about 20 days in 10 excursions by two people on various dates. They were caught by net, hand or using fish traps.

## RESULTS

In this study, a total of 195 taxa of terrestrial vascular flora and 134 species of aquatic flora (97 species of phytoplankton, 37 species of benthic algae); 23 macrobenthos taxa from lotic and lentic biotopes; and 131 species from marine biotope were identified. Furthermore, 4 fish, 14 reptilians, 3 amphibian and 71 bird species were observed in the study area. Although, one species of phytoplankton was found as a new record for the Turkish aquatic flora, a total of 71 marine invertebrate species were reported for the first time in the marine fauna of Gökçeada. The species lists, which were observed at the study area, are detailed in Tables 2-6.

**Algae.** A total of 97 phytoplankton taxa belonging to Cyanobacteria (2), Bacillariophyta (56), Bigyra (1), Chlorophyta (11), Cryptophyta (4), Dinoflagellata (21), Haptophyta (1) and Ochrophyta (1) were identified in the water samples collected from the lentic, lotic and coastal marine stations of Gökçeada Salt Lake. The list of phytoplankton species and their distributions are presented in Table 3 and Figure 2, respectively. Dominant phytoplankton groups consist of pennate diatoms, techate and atechate dinoflagellates and flagellated chlorophytes. The most abundant sampling station was TG3 (2.533.980 cell$L^{-}$) according to cell counts in the water samples from the lentic, lotic and coastal marine stations of Gökçeada Salt Lake (Figure 2). The lowest abundance was 1335 cell$L^{-}$ in the TK1, whereas the most abundant systematic category was the Chlorophyta (1.431.840 cell$L^{-}$). Common species among the stations were *Chlamydomonas reinhardi* and *Cryptomonas ovata*. In the lotic station (TK1), the highest cell abundance was 976.540 cell$L^{-}$ in May 2016 (Figure 2). In the coastal marine stations, the highest abundance was observed in TD7 (33.000 cell$L^{-}$) in February 2016. Chlorophytes and diatoms were the most abundant and common groups of coastal marine phytoplankton. A total of 37 taxa were identified from the lotic (TK1) and lentic (TG2, TG3, TG4 and TG5) sampling stations of Gökçeada Salt Lake. The most abundant and common species are *Epithemia sorex* Kützing during the first half of the sampling period and *Gyrosigma acuminatum* (Kützing) Rabenhorst during the second half.

**Plants.** A total of 195 taxa belonging to terrestrial vascular flora were observed in this study. While the Poaceae were represented by 36 taxa, it was followed by Asteraceae and Fabaceae with 21 taxa, Lamiaceae with 12 taxa, Caryophyllaceae with 9 taxa, Brassicaceae with 8 taxa, Apiaceae and Cyperaceae with 6 taxa, Gentianaceae, Ranunculaceae and Plantaginaceae with 5 taxa, Juncaceae and Polygonaceae with 4 taxa, Boraginaceae, Convolvulaceae, Euphorbiaceae, Rosaceae, Orobanchaceae, Papaveraceae and Iridaceae with 3 taxa, Asparagaceae, Cistaceae, Linaceae, Malvaceae, Oleaceae and Rubiaceae with 2 taxa. The other groups (Araceae, Aspleniaceae, Campanulaceae, Caprifoliaceae, Dennstaedtiaceae, Equisetaceae, Hypericaceae, Papaveraceae, Pteridaceae, Orchidaceae, Violaceae, Salicaceae, Scrophulariaceae, Tamaricaceae, Typhaceae, Verbenaceae, Xanthorrhoeaceae) were represented by only one taxa.

**Macroinvertebrates.** The taxonomic analysis of the invertebrate samples collected from the sea resulted in 1,205 individuals belonging to 131 species of 8 taxa (Porifera, Anthozoa, Sipuncula, Polychaeta, Crustacea, Mollusca, Bryozoa, Echinodermata) (Table 4). The seasonal distribution of the species at the sampling stations was exhibited in Figure 3a. Mollusks were the most abundant taxon (682 individuals and 64 species), followed by crustaceans (420 individuals and 45 species) and polychaetes (94 individuals and 15 species) (Figure 3b). The most abundant species were the mollusks (*Bittium latreillii, B. reticulatum* and *Sepiola rondeletii),* and grouped as "constant"; the mollusk (*Cerithium vulgatum, Mangelia callosa, Rissoa violacea, Chamelea gallina, Donacilla cornea, Lucinella divaricata*), the crustaceans (*Nototropis massiliensis, Eurydice spinigera, Cumella (Cumella) pygmaea, Clibanarius erythropus, Diogenes pugilator, Liocarcinus depurator, Philocheras trispinosus*). The polychaetes (*Sphaerosyllis* sp., *Lumbrinerides amoureuxi*) were grouped as "common" in the results of the frequency index. A total of 23 taxa belonging to benthic macroinvertebrates were determined in Gökçeada Salt Lake (lotic and lentic biotopes) (Table 4).

**TABLE 4**
**The list of invertebrate species the study area. New record fauna for the Gökçeada island were marked with ****

| MARINE SPECIES | | | |
|---|---|---|---|
| **Phylum / Species** | **Phylum / Species** | **Phylum / Species** | **Phylum / Species** |
| **Porifera** | *Mangelia* sp. ** | **Arthropoda** | *Nototropis guttatus* |
| *Halichondria panicea* | *Mangelia striolata* ** | *Ampelisca brevicornis* ** | *Nototropis massiliensis* |
| **Anthozoa** | *Manzonia crassa* ** | *Ampelisca sarsi* ** | *Pachygrapsus marmoratus* |
| *Calliactis parasitica* ** | *Modiolula phaseolina* | *Ampelisca* sp. | *Paragnathia formica* |
| **Mollusca** | *Monophorus* sp | *Anoplodactylus petiolatus* ** | *Paranthura costana* ** |
| *Alvania cimex* | *Muricopsis cristata* | *Aora gracilis* ** | *Perioculodes longimanus* ** |
| *Bela nuperrima* ** | *Musculus costulatus* | *Bathyporeia guilliamsoniana* | *Philocheras trispinosus* |
| *Bela zonata* ** | *Mytilus galloprovincialis* | *Bathyporeia phaiophthalma* | *Porcellio scaber* |
| *Bittium lacteum* ** | *Naticarius stercusmuscarum* ** | *Chrinomid* sp | *Sphaeroma serratum* ** |
| *Bittium latreillii* | *Neverita josephinia* | *Clibanarius erythropus* | *Squilla mantis* |
| *Bittium reticulatum* | *Ocinebrina aciculata* ** | *Cumella pygmaea* ** | *Stenosoma capito* ** |
| *Bolinus brandaris* | *Peronidia albicans* ** | *Deflexilodes griseus* | *Urothoe pulchella* ** |
| *Caecum* sp. ** | *Pisania striata* | *Dexamine spinosa* | *Thracia phaseolina* ** |
| *Caecum trachea* ** | *Pitar rudis* | *Diogenes pugilator* | **Bryozoa** |
| *Cerithium vulgatum* | *Raphitoma linearis* ** | *Dynamene* sp. | *Cryptosula pallasiana* ** |
| *Chamelea gallina* | *Rissoa* sp. | *Ericthonius brasiliensis* | *Shcizomavella* sp. |
| *Clanculus cruciatus* | *Rissoa variabilis* | *Eurydice spinigera* | Bryozoa (sp) |
| *Conus ventricosus* | *Rissoa violacea* ** | *Gammarella fucicola* ** | **Polychaeta** |
| *Cuspidaria cuspidata* | *Sepiola rondeletii* | *Gammarus subtypicus*** | *Sphaerosyllis* sp. |
| *Donacilla cornea* | *Solen marginatus* | *Gastrosaccus sanctus* ** | *Arabella iricolor* ** |
| *Donax semistriatus* ** | *Spisula subtruncata* | *Harpackoid* sp | *Phyllodocidae (sp).* |
| *Donax trunculus* | *Thracia phaseolina* ** | *Hyale schmidti* ** | *Nephtys cirrosa* ** |
| *Donax variegatus* | *Tricolia pullus* | *Gammarus subtypicus* ** | *Micronephthys stammeri* ** |
| *Enginella leucozona* ** | *Tricolia speciosa* ** | *Homalopoma sanguineum* ** | *Glycera* sp. |
| *Epitonium* sp. | *Tritia incrassata* ** | *Hyale* sp. | *Lumbrinerides amoureuxi* ** |
| *Eulima glabra* | *Tritia mutabilis* ** | *Idotea balthica* | *Schistomeringos neglecta* ** |
| *Gibbula* sp | *Tritia neritea* ** | *Leucothoe spinicarpa* ** | *Protodorvillea kefersteini* |
| *Haliotis tuberculata* | *Tritia neritea* ** | *Liocarcinus depurator* | *Saccocirrus* sp. |
| *Hiatella arctica* | *Turbonilla* sp | *Lysianassa costae* ** | *Spio filicornis* ** |
| *Hiatella rugosa* | *Turritella communis* | *Macropodia rostrata* | *Platynereis dumerilii* |
| *Loripes orbiculatus* ** | *Vexillum ebenus* | *Microdeutopus algicola* | *Fabricia* sp. |
| *Lucinella divaricata* | *Vexillum granum* ** | *Microdeutopus* sp | *Pisione* sp. |
| *Mactra stultorum* ** | **Echinodermata** | *Microdeutopus versiculatus* ** | *Magelona mirabilis* ** |
| *Mangelia callosa* ** | *Echinocardium cordatum* | *Monoculodes* sp | **Spinculoid** |
| *Mangelia costulata* ** | | *Mysid* sp | *Aspidosiphon muelleri* |

| LAKE SPECIES | | | |
|---|---|---|---|
| **Oligochaeta** | **Amphipoda** | **Insecta** | |
| *Tubifex* sp. | *Gammarus* sp. | *Chironomus plumosus* | *Microtendipes chloris* |
| *Stylaria lacustris* | *Gammarus komareki* | *Stictochironomus* sp. | *Crocothemis erythraea* |
| *Nais bretscheri* | **Isopoda** | *Cricotopus bicinctus* | *Ischnura elegans* |
| *Limnodrilus hoffmeisteri* | *Idothea baltica* | *Procladius (Holotanypus)* sp. | Coenagrienidae |
| *Dero digitata* | *Asellus aquaticus* | *Chironomus riparius* | *Caenis* sp. |

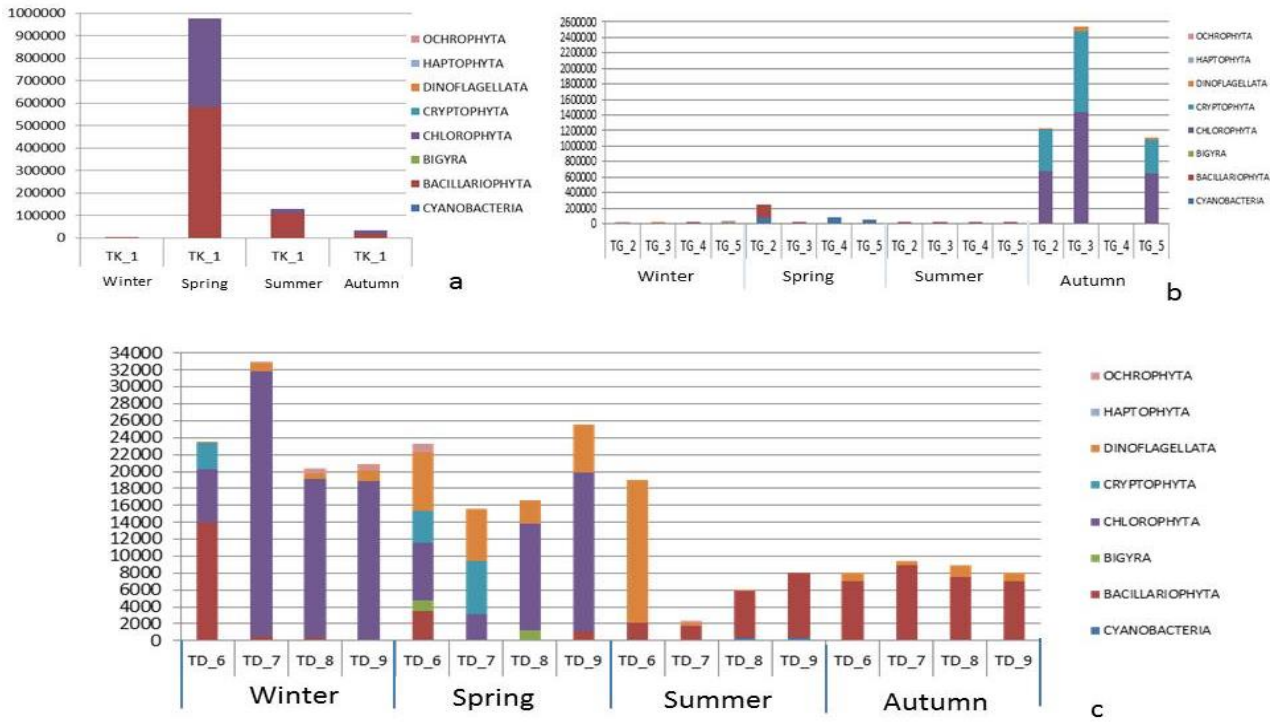


**FIGURE 2**
**Phytoplankton abundance and variation in the water samples from the study area.**
**a) lotic, b) lentic, c) marine**

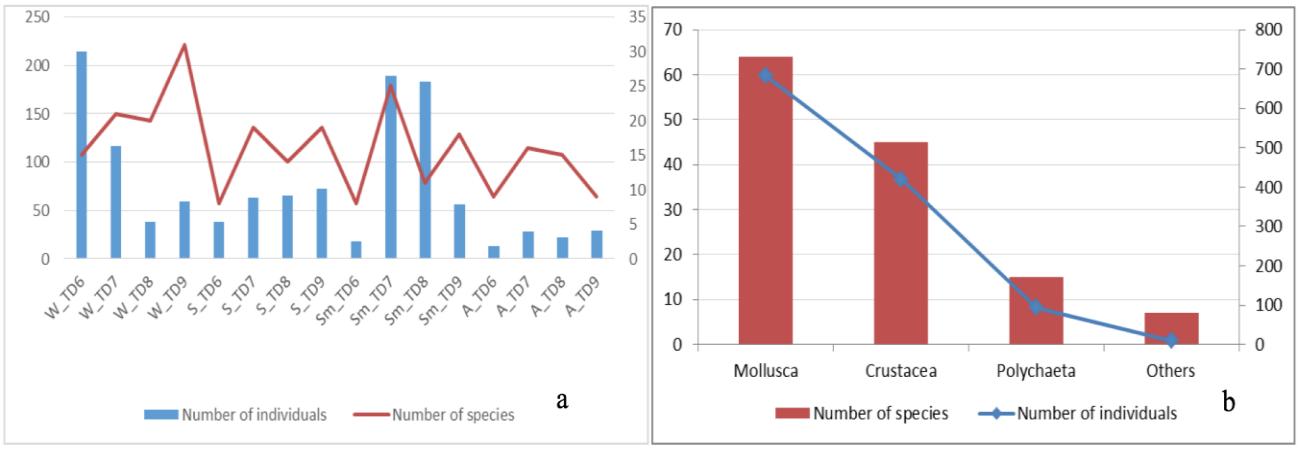


**FIGURE 3**
**Marine macrozoobenthos a) Seasonal distribution of the individual and species numbers at the sampling stations b) The number of individual and species numbers of the marine macrozoobenthos**

According to the results, we found 2 taxa in the summer sampling, 4 taxa in the winter sampling, 10 taxa in the spring sampling, 16 taxa in the autumn sampling (Table 5). We found cross-larval chironomids only in the spring sampling. At the sampling stations, station TK1 was the richest location with 15 taxa during the sampling period, followed by station TG2 with 5 taxa and stations TG4 and TG5 with 3 taxa. According to the individual site results, station TK1 was also found to be the richest (155 individuals $m^{-2}$) followed by the others with 22 individuals $m^{-2}$. The specimens belonging to Oligochaeta were found at all sampling stations in all seasons except summer. However, the group Amphipoda was found only at three stations (TG2, TG4 and TG5) and the group Isopoda was found only at stations TK1 and TG4. The larval chironomids were the most dominant group belonging to Insecta. This group was followed by Odonata and Ephemeroptera. The specimens belonging to Gastropoda were found only at station TK1 (Table 5). Although the shells of Ostracoda were recognized, they were not identified.

**TABLE 5**
**The seasonal distributions of benthic macroinvertebrates from lotic and lentic biotopes (individuals/m2)**
***diagnostik characters are damaged **juvenile forms**

| SUMMER | | | | | | | AUTUMN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Taxa↓ | Station → | TK1 | TG2 | TG3 | TG4 | TG5 | Taxa ↓ | Station → | TK1 | TG2 | TG3 | TG5 |
| INSECTA | *Chironomus plumosus* | - | 44 | - | - | - | OLIGOCHAETA | *Tubifex* sp. | 288** | - | - | - |
| | *Stictochironomus* sp. | 66** | - | - | - | - | | *Limnodrilus hoffmeisteri* | 200 | - | - | - |
| | **Total** | 66 | 44 | 0 | 0 | 0 | | *Dero digitata* | 88 | - | - | - |
| SPRING | | | | | | | ISOPODA | *Asellus aquaticus* | 2777 | - | - | - |
| Taxa↓ | Station → | TK1 | TG2 | TG3 | TG4 | TG5 | | Chironomidae | 25** | - | - | - |
| OLIGOCHAETA | | 22* | - | - | - | - | | *Chironomus plumosus* | 222 | - | - | - |
| | *Stylaria lacustris* | - | 66 | - | - | - | | *Procladius (H. )* sp. | 155 | - | - | - |
| | *Nais bretscheri* | - | 66 | - | - | - | | *Chironomus riparius* | 22 | - | - | - |
| AMPHIPODA | *Gammarus* sp. | - | 22* | - | - | 222** | INSECTA | *Microtendipes chloris* | 88 | - | - | - |
| | *Gammarus komareki* | - | - | - | 333 | - | | *Crocothemis erythraea* | 44 | - | - | - |
| ISOPODA | *Idothea baltica* | - | - | - | 22 | - | | *Ischnura elegans* | 44 | - | - | - |
| | *Asellus aquaticus* | 44 | - | - | - | - | | Coenagrienidae | 44** | - | - | - |
| INSECTA | *Chironomus plumosus* | - | - | - | - | 22 | | *Caenis* sp. | 44* | - | - | - |
| | *Stictochironomus* sp. | 444 | 22 | - | - | - | GASTROPODA | Bithyniidae | 177** | - | - | - |
| | *Cricotopus bicinctus* | - | - | - | - | 266 | | Planorbidae | 200** | - | - | - |
| | **Total** | 510 | 176 | 0 | 355 | 510 | | **Total** | 4506 | 0 | 0 | 0 |
| WINTER | | | | | | | | | | | | |
| Taxa↓ | Station → | TK1 | TG2 | TG3 | TG4 | TG5 | | | | | | |
| OLIGOCHAETA | *Tubifex* sp. | 155* | - | - | - | - | | | | | | |
| AMPHIPODA | *Gammarus* sp. | - | - | - | - | 22* | | | | | | |
| INSECTA | *Chironomus plumosus* | - | 22 | - | - | - | | | | | | |
| | *Stictochironomus* sp. | - | - | - | 22** | - | | | | | | |
| | **Total** | 155 | 22 | 0 | 22 | 22 | | | | | | |

**Fish.** Fish samples collected from the sea (TD6 & TD8) resulted in 28 individuals belonging to four species (Table 6). *Arnoglossus laterna* had the highest individual number. Additionally, *Trachinus draco* was grouped as "common" in the results of the frequency index.

**Amphibian and Reptiles.** Three amphibian species were found at the Salt Lake in Gökçeada during the sampling period (Table 6). The Marsh Frog (*Pelophylax ridibundus*) has been observed in all rivers and streams around the lake at the beginning of spring and at the beginning of winter. The nightly frog (*Bufotes variabilis*), a terrestrial species, was found in the areas close to the settlements and was encountered throughout nearly the entire sampling period except winter. Tree frog (*Hyla orientalis*) was more frequently observed in vegetative wetlands, during spring and summer. Twelve reptile species (2 turtles, 3 lizards, 7 snakes) were found on the Salt Lake (Table 6). No mammals were observed.

**Birds.** As a result of the 12-month bird watching study, 71 bird species were identified on and around the Salt Lake (Table 6). Flamingo could not be observed in August, July and September 2016 because the Salt Lake was almost completely dry (Figure 4). Windsurfing was observed in the lake during the bird monitoring studies on April 24, 2016. On the same date, gull eggs and pups were also recorded around the lake.

## DISCUSSION

Inland, marine and terrestrial ecosystems are under global pressure from human impacts in various forms, i.e. pollution, habitat degradation, urbanization, etc. A better understanding of the biodiversity is urgently needed to mitigate the human impacts through effective conservation and

**TABLE 6**

**The list of vertebrate species observed Gokceada Salty Lake Wetlands and around biotopes and their IUCN Status (NE: Not Evaluated, DD: Data Deficient, LC: Last Concern, NT: Near Threatened, VU: Vulnarable, EN: Endangered)**

| Family / Species | IUCN | Family / Species | IUCN | Family / Species | IUCN | Family / Species | IUCN |
|---|---|---|---|---|---|---|---|
| **(PISCES)** | | *Platyceps najadum* (Eichwald, 1831) | LC | **(AVES)** | | **Muscicapidae** | |
| **Bothidae** | | *Malpolon insignatus* (Geoffroy 1809) | LC | **Podicipedidae** | | *Ficedula parva* (Bechstein, 1792) | LC |
| *Arnoglossus laterna* (Walbaum. 1792) | LC | *Zamenis situla* (Linnaeus, 1758) | LC | *Podiceps cristatus* (Linnaeus, 1758) | LC | *Ficedula semitorquata* (Homeyer, 1885) | LC |
| **Gobiidae** | | *Natrix natrix* Linnaeus, 1758 | LC | **Phalacrocoracidae** | | *Erithacus rubecula* (Linnaeus, 1758) | LC |
| *Deltentosteus quadrimaculatus* (Valenciennes. 1837) | NE | **Scolopacidae** | | *Phalacrocorax aristotelis* (Linnaeus, 1761) | LC | *Luscinia megarhynchos (Brehm, 1831)* | LC |
| **Trachinidae** | | *Calidris alba* (Pallas, 1764) | LC | **Ardeidae** | | *Oenanthe oenanthe* (Linnaeus, 1758) | LC |
| *Trachinus draco* Linnaeus. 1758 | LC | *Calidris minuta* (Leisler, 1812) | LC | *Egretta garzetta* (Linnaeus, 1766) | LC | *Oenanthe hispanica* (Linnaeus, 1758) | LC |
| Rajidae | | *Calidris alpina* (Linnaeus, 1758) | LC | *Ardea alba* Linnaeus, 1758 | LC | **Turdidae** | |
| *Raja radula* Delaroche. 189 | EN | *Gallinago gallinago* (Linnaeus, 1758) | LC | *Ardea cinerea* Linnaeus, 1758 | LC | *Turdus merula* Linnaeus, 1758 | LC |
| **(AMPHIBIA)** | | *Numenius arquata* (Linnaeus, 1758) | NT | **Phoenicopteridae** | | *Turdus pilaris* Linnaeus, 1758 | LC |
| **Bufonidae** | DD | *Tringa totanus* (Linnaeus, 1758) | LC | *Phoenicopterus ruber* Linnaeus, 1758 | LC | **Paridae** | |
| *Bufotes variabilis* (Pallas, 1769) | | *Tringa nebularia* (Gunnerus, 1767) | LC | **Anatidae** | | *Cyanistes caeruleus* (Linnaeus, 1758) | LC |
| **Hylidae** | | **Laridae** | | *Cygnus cygnus* (Linnaeus, 1758) | LC | *Parus majör* Linnaeus, 1758 | LC |
| *Hyla orientalis* Bedriaga, 1890 | LC | *Larus audouinii* Payraudeau, 1826 | LC | *Tadorna ferruginea (Pallas, 1764)* | LC | **Laniidae** | |
| **Ranidae** | | *Larus michahellis* J.F. Naumann, 1840 | LC | *Tadorna tadorna* (Linnaeus, 1758) | LC | *Lanius collurio* Linnaeus, 1758 | LC |
| *Pelophylax ridibundus* (Pallas, 1771) | LC | **Columbidae** | | *Anas penelope* Linnaeus, 1758 | LC | **Corvidae** | |
| **(REPTILIA)** | | *Streptopelia turtur* (Linnaeus, 1758) | VU | *Anas platyrhynchos* Linnaeus, 1758 | LC | *Garrulus glandarius* (Linnaeus, 1758) | LC |
| Geoemydidae | | **Meropidae** | | *Aythya ferina* (Linnaeus, 1758) | VU | *Corvus monedula* Linnaeus, 1758 | LC |
| *Mauremys rivulata* (Valenciennes, 1833) | - | *Merops apiaster* Linnaeus, 1758 | LC | **Accipitridae** | | *Corvus cornix* (Linnaeus, 1758) | LC |
| **Testudinidae** | | **Picidae** | | *Circus aeruginosus* (Linnaeus, 1758) | LC | *Corvus corax* Linnaeus, 1758 | LC |
| *Testudo graeca* Linnaeus, 1758 | VU | *Dendrocopos syriacus* (Ehrenberg, 1833) | LC | **Haematopodidae** | | **Sturnidae** | |
| **Lacertidae** | | **Sylviidae** | | *Haematopus ostralegus* Linnaeus, 1758 | NT | *Sturnus vulgaris* Linnaeus, 1758 | LC |
| *Ophisops elegans* Ménétries, 1832 | - | *Acrocephalus scirpaceus* (Herman, 1804) | LC | **Recurvirostridae** | | **Passeridae** | |
| **Gekkonidae** | | *Sylvia cantillans* (Pallas, 1764) | LC | *Himantopus himantopus* (Linnaeus, 1758) | LC | *Passer domesticus* (Linnaeus, 1758) | LC |
| *Hemidactylus turcicus* (Linnaeus, 1758) | LC | *Sylvia melanocephala* (Gmelin, 1789) | LC | *Recurvirostra avosetta* Linnaeus, 1758 | LC | **Fringillidae** | |
| **Anguidae** | | *Sylvia curruca* (Linnaeus, 1758) | LC | **Charadriidae** | | *Fringilla coelebs* Linnaeus, 1758 | LC |
| *Pseudopus apodus* (Pallas, 1775) | LC | *Sylvia communis* Latham, 1787 | LC | *Charadrius dubius* Scopoli 1786 | LC | *Chloris chloris* (Linnaeus, 1758) | LC |
| **Typhlopidae** | | *Sylvia atricapilla* (Linnaeus, 1758) | LC | *Charadrius hiaticula* Linnaeus, 1758 | LC | *Carduelis carduelis* (Linnaeus, 1758) | LC |
| *Xerotyphlops vermicularis* (Merrem, 1820) | - | *Phylloscopus collybita (Vieillot, 1817)* | LC | *Charadrius alexandrinus* Linnaeus, 1758 | LC | | |
| **Boidae** | | **Emberizidae** | | *Pluvialis apricaria* Linnaeus, 1758 | LC | | |
| *Eryx jaculus* (Linnaeus, 1758) | LC | *Emberiza cirlus* Linnaeus, 1766 | LC | *Pluvialis squatarola* (Linnaeus, 1758) | LC | | |
| **Colubridae** | | *Emberiza hortulana* Linnaeus, 1758 | LC | **Troglodytidae** | | | |
| *Dolichophis caspius* (Gmelin, 1789) | - | *Emberiza schoeniclus* (Linnaeus, 1758) | LC | *Troglodytes troglodytes* (Linnaeus, 1758) | LC | | |
| | | *Emberiza calandra* | LC | | | | |

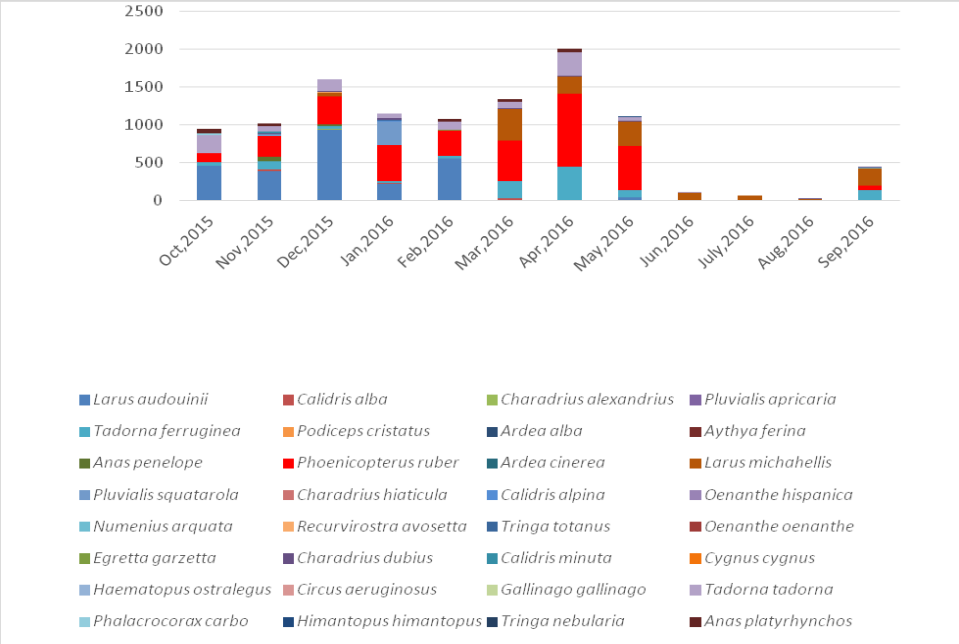


**FIGURE 4**
**The abundance of the aquatic birds observed montly in the study area**

management actions. The wetlands are the most significant ecosystems on Earth in respect to their natural function and economic benefits. Despite their natural and economic importance, they have faced detrimental human impacts throughout the last century in Turkey [46]. The Gökçeada Salt Lake Wetland encounters multiple serious problems such as increased human interaction, especially during summer, from surfing activities that result in physical and some environmental impacts. Assessing the state of the area's biodiversity gives us the ability to understand the actual situation of the wetlands and the dimension of threats the species are facing. Monitoring of the biodiversity is essential to emphasize the importance of these areas. The main point of this study is to describe the present state of the biodiversity of Gökçeada Salt Lake Wetlands.

In this study, while a total of 195 terrestrial vascular plant taxa were identified from Gökceada Salt Lake Wetland and its surroundings, 97 taxa were identified in the phytoplankton of lentic (TG2, TG3, TG4 and TG5), lotic (TK1) and coastal marine stations of Gökçeada Salt Lake. This aquatic flora belongs to Cyanobacteria (2), Bacillariophyta (56), Bigyra (1), Chlorophyta (11), Cryptophyta (4), Dinoflagellata (21), Haptophyta (1) ve Ochrophyta (1). In the lotic station, the most abundant phytoplankton groups were chlorophyes and diatoms, while chlorophytes and cryptophytes were dominant in lentic stations. Chlorophytes and dinoflagellates in the first half of the year and the diatoms in the second half were the most abundant groups of coastal marine phytoplankton. Benthic algae consisted of 37 taxa from the lotic and lentic sampling stations of Gökçeada Salt Lake. Among those taxa, the most abundant and common species were the species *E. sorex* in the first half of the sampling period and *G. acuminatum* in the second half. Benthic algal composition of the Salt Lake included the common diatom species, which are resistant to the dramatic salinity variations and eutrophic conditions. This is the first study including a detailed benthic algal flora (37 taxa) of the Gökçeada Salt Lake, although Bassler-Veit et al., [31] observed four epizoic *Cocconeis placentula* varieties on the shells of *Loxoconcha elliptica* Brady.

Macroinvertebrates are reported as an important group of organisms, which are found in sediment beneath the water column and act as key components in any aquatic ecosystem [9]. Furthermore, the invertebrate communities of the Salt Lake wetlands are more diverse than expected [47]. In this study of the aquatic invertebrates, a total of 23 macrobenthic species from lotic and lentic biotopes and 131 species from the marine biotope were identified. The station TK1 was found to be the richest location with 15 taxa during the sampling period while the highest taxa were found in the autumn sampling with 16 taxa found in the lake. Oligochaeta was found predominantly at the station TK1, related to its freshwater feature. *Gammarus komareki*, Amphipoda, usually known from unpolluted water resources, was not found in the station TK1. In this study, Isopoda was presented by the species *Asellus aquaticus*, commonly known from freshwater ecosystems, and the species *Idothea baltica*, known from brackish waters. Chironomidae was a dominant group in the lake with 5 taxa. Two species *Chironomus plumosus* and *C. riparius* are known as indicator species for eutrophic ecosystems [48]. The low individual numbers belonging to

Odonata and Ephemeroptera supported the findings on organic loads. In this study, we observed only two species belonging to Odonata nymphs (*Crocothemis erythraea* and *Ischnura elegans*) and two taxa belonging to Ephemeroptera (Coenagrienidae and *Baetis* sp.). The other specimens belong to popular indicator groups for wetland ecosystems like Plecoptera and Trichoptera, which were not observed in the sampled aquatic ecosystem. These groups are known from nonpolluted areas. The results belonging to the benthic macro invertebrates in the lake show that the organic load entering the lake should be controlled. In the previous Gökçeada Salt Lake study, three Gastropod species (*Hydrobia ulvae*, *Bittium latreilli*, and *Bittium* sp.) and two Bivalve species (*Cerastoderma glaucum, Scrobicularia plana*) were reported [31]. In our current study, only two taxa belong to Gastropoda (Bithynidae and Planorbiidae) are being reported. Many shells of Ostracoda were observed in the study area, but they were not evaluated quantitatively.

Viaroli et al. [49] emphasizes the lack of information comprising the relationship between river–wetland connectivity as a driver of zooplankton and macroinvertebrate communities. This study includes macroinvertabrates but zooplankton could not be studied which are often neglected in wetland studies [49]. Also, Brraich and Kaur [9] indicate that moderately polluted wetlands affect the occurrence of benthic macroinvertebrates.

Gönülal and Güreşen [24] reported 685 marine species from Gökçeada Island, except Peracarida and Polychaeta groups. Although only 131 species were found in this study due to the small sampling area and small tools, 71 species of them are newly recorded for marine fauna of Gökçeada Island.

In addition, 4 fishes, 12 reptilian species and 3 amphibian species were observed in the study area. According to the literature [26-29], 14 reptile species (3 turtles, 3 lizards, 8 snakes) are known from Gökçeada. But, 2 of those reptile species, *Emys orbicularis, Montivipera xanthina* species are not found in Salt Lake. A total of 143 bird species [30] and 178 bird species [32] were reported in Gökçeada. There is no detailed ornithological study at the Salt Lake. In this study, 71 bird species were observed during the sampling period. In fact, flamingos can be observed all year (except during the lake's dry season). However, human activities such as hunting, surfing and mud baths have negative effects on this area, preferred by flamingos. Almost 50 dead flamingos were also recorded during the bird watching.

Sulaiman et al. [8] reported that bird abundance and diversity is fundamentally affected by attributes of wetland size and type. Datry et al. [50] mentioned that the habitat mosaics, including the lotic, lentic and terrestrial, should make scientists responsible for integrating the concepts, understanding these ecosystems and managing them. In this sense, this study contributes to this opinion and includes marine wetland habitats. This study builds upon the central concept in ecology of disturbance, which is widely known to affect from populations to ecosystems [52].

Even though the present study reported a rich biodiversity despite the current human impacts in the Gökçeada Salt Lake, the area urgently needs protection through an effective conservation and management due to its importance to the island's biodiversity. Pollution may lead to the elimination of some macrobenthos while some may remain abundant due to higher tolerance to new conditions. Coastal areas have a high value in terms of biodiversity. Furthermore, these areas have a great appeal for tourism with potential for "eco-tourism." Therefore, wetlands are in a difficult situation stuck between ecological and management processes. Pérez-Ruzafa et al. [11] recommend developing close contact between researches and municipalities. Consequently, the composition of the communities in Gökçeada Salt Lake Wetland is a reflection of the health of the overall area. We hope this information can be used to design further strategies on conservation and management programmes. For a sustainable ecosystem, a management plan will be necessary in light of scientific wetlands research. As a conclusion, wetlands which are known as the most sensitive areas for biological diversity in the world, need to be protected by humans.

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