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New records for the freshwater algal flora of Turkey

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Abstract

The algal samples were taken from Koçdüzü Great Lake on 21 August 2019 and from Adsız Pond on 28 August 2020. The algal samples were collected from epipelic and epiphytic habitats and observed under light microscope for their morphometric characteristics based identification. *Palmodictyon varium* (Nägeli) Lemmermann (Chlorophyta) and *Isthmochloron trispinatum* (West & G.S.West) Skuja (Ocrophyta) species were assessed as a new records for the freshwater algal flora of Turkey. In this paper, morphotaxonomy, ecology, and geographic distribution of each species is discussed in detail and it has been also recorded the geographic distribution of the species in Turkey.

Keywords: Chlorophyta, Ochrophyta, new record, high mountain lakes, Turkey

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Türkiye'nin tatlısu alg florası için yeni kayıtlar

Özet

Alg örnekleri 21 Ağustos 2019'da Koçdüzü Büyük Gölü'nden ve 28 Ağustos 2020'de Adsız Gölet'ten alınmıştır. Alg örnekleri epipelik ve epifitik habitatlardan toplanmış ve morfometrik özelliklerine dayalı tanımlamaları için ışık mikroskobunda gözlemlenmiştir. *Palmodictyon varium* (Nägeli) Lemmermann (Chlorophyta) ve *Isthmochloron trispinatum* (West & G.S.West) Skuja (Ocrophyta) türleri Türkiye tatlısu alg florası için yeni kayıt olarak değerlendirilmiştir. Bu yazıda her bir türün morfotaksonomisi, ekolojisi ve coğrafik yayılışları ayrıntılı olarak ele alınmış ve türlerin Türkiye'deki coğrafi yayılışları da kaydedilmiştir.

Anahtar kelimeler: Chlorophyta, Ochrophyta, yeni kayıt, yüksek dağ gölleri, Türkiye

1. Introduction

Benthic algae are important primary producers in all aquatic environments. They are chemical modulators in aquatic ecosystems. They transform many inorganic chemicals into organic forms. Benthic algae on the surface and plants are considered to be important sinks for nutrients. In addition, they can also be important habitats for many other organisms. Therefore, to investigate benthic algae provide important contributions to the understanding of the lake ecosystem [1].

High mountain lakes formed during the ice age, therefore, they are young ecosystems and the most similar to each other between ecosystems on earth. High mountain lakes are usually small, not very deep, species poor, and characterized by a simple food web. They are, therefore, generally easier to understand than other ecosystems. Also, in terms of nutrient poor water, snow and ice layers, high radiation and limited light in the high mountain lakes provides extreme living conditions for organisms. High mountain lakes are very sensitive to environmental changes and have been used since the 1980s as early warning systems. Therefore, high mountain lakes are considered the most important indicators of environmental changes in the past and present. Despite being away from agricultural and industrial pollution, high mountain lakes are under threat of acid rain, toxic air pollutants and climate change [2, 3, 4].

High mountain lakes in Turkey are predominantly located in the Eastern Black Sea Region. The studies carried out in these lakes revealed the existence of a rich algal flora in the region and made significant contributions to Turkey's freshwater algal flora [5, 6-13, 14-17]. However, there are still many lakes with unknown algal flora in the region.

The goal of this study is to make taxonomic definitions of taxa and to give information about their ecological preferences and distributions in the studied area.

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2. Materials and methods

2.1. Study area

Rize is located in the Eastern Black Sea Region (Figure 1a). The climate of the Rize is generally cool in summers and temperate in winters and rainy in all seasons (annual means temperature 14.3 oC, annual precipitation 2254.4 mm) [18]. Rize is most famous for its high number of endemic plant and animal species. Terrestrial vegetation is composed of trees, shrubs and herbs, including genera *Abies*, *Astragalus*, *Campanula*, *Fagus*, *Geranium*, *Picea*, *Pinus*, *Ranunculus*, *Trifolium*, *Veronica* and *Vicia* [19]. *Tetraogallus caspius*, *Vipera kaznakovi* and *Ursus arctos* are among the animals found in the Rize [20]. Rize province is located in the Eastern Black Sea Mountain System. There are many glacial lakes in these mountains, which are over 3500 meters high (for example, the Kaçkar Mountains (3937 m). Koçdüzü Great Lake and Adsız Pond are located within the borders of Çamlıhemşin district (Figure 1b, c). Koçdüzü Great Lake is located at 41º00'15" N – 41º11'53" E coordinates. It has 8.1896 hectares of surface area [21]. Adsız Pond is not located in google earth, so its coordinates and surface area could not be determined.

2.2. Sampling and laboratory studies

Epiphytic samples were collected by squeezing out the macrophytes (*Potamogeton* sp. and *Juncus* sp.) from Koçdüzü Great Lake on 21 August 2019. Epipelic samples were taken with a one meter long and 0,8 cm diameter glass tube from the surface of the sediments of the Adsız Pond on 28 August 2020 [22, 23]. All samples were fixed in solution of 4% formaldehyde. Temperature, dissolved oxygen, conductivity and pH values of the waters were measured in the field using Thermo Orion-4-Star pH and YSI-55 portable devices. The temporary slides prepared in the laboratory were examined and photographed using a Leica DM 2500 light microscope and a Leica MC170 HD camera attached to it.

For taxonomic identification Schmidle [24]; Prescott [25]; Dillard [26]; Lenzenweger [27] and John et al. [28] books and articles were used. The species were checked using the freshwater algae checklist of Turkey [29] and the algae of Turkey database [30]. The current status of nomenclature of the species identified has been checked in the Algaebase website [31].

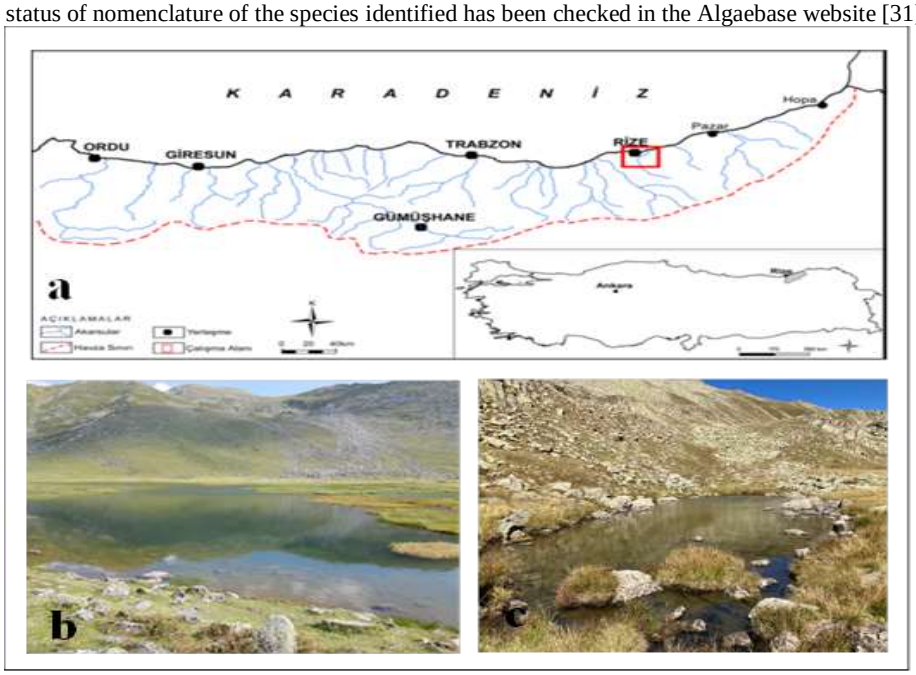

Figure 1. a. The location of the study area [17], b. Koçdüzü Great Lake, c. Adsız Pond [Photos: Şahin]

3. Results

At the end of the study, two new records species for the freshwater algal flora of Turkey were identified from epipelic and epiphytic algae samples taken from Koçdüzü Great Lake and Adsız Pond. The species belong to the Chlorophyta (1) and Ochrophyta (1) divisions.

Phylum: Chlorophyta
Subphylum: Chlorophytina
Class: Chlorophyceae
Order: Sphaeropleales
Family: Radiococcaceae
Genus: Palmodictyon
Palmodictyon varium (Nägeli) Lemmermann (Figure 2a, b, c)
Prescott, 1962, p. 85, pl. 4, figs 3,4.
Dillard, 1989, p. 62, pl. 16, fig. 4.
John et al., 2003, p. 376, pl. 99, fig. R.
Basionym: *Palmodactylon varium* Nägeli
Homotypic synonym: *Palmodactylon varium* Nägeli 1849
Heterotypic synonym: *Palmodactylon subramosum* Nägeli 1849.
Dimensions: The diameter of the cells is 8.55 µm, the width of the thallus is 37.38 µm.

Description: Thallus is an unbranched, non-lamellate mucilaginous tube (Figure 2a). It contains spherical cells in a single row or grouped (Figure 2b, c). Chloroplasts are disc-shaped and without pyrenoid.

Ecology: This species occurs in peaty ditches, bog pools and in lakes, which have soft waters. It was found in the epipelic samples of the Adsız Pond.

Distribution: (as *Palmodactylon subramosum* Nägeli) Europe: Ireland, Slovakia, South America: Brazil, Australia and New Zealand: Queensland, (as *Palmodactylon varium* Nägeli) Aurope: Ireland, Slovakia, Australia and New Zealand: Queensland, (as *Palmodictyon varium* (Nägeli) Lemmermann) Europe: Britain, Bulgaria, Czech Republic and/or Slovakia, Georgia, Germany, Netherlands, Portugal, Romania, Scandinavia, Slovakia, Spain, Ukraine, North America: Laurentian Great Lakes, Michigan, Northwest Territories, Québec, Wisconsin, South America: Argentina, Uruguay, Africa: Zimbabwe, Middle East: Iraq, South-west Asia: India, Asia: Japan, Russia (Far East) [31].

Phylum: Ochrophyta
Class: Xanthophyceae
Order: Mischococcales
Family: Pleurochloridaceae
Genus: Isthmochloron
Isthmochloron trispinatum (West & G.S.West) Skuja (Figure 2d)
Schmidle, 1895, p. 350, pl. 15, figs 9a, b.
Lenzenweger, 1997, p. 8, pl. 18, figs 8, 9.
Basionym: *Arthrodesmus trispinatus* West & G.S.West.

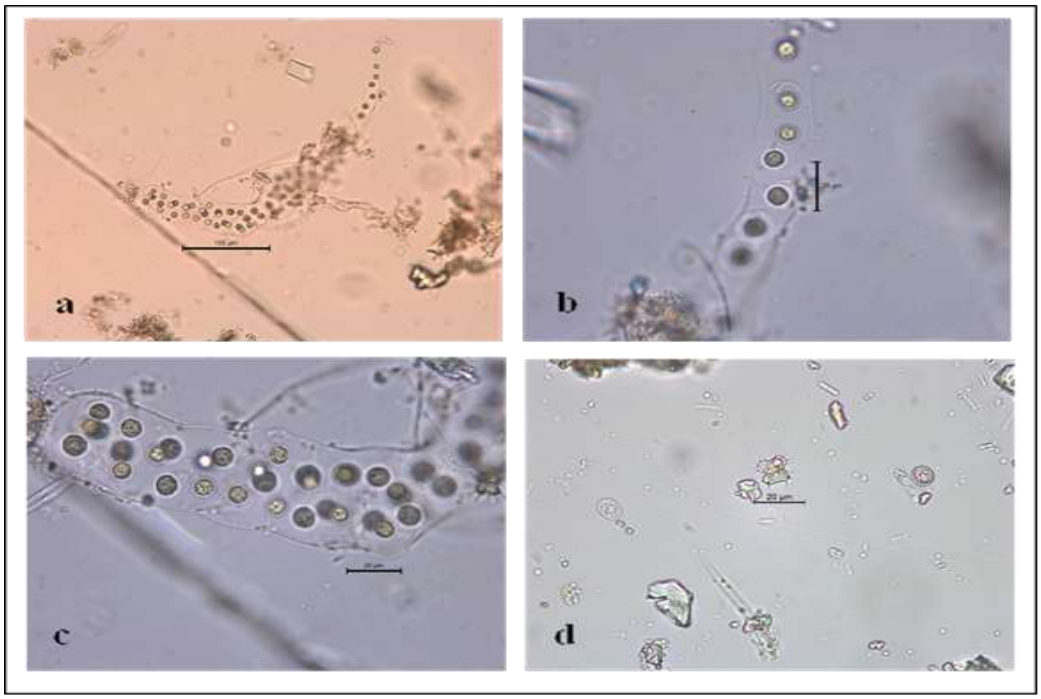

Figure 2. a,b,c. *Palmodictyon varium*, d. *Isthmochloron trispinatum*.

Homotypic synonyms: *Arthrodesmus trispinatus* West & G.S.West 1902, *Xanthidium trispinatum* (West & G.S.West) Deflandre 1929, *Pseudostaurastrum trispinatum* (West & G.S.West) Skuja) 1960, *Octacanthium trispinatum* (West & G.S.West) Compère 1996.

Dimensions: Length: 10.81 µm, Breadth: 11.22 µm.

Description: Cells are small and about as wide as long. Semicells approximately square in outline. The lateral margins of the semicell are slightly convex, the cell apices straight or flat concave. Apical angles are broadly rounded and have 4 spines. The central incision on the inside is narrowly rounded, wide open to the outside.

Remarks: The taxonomic position of this species is unclear. It was first described from the Austrian Alps by Schmidle [24], and its first name is *Xanthidium alpinum*. But later authors suggested that it may not be a desmid but rather belongs to a very different group of algae and the correct name indeed is *Isthmochloron trispinatum* [27, 32].

Ecology: It was described from peatlands in the Ötztaler Alpen (T) (1900 m a.s.l.) by Schmidle [24]. It has also been reported from *Sphagnum* pools in the Austrian Alps (1700 m a.s.l.) [27]. In this study, it was found in the epiphytic samples of the Koçdüzü Great Lake, which has pH 8.45 value. The Koçdüzü Great Lake is located at an elevation of 2382 m a.s.l.

Distribution: (as *Arthrodesmus trispinatus* West & G.S.West) Europe: Britain, Ireland, Italy, Latvia, Slovakia, (as *Xanthidium trispinatum* (West & G.S.West) Deflandre) Asia: Russia, (as *Isthmochloron trispinatum* (West & G.S.West) Skuja) Europe: Britain, Germany, Netherlands, Scandinavia, Slovakia, Spain, Sweden, North America: Québec, (as Pseudostaurastrum trispinatum (West & G.S.West) Skuja) Europe: Spain, (as *Octacanthium trispinatum* (West & G.S.West) Compère) Europe: Spain, Ukraine [31].

4. Conclusions and discussion

In this study, two newly recorded species were reported for the freshwater algal flora in Turkey. Although the results of the research are of a qualitative nature, they provide basic data on the biogeographical distribution of the species.

The fact that Turkey has different geographical and climatic conditions causes a rich diversity of freshwater algae as well as terrestrial biodiversity. High mountain lakes, which are far from human influence, appear as important habitats in this regard. We are of the opinion that the number of new recorded species will increase as the number of algae studies carried out in high mountain lakes increases.

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