

Contributions to Akçaabat (Trabzon) fern flora in Türkiye

Ceyda Demirtaş

Nevzat Batan¹

Karadeniz Technical University, Faculty of Sciences, Department
of Molecular Biology and Genetics, Trabzon, 61080, Türkiye

Zeynep Gizem Yılmaz

Karadeniz Technical University, Institute of Science, Department
of Biology, Trabzon, 61080, Türkiye

Huseyin Erata

Gümüşhane University, Kürtün Vocational School, Gümüşhane,
29810, Türkiye

Abstract: In this study, the fern flora of Akçaabat district in Sera Lake Nature Park, which is important in terms of socio-economic contributions to Trabzon province, was evaluated. The ferns were collected from the nature park in 2024 and their various morphological features including leaves and stems were studied in the laboratory. The identification was done using the determination keys on the known floras. Specimens were identified as seven species belonging to the families Aspleniaceae (*Asplenium scolopendrium* L., *A. trichomanes* L., *A. adiantum-nigrum* L.), Polypodiaceae (*Polypodium vulgare* L.), Equisetaceae (*Equisetum arvense* L.), Pteridaceae (*Pteridium aquilinum* (L.) Kuhn), Dennstaedtiaceae (*Adiantum capillus-veneris* L.). Sporangium and spore structures of ferns were studied in detail for the first time in the country.

Keywords: biodiversity, pteridophyta, SLNP, species, sporangium, spore

INTRODUCTION

The ferns (Polypodiophyta) are known as non-flowering plants represented by about 265-300 genera and 10900-11100 species in the world, with a fragmented leaf structure [Smith et al., 2006; Sarıgül, 2018.; Kaynak et al., 2022]. Their history dates back to ancient times, approximately 300 million years ago. This plant group first appeared during the Devonian and diversified significantly into tree-like forms during the Carboniferous, which is considered as the peak of plant evolution. With the onset of the Carboniferous period, the Earth's humid climate facilitated the widespread distribution of ferns. Therefore, this period

is often referred to as the “Age of Ferns” [Rothwell Stockey, 2008]. The fern forests of the Carboniferous period are regarded to be the source of coal deposits.

Ferns with a broad distribution are found in nearly every habitat except deserts and polar regions, except the genera like *Hemionitis* L. (Syn: *Cheilanthes* Sw.) and *Woodsia* R.Br. [Akkaya, 2005; Sarıgül, 2018; Sefalı, 2022]. Ferns and their relatives have spread worldwide because their spores are small and weigh approximately 0.01 mg [Mehlreter et al., 2010, Esaete et al., 2014, Bodur, 2015]. Geologically, this group of plants is among the oldest vascular plants, possessing vessels in their roots, stems, and leaves which facilitate the transport of nutrients and water, however, today they are not the dominant plant group [Tütüncü, 2006; Kambek, Ertürk, 2006; Sarıgül, 2018; Sefalı, 2022].

In the earlier studies, the number of fern species recorded in the flora of Türkiye was 93 [Davis, 1965]. Subsequent studies by other researchers has increased the number of taxa to 101 [Sarıgül, 2018].

The Sera Lake Nature Park (SLNP) is located approximately 13 km from the city center, situated within the boundaries of Yıldızlı in Akçaabat district (Fig. 1). The study area was chosen due to its proximity to the city center, presence of water, richness of vegetation. Tourism potential, and recreational opportunities of the area was also considered. The lake was formed as a result of a natural event, a landslide which occurred in 1950. The lake is fed by the water of Sera stream [Bekar et al., 2018].

The soils in Akçaabat, Trabzon are tuff with a debris slope and residual clay. This geological structure contributes to landslide formations [Bayrak, Ulukavak, 2009]. The nature park covers an area of 0.219 (0.219 km²) decare, with a length of 1200 meters and an average width of 150 meters. The lake widens to 250 meters towards the north and narrows to approximately 110 meters towards the south. It contains one large (60 m²) and two small (5-10 m²) islands. Due to its extensive wetland territory and vegetation characteristics, SLNP was designated as a nature park and placed under protection on April 24, 2010 [Çavuş, 2014]. A few trees (*Alnus glutinosa* (L.) Gaertn., *Platanus orientalis* L., *Corylus avellana* L., *Salix* sp., *Populus*

¹E-mail: nevzatbatan@gmail.com

Received: 15.09.2024; Received in revised form 10.10.2024; Accepted: 15.11.2024

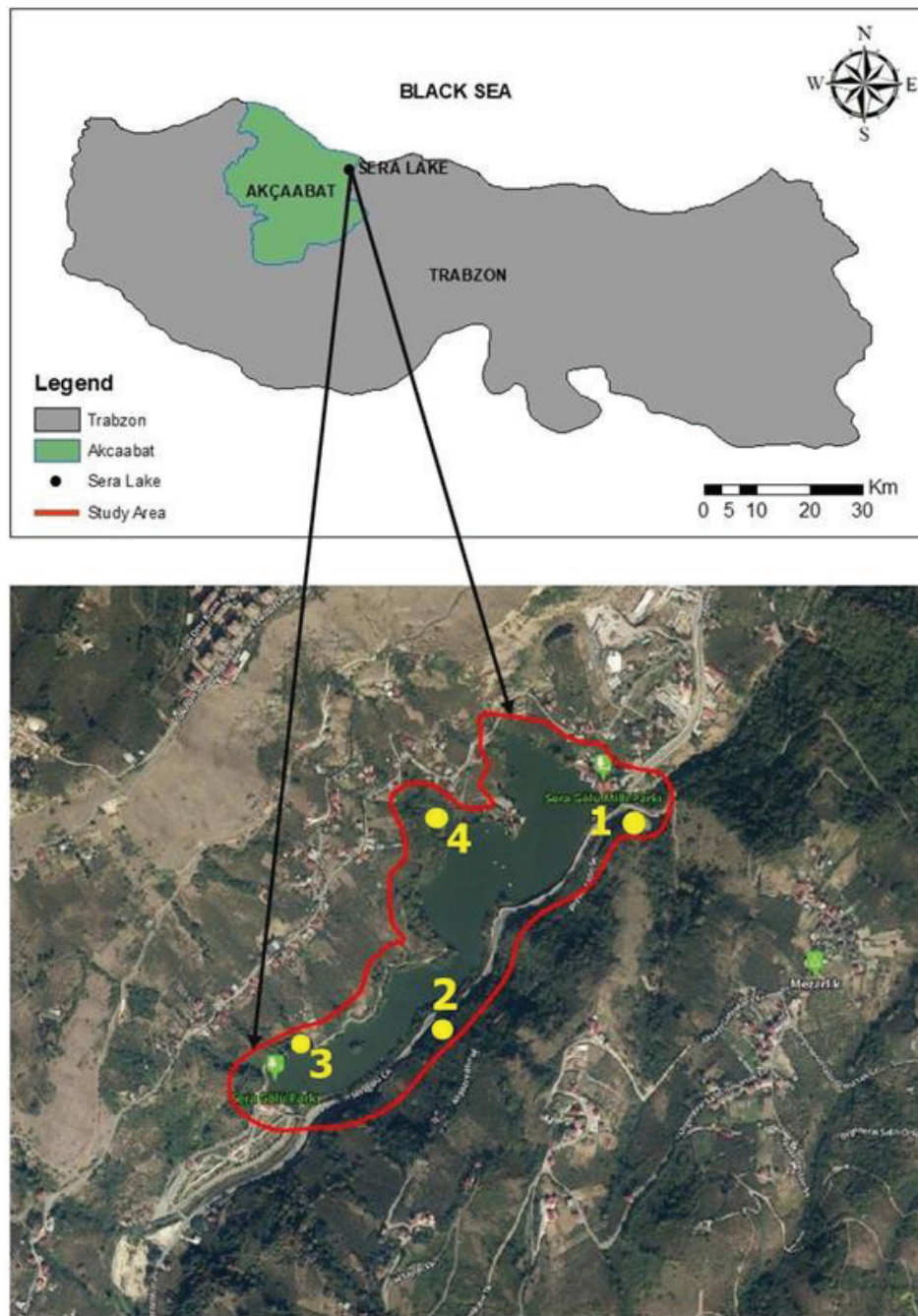


Figure 1. Map of the study area and Trabzon Province: 1. SLNP entrance, 2. SLNP exit, 3. recreation area in SNLP, and 4. end of the SLNP walking path.

sp.) continue to thrive on the small islands in the lake. The surrounding area is bordered by acacia, willow, and plane trees, as well as hazelnut orchards. To the northwest of the lake, there are orange and mandarin tree plantations [Çavuş, 2014]. The forest area is 14,311 hectares, constituting 37 % of the total area.

The climate in the area shows typical characteristics of the Black Sea, the winters being mild, summers with

average (12.1°C) temperatures. The average annual rainfall is 1466 mm, and the average humidity is 73.3 %. The elevation of Akçaabat (Trabzon) is 10 meters above sea level. The temperate climate, the prevalence of northwesterly winds, and the presence of mountains rising from the coastal strip contribute to the rich vegetation of the district [Akman, 2010].

MATERIAL AND METHODS

Field trips were conducted to collect fern specimens from four different stations in SLNP in March and April, 2024. These locations are shown in the table 1. The specimens were collected during their maturation period and labeled, were examined both in the field and laboratory. The specimens were examined with stereomicroscope (Carl Zeiss Stemi 2000-C) and a light microscope (Carl Zeiss Axio Imager A2). Identification was carried out according to the appropriate literature [Davis 1965; Davis et al., 1988; Güner et al., 2000, 2018; Frey et al., 2006; Lünser, Fischer 2006]. The identification was focused on the morphological characteristics of the fern stems, leaves and spores. Vouchers were deposited to the herbarium of the Department of Molecular Biology and Genetics, Faculty of Science, Karadeniz Technical University (KATO).

RESULTS

The study conducted by us helped to document fern flora of the SLNP. During the study no new species were recorded. The identified species belong to five families. Aspleniaceae family is generally found on rocky and mountainous areas, whereas Pteridaceae and

Dennstaedtiaceae families are distributed in the cleared forest areas. The Polypodiaceae family members are found on rocky mountainous regions whereas the Equisetaceae family members are found along wetland edges (Table 1). The data obtained provides a significant source on the fern flora of the nature park. It is the first detailed study of fern sporangia and spore structures in the country.

The photographs of the ferns collected from SLNP were taken during this study and the characteristics of their spores, leaves and stems examined. This investigation provides important information about fern diversity of the mentioned territory. First study on the ferns in Akçaabat district was conducted by M. Yıldız and colleagues in 2003. They reported 37 taxa belonging to 12 families. It is the second study in the Akçaabat district, specifically focused on SLNP. The distribution of families based on the number of taxa within the study area is as follows (Table 2) – Aspleniaceae: *Asplenium adiantum-nigrum* L. (Fig. 2.1), *A. scolopendrium* L. (Fig. 2.2), *A. trichomanes* L. (Fig. 2.3); Polypodiaceae: *Polypodium vulgare* L. (Fig. 2.4); Equisetaceae: *Equisetum arvense* L. (Fig. 2.5), Pteridaceae: *Pteridium aquilinum* (L.) Kuhn (Fig. 2.6); Dennstaedtiaceae: *Adiantum capillus-veneri* L. (Fig. 2.7).

Table 1. Locations of the collected species Sera Lake Nature Park (Akçaabat, Trabzon).

No	Species	GPS coordinates	Elevation (m, a.s.l.)	Collection site number
1	<i>Asplenium scolopendrium</i> L.	40°59'15"N; 39°37'12"E	113,09	1
2	<i>Asplenium trichomanes</i> L.	40°58'56"N; 39°36'45"E	110,04	3
3	<i>Asplenium adiantum-nigrum</i> L.	40°58'57"N; 39°36'35"E	91,77	4
4	<i>Equisetum arvense</i> L.	40°59'04"N; 39°36'46"E	101,89	2
5	<i>Pteridium aquilinum</i> (L.) Kuhn	40°58'56"N; 39°36'45"E	110,04	3
6	<i>Polypodium vulgare</i> L.	40°58'57"N; 39°36'35"E	91,77	4
7	<i>Adiantum capillus-veneri</i> L.	40°59'04"N; 39°36'46"E	101,89	2

Table 2. Species of ferns collected from Sera Lake Nature Park.

Class	Family	Genus	Species
Polypodiopsida	Aspleniaceae	<i>Asplenium</i>	<i>Asplenium adiantum-nigrum</i> L.
			<i>Asplenium scolopendrium</i> L.
			<i>Asplenium trichomanes</i> L.
	Equisetaceae	<i>Equisetum</i>	<i>Equisetum arvense</i> L.
	Dennstaedtiaceae	<i>Pteridium</i>	<i>Pteridium aquilinum</i> (L.) Kuhn
	Polypodiaceae	<i>Polypodium</i>	<i>Polypodium vulgare</i> L.
Pteridaceae	<i>Adiantum</i>	<i>Adiantum capillus-veneri</i> L.	

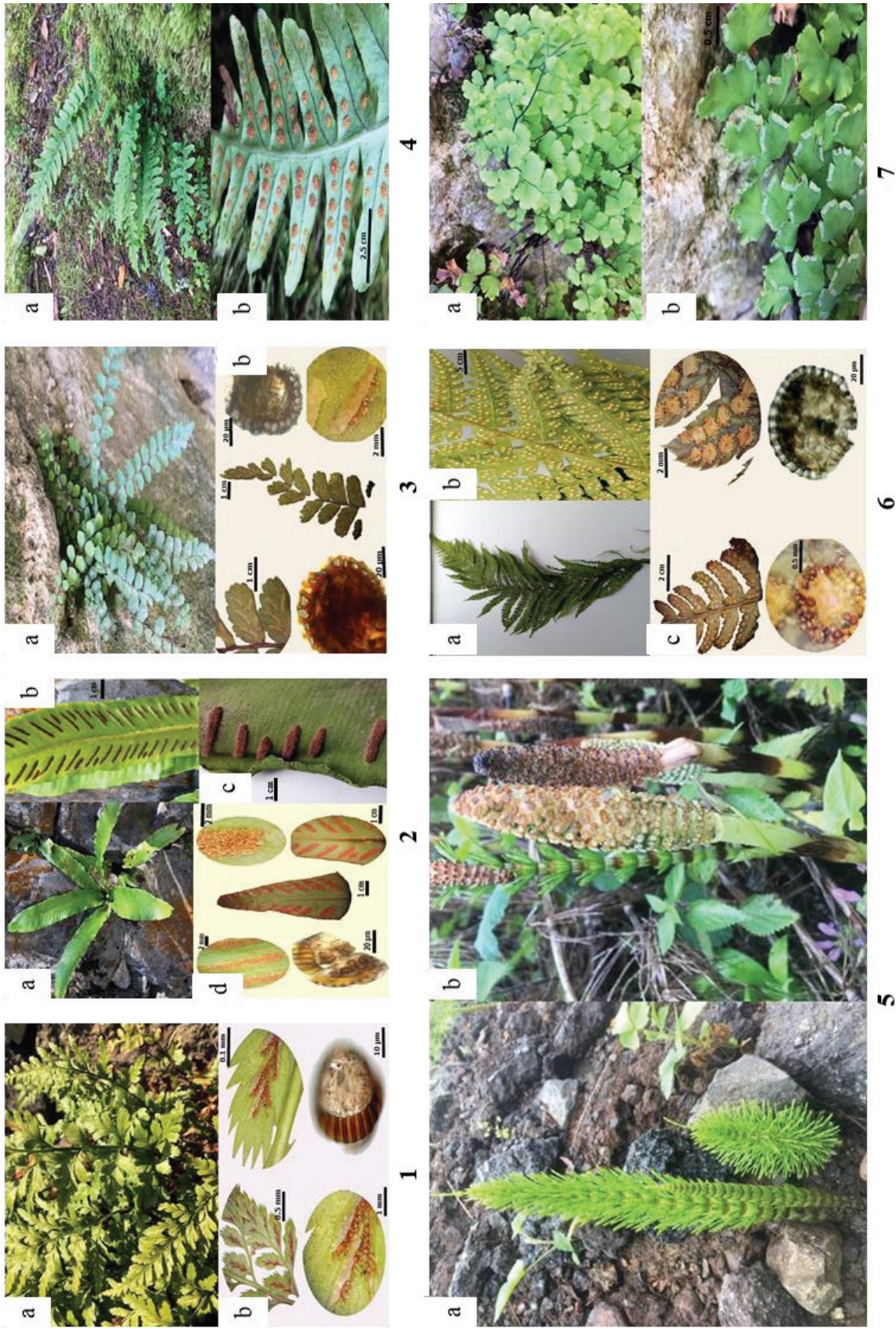


Figure 2. Fern species: 1. *Asplenium adiantum-nigrum* L. a) habitat of species, b) microscopic image of sporangium; 2. *A. scolopendrium* L. a) habitat of species, b) c), image of Sporangium, d) microscopic image of sporangium and spore; 3. *A. trichomanes* L. a) habitat of species b) microscopic image of sporangium and spore; 4. *Polypodium vulgare* L. a) habitat of species, b) image of sporangium; 5. *Pteridium vulgare* L. a) habitus of male species, b) image of sporangium c) microscopic image of sporangium and spore; 6. *Pteridium aquilinum* (L.) Kuhn a) Habitus of species, b) image of sporangium c) microscopic image of sporangium and spore; 7. *Adiantum capillus-veneris* L. a) habitat of species, b) image of sporangium.

This study identified seven fern taxa in Akçaabat. It will serve as a guide for future studies. The taxa identified in this study have a potential for use in the urban landscape planning.

ACKNOWLEDGEMENT

This article has been written as part of a bachelor's thesis in the Department of Molecular Biology and Genetics, Faculty of Science, Karadeniz Technical University in 2024.

REFERENCE

- Akman Y. Climate and Bioclimate. Palme publishing, 2010, 352p.
- Akkaya A. Taxonomic and ecological studies on the fern flora of the area between Gölge Mountains (Denizli) and Geyik Mountain (Antalya), Dumlupınar University, Master Thesis, Kütahya, 2005, 45 p. [Akkaya A. Gölge Dağları (Denizli) ile Geyik Dağı (Antalya) arasında kalan Alanın Eğrelti Florası Üzerine Taksonomik ve Ekolojik Araştırmalar, Dumlupınar Üniversitesi, Yüksek Lisans Tezi, Kütahya, 2005, 45 s.]
- Bayrak T., Ulukavak, M. (2009) Trabzon landslides. *Harita. Teknol. Elektro. Derg.*, 1: 20-30 [Bayrak T., Ulukavak, M. (2009) Trabzon heyelanları. *Harita. Teknol. Elektro. Derg.*, 1: 20-30]
- Bodur A. Biodiversity of ferns (Pteridophyta) in Çanakkale Province, Çanakkale Onsekiz Mart University, Institute of Science, Master Thesis, Çanakkale, 2015, 138 p. [Bodur A. Çanakkale İli Eğrelti Otlarının (Pteridophyta) Biyolojik Çeşitliliği, Çanakkale Onsekiz Mart Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Çanakkale, 2015, 138 s.]
- Çavuş A. (2014) A touristic area evaluated in terms of nature tourism in Trabzon: Sera Lake, *Turkish Geographical Review*, 63: 43-49 [Çavuş A. (2014) Trabzon'da doğa turizmi açısından değerlendirilmesi gereken turistik bir alan: Sera Gölü, *Türk Coğrafya Dergisi*, 63: 43-49]
- Davis P.H. Flora of Turkey and East Aegean Islands, v 1. Edinburgh: Edinburgh University Press. 1965, 656 p.
- Esaete J., Eycott A.E., Reiniö J., Telford R.J., Vandvik V. (2014) The seed and fern spore bank of a recovering African tropical forest, *Biotropica*, 46(6): 677-686.
- Frey, W., Frahm, J. P., Lobin, W., Lünser, H., Fischer, E. The liverworts, mosses and ferns of Europe. Colchester: Edmundsbury Press. 2006, 528 p.
- Güneroğlu N., Pektaş S. (2022) Evaluation of Sera Lake Nature Park in terms of user satisfaction. *Orman. araşt. derg.*, 9: 124-132 [Güneroğlu N., Pektaş S. (2022) Sera Gölü Tabiat Parkı'nın kullanıcı memnuniyeti açısından değerlendirilmesi. *Orman. araşt. derg.*, 9: 124-132]
- Kambek Ertürk S. Morphological, Corological and Ecological Studies on ferns of Kocaeli Province, Dumlupınar University, Institute of Science, Master Thesis, Kütahya, 2006, 97 p. [Kambek Ertürk S. Kocaeli İli Eğreltileri Üzerinde Morfolojik, Korolojik ve Ekolojik Çalışmalar, Dumlupınar Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Kütahya, 2006, 97 s.]
- Kaynak G., Yılmaz Ö., Ahıskalı M. (2022) A study on the ecology and corology of *Asplenium* L. *IJFAA*, 2(2): 56-67.
- Mehltreter K., Walker L.R., Sharpe J.M. Fern ecology. Cambridge: Cambridge University Press. 2010, 444 p.
- Rothwell GW, Stockey RA. (2008) Phylogeny and evolution of ferns: a paleontological perspective. In: Ranker TA, Hauffer CH, eds. Biology and Evolution of Ferns and Lycophytes. Cambridge University Press; 332-366.
- Sarıgül M. Contributions to fern flora of Kaçkar Mountains National Park (Rize), Recep Tayyip Erdoğan University, Institute of Science, Master Thesis, Rize, 2018, 100 p. [Sarıgül M. Kaçkar Dağları Milli Parkı (Rize) Eğreltiotu Florasına Katkıları, Recep Tayyip Erdoğan Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Rize, 2018, 100 s.]
- Sefalı A. (2022) Identification of fern (Pteridophyta) species growing in Bayburt. 4. International Palandöken Scientific Studies Congress, Erzurum, Türkiye, 783-788 p.
- Smith R.A., Pryer K.M., Schuettpelz E., Korall P., Schneider H., Wolf P.G. (2006) A classification for extant ferns, *Taxon*, 55(3): 705-731.
- Tütüncü M. Fern (Pteridophyta) Flora of Ilgaz Mountain National Park and its surroundings, 2006, 55 p. [Tütüncü M. Ilgaz Dağı Milli Parkı ve Yakın Çevresinin Eğrelti Otları (Pteridophyta) Florası, 2006, 55 s.]
- Google Earth, accessed May 17, 2024: <https://earth.google.com/web>
- Yıldız M., Babul-Bayır F., Özdemir T. (2003). Ferns and fern allies (Pteriophyta) of the Akçaabat district (Trabzon). *Herb Journal of Systematic Botany*, 10(2):189-196 [Yıldız M., Babul-Bayır F., Özdemir T. (2003) Akçaabat ilçesinin (Trabzon) eğrelti otları ve eğrelti otu akrabaları (Pteriophyta). *Ot Sistematik Botanik dergisi*, 10(2):189-196]

Türkiyədə Akçaabat (Trabzon) qıjı florasına töhfə

Ceyda Demirtaş

Nevzat Batan

Qaradəniz Texniki Universiteti, Elmlər Fakültəsi, Molekulyar Biologiya və Genetika Fakültəsi, Trabzon, 61080, Türkiyə

Zeynep Gizem Yılmaz

Qaradəniz Texniki Universiteti, Elm İnstitutu, Biologiya Fakültəsi, Trabzon, 61080, Türkiyə

Hüseyin Erata

Gümüşhanə Universiteti, Kürtün Peşə Liseyi, Gümüşhanə, 29810, Türkiyə

Bu araşdırmada Trabzon vilayətinin sosial-iqtisadi töhfələri baxımından əhəmiyyətli olan Sera Gölü Təbiət Parkına daxil olan Akçaabat rayonunun qıjı florası qiymətləndirilmişdir. 2024-cü ildə təbiət parkından qıjılar toplanmış və onların müxtəlif morfoloji xüsusiyyətləri, o cümlədən yarpaq və gövdəsi laboratoriya şəraitində tədqiq edilmişdir. Təyinat məlum floralar üzrə təyinedicilərdən istifadə etməklə aparılmışdır. Nümunələr *Aspleniaceae* (*Asplenium scolopendrium* L., *A. trichomanes* L., *A. adiantum-nigrum* L.), *Polypodiaceae* (*Polypodium vulgare* L.), *Equisetaceae* (*Equisetum arvense* L.), *Pteridaceae* (*Pteridium aquilinum* (L.) Kuh), *Dennstaedtiaceae* (*Adiantum capillus-veneri* L.). fəsilələrinə aid yeddi növ olaraq müəyyən edilmişdir. Ölkədə ilk dəfə qıjıların sporangium və spor strukturları ətrafı tədqiq edilmişdir. **Açar sözlər:** *biomüxtəliflik, pteridofit, SGTP, növ, sporangium, spor*

Вклад во флору папоротников Акчаабат (Трабзон) в Турции

Джейда Демирташ

Невзат Батан

Караденизский технический университет, факультет естественных наук, кафедра молекулярной биологии и генетики, 61080, Трабзон, Турция

Зейнеп Гизем Йылмаз

Караденизский технический университет, Институт науки, факультет биологии, Трабзон, Турция

Хусейн Эрата

Университет Гюмюшане, Кюртунское профессиональное училище, 29810, Гюмюшане, Турция

В этом исследовании была оценена флора папоротников Акчаабата в Природном Парке Озера Сера, которая имеет важное значение с точки зрения социально-экономического вклада в провинцию Трабзон. В 2024 году в природном парке были собраны папоротники и в лабораторных условиях изучены их различные морфологические особенности, включая листья и стебли. Идентификация проводилась с использованием определителей по известным флорам. Образцы были идентифицированы семи видами, которые относятся к семействам *Aspleniaceae* (*Asplenium scolopendrium* L., *A. trichomanes* L., *A. adiantum-nigrum* L.), *Polypodiaceae* (*Polypodium vulgare* L.), *Equisetaceae* (*Equisetum arvense* L.), *Pteridaceae* (*Pteridium aquilinum* (L.) Kuh), *Dennstaedtiaceae* (*Adiantum capillus-veneri* L.). Впервые в стране подробно изучены споры папоротников и структуры спорангиев.

Ключевые слова: *биоразнообразие, птеридофиты, СГТП, вид, спорангий, спор*