EKOLoji 2024
11.ULUSLARARASI EKOLOJİ SEMPOZYUMU
"SU VE İKLİM DEĞİŞİKLİĞİ"

EKOLoji 2024 | ECOLOGY 2024

11. INTERNATIONAL ECOLOGY SYMPOSIUM

SU VE İKLİM DEĞİŞİKLİĞİ
WATER AND CLIMATE CHANGE

29 Mayıs - 1 Haziran 2024
29 May - 1 June 2024

SİNOP / TÜRKİYE
PROCEEDINGS BOOK

PRESENTATION

The 11th International Ecology Symposium, hosted by our university between 29 May - 1 June 2024, which bring together many different disciplines such as biology, aquaculture, environment, physics, chemistry, agriculture, tourism, especially water and climate change, which fundamentally affect the ecosystem, and contributed to the sharing of information, discussion of problems and solution proposals.

I believe that the oral and poster presentation abstracts and full-text papers in the Symposium Proceedings Book will contribute to the solutions of the problems addressed in the 11th International Ecology Symposium (Ecology 2024). I would like to state that we are happy to see all stakeholders who participated as listeners as well as oral and poster presentations at the 11th International Ecology Symposium, where scientists, private sector, representatives of public institutions and organizations, students and anyone interested in the subject participated. In addition, I would like to thank all my colleagues who contributed to the organization of the symposium, as well as public institutions and organizations, private sector representatives and stakeholders who contributed to the symposium on behalf of our University and myself.

Prof. Dr. Şakir TAŞDEMİR
Rector
PREFACE

Total water resources in the world, especially fresh water resources that directly affect our lives, are under threat due to many factors, especially population growth and climate change. Our country has a geographical location where the effects of global climate change will be felt intensely in the future and water resources are limited. For these reasons, it is inevitable that the water reserves we will have in the future will be negatively affected. In general terms, the impact of climate change on water resources all over the world, including our country, is analyzed in terms of changes in the hydrological cycle and quality. The impact of climate change on water quantity and quality means that many water-related sectors such as agriculture, energy, animal husbandry and tourism will also be affected.

The starting point of the 11\textsuperscript{th} International Ecology Symposium (Ecology 2024) was the topic of "Water and Climate Change", which directly affects these sectors. The symposium, hosted by Sinop University, was held for three days on May 29-June 1, 2024 at the Ahmet Muhip Diranas Application Hotel, with oral, poster and audience participation from many different fields of study. I believe that the results obtained after the symposium have made positive contributions to all the issues addressed, especially the issue of Water and Climate Change.

I am proud and happy to host the 11\textsuperscript{th} Ecology Symposium, which has been held 7 times nationally since 2010 and internationally since 2017. I would like to thank all our sponsors, especially the Rectorate of our University, who provided all kinds of material and moral contributions in the organization of the symposium, where universities, public institutions and organizations as well as sector representatives and stakeholders came together, for their contributions at every stage of the Ecology 2024 symposium. I would also like to thank the Scientific Committee for the evaluation of the oral and poster presentations, and the Symposium Organizing Committee and Secretariat who worked devotedly at all stages of the symposium.

I would like to thank you all again for your contributions and participation in the 11\textsuperscript{th} International Ecology Symposium (Ecology 2024) hosted by our University in Sinop, which has many ecosystems together in the north of Turkey, face-to-face after a long break.

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University of Ss. Cyril and Methodius, Makedonya
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ORAL PRESENTATIONS
Determination of Morphological Characteristics and Leaf, Stem and Root Nutrient Element Contents of Kasnak Oak Seedlings

Abdullah SARIMEHMETOĞLU\textsuperscript{1,2*}, Münevver ARSLAN\textsuperscript{3}, Mehmet SAYMAN\textsuperscript{3} and Hakan DEMİRBAĞ\textsuperscript{1}

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Abstract

\textit{Quercus vulcanica} (Kasnak oak), which is endemic and in the danger category VU (vulnerable), is a species in the white oak group. Spreading in a small part of Turkey, Kasnak oak is most widespread in Eğirdir and Sultan Mountains in the Lakes Region. Establishing Kasnak oak plantations is needed in terms of biodiversity conservation. One of the primary criteria for successful stand establishment is the production of quality seedlings. This study was carried out to determine the morphological characteristics of 2+0 bags of oak seedlings and the plant nutritional elements found in leaves, stems, and roots. The seeds were collected from the Afyon-Çay Genetic Conservation Forest in the Sultan Mountains. The weight of 1000 seeds was found 4.25 kg. Seeds were planted in polyethylene bags (12 x 30 cm) in the autumn at Eskişehir Forest Nursery. Growing media consist of 60% soil, 20% humus, 10% pumice and 10% sand. The germination was found at 80%. The average seedling diameter of the root collar was 5.98 mm, seedling height was 10.9 cm, fresh trunk weight (leaf + trunk) was 3.6 g, fresh root weight was 7.7 g, dry trunk weight was 1.9 g, dry root weight was measured as 4.3 g, stem/root ratio was 0.49 and root length was 49.5 cm. Among the plant nutrients, the concentrations of N (1.7%), P (1617 ppm), Ca (23857 ppm), Mg (11433 ppm), Mn (82 ppm) and Cu (16 ppm) are highest in the leaves; K (4575 ppm), Na (427 ppm) and Fe (775 ppm) concentrations are in the roots; Zn (37 ppm) concentration was determined in the stems. The Dickson Quality Index of the seedlings was ranged from 1.4 to 6.3. The quality classes of seedlings were evaluated according to the Turkish Standard Institute (TSI) called “the standard on broad-leaved forest tree seedlings (TS 5624, 1988). When the minimum seedling height and root collar diameter characteristics were evaluated together, the Kasnak oak seedlings were found substandard.

Keywords: Seedlings quality, macro and micro elements, \textit{Quercus vulcanica}, Sultandağları
Heavy Metal Pollution in Fresh Tea Leaves According to Gasoline Tea Leaf Cutting Machines

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Abstract

Tea is one of the most popular beverages consumed worldwide. The intake of food and beverages contaminated with heavy metals is harmful to human health, and several countries have imposed laws to restrict the presence of heavy metal concentrations in food and beverages. This experiment aimed to examine the presence of heavy metal contamination in fresh tea that was harvested using various tea harvesting implements. For this purpose, tea samples were taken from the tea gardens collected with tea cutting scissors in the clean area (not driven by vehicle), gasoline tea leaf cutting machines in the clean area (not driven by vehicle), and tea cutting scissors in the dirty area (close to the highway) determined in the Central district of Rize during the three harvest periods in 2023. The lead (Pb), nickel (Ni), cobalt (Co), chromium (Cr), copper (Cu), zinc (Zn), and manganese (Mn) contents of all samples were determined by inductively coupled plasma-mass spectrometry (ICP-MS). The Pb, Ni, Co, Cr, Cu, Zn, and Mn contents of fresh tea plant samples collected in all harvest periods showed statistically significant differences at the P<0.01 level according to tea collection tools. Analysis revealed that the fresh tea samples collected from the tea gardens, which were identified as clean gardens where only tea cutting scissors were employed, had heavy metal levels that were under the acceptable limit, thus posing no health risks. It was determined that the copper and manganese contents of the samples taken from the other two gardens were above the maximum permissible limit specified in the literature and would pose a potential health risk. It was predicted that the fresh tea samples of these gardens were affected by traffic and gases released from the gasoline-powered tea cutting engine and were (and will remain) exposed to pollution directly or indirectly.

This study was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) project number 123O604 and Recep Tayyip Erdoğan University Scientific Research Projects Coordination Unit (Tea Specialization Project) with project number 1123.

Keywords: Food security, heavy metal, tea, tea harvesting implements, Rize.
Determination of Mesozooplankton Communities and Abundance in the Coastal Waters of the Sea of Marmara

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Abstract

Zooplankton, which has an important place in the food chain, is affected by changes in the ecosystem. The mucilage event in the Sea of Marmara in 2020-2021 also affected the zooplankton in the environment. In this study, the current status of mesozooplankton in the coastal area of the Sea of Marmara after mucilage and its relationship with environmental parameters were determined. The samples examined in the study were obtained from seven stations in 2022 within the scope of the Marine Integrated Pollution Monitoring Programme (DEN-IZ) with a UNESCO-WP2 type closing plankton net in January, April and August. The sampling depths in the upper layer were decided according to the temperature and salinity values. Temperature and salinity were measured by SBE 25 Plus CTD, dissolved oxygen content in water was analyzed by Winkler method and chlorophyll-a content was determined by acetone extraction method. In the study, 52 mesozooplankton species and groups were identified. In all seasons, Cladocera constituted 40.86-62.84% of the total mesozooplankton and Copepoda constituted 18.43-33.82%. Cladoceran *Pleopis polyphemoides* reached the highest number of individuals (25 487 individuals/m\(^3\)) among all mesozooplankton in winter season. *Paracalanus parvus* (Copepoda) was the only species observed at every station in every season throughout the study. In order to determine the diversity of species according to seasons, Shannon Diversity Index (H') was calculated using abundance (individuals/m\(^3\)) data. It was determined that the highest H' value was in summer season (3.24) and the lowest H' value was in winter season (0.64). According to the CCA results, the most important parameter affecting the species distribution was temperature. *Podocorynoides minima, Euterpinia acutifrons, Penilia avirostris* and Chaetognatha showed a positive relationship with temperature. The results of the study demonstrated that mesozooplankton structure of the coastal areas, which were most affected during the mucilaginous period, started to recover in 2022.

Keywords: Zooplankton, the Sea of Marmara, copepoda, cladocera.
**The Importance of Tatlıcak Wastewater Treatment Plant Located in Konya-Türkiye for the Lake Tuz Ecosystem**

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**Abstract**

The Lake Tuz is the second largest lake in Türkiye. This hypersaline lake is located in a closed basin called Konya basin and it is the most important salt extraction center. Because 70% of salt used in Türkiye is optained from Lake Salt. The Lake Tuz is one of the most important wetland area in Türkiye due to its unique ecosystem and biota. For this reason, the Lake Tuz was declared by the Decision of Cabinet of Ministers numbered 2000/1381 dated 14.09.2000 as Special Environmental Protected Area (SEPA). According to World Heritage (UNESCO) Convention, There are 279 plant species and 120 halophytic bacteria recorded in the Lake Tuz ecosystem. Thirty-nine of these are endemic and, 4 are endangered. There are 129 insect species of which 4 endemic, and 15 mammalian species in this ecosystem. This special site provides habitat for many wintering birds. İnsuyu stream, Peçeneközü stream and Melendiz streams are reach to the lake. In addition, wastewater from Konya is also discharged into the Lake Tuz. It is mainly fed by undergroundwater. There are small interrelated small lakes (Akgöl, Bolluk Gölü, Düden Gölü ve Tersakan Gölü) near the Lake Tuz. There are thousands of wells for irrigation in the Konya closed basin. Most of them are not licensed. In this study, the importance of Tatlıcak wastewater treatment plant in Konya for Protection of the Lake Tuz ecosystem and economic contributions to the local people have been revealed through scientific literature.

**Keywords:** The Lake Tuz ecosystem, wastewater, biomass energy, wastewater treatment plant, Konya
Unveiling the Green Shields: Ecological Insights into *Buxbaumia viridis* and Climate Change Forecasts

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Abstract

Old forests are crucial for supporting biodiversity, with large, old trees and deadwood being key components. Deadwood is essential for forest ecosystems, and maintaining it in various decay stages is important for promoting biodiversity. Different organisms rely on different stages and volumes of deadwood for survival. Indicator species, such as saproxylic beetles and bryophytes, are used to assess the health and biodiversity of old-growth forests. *Buxbaumia viridis* (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl., also called the green shield moss, is a rare epixylic moss that is an important indicator species due to its association with deadwood-rich, old-growth near-natural or natural forests. Its distribution is limited compared to generalist bryophyte species, with specific substrate and climate requirements. Therefore, it serves as a crucial indicator of forest conditions. The presence or absence of *Buxbaumia viridis* can provide valuable insights into forest ecosystem health and biodiversity.

In this study, we investigated the current and future distribution of *Buxbaumia viridis* in Turkey. To do so, we used the Wallace platform via R software to perform species distribution modeling. Our results suggest that the species is likely to disperse in the Bursa-Uludağ region and along the Black Sea coasts. However, according to all climate scenarios, the distribution is decreasing or even disappearing throughout Anatolia. It is important to determine the true distribution area of *Buxbaumia viridis* to protect this species and the old-growth and natural forests it represents.

**Keywords:** *Buxbaumia viridis*, indicator species, species distribution modelling, climate change
Eutrophication-Induced Microbial Ecology Dynamics in Oligotrophic Marine Ecosystems: Insights from Mersin Bay

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Abstract

Eastern Mediterranean presents a unique ecosystem characterized by nutrient scarcity profoundly impacting primary productivity and plankton succession. Within this region, Mersin Bay emerges as a pivotal area, deemed a "hot spot" due to its susceptibility to eutrophication. Microorganisms offer valuable insights into ecosystem health and can serve as early warning signals of environmental degradation. Focusing on three picoplanktonic groups: heterotrophic bacteria, *Synechococcus* and flagellates, this study investigates the spatial and vertical distribution patterns as well as seasonal and inter-annual variations of microbial dynamics in relation to ambient biological, chemical, and physical parameters in Mersin Bay. A comprehensive sampling strategy spanning multiple years and employing 50 stations with multiple depths covering both domestic effluent and freshwater input points alongside open reference offshore stations is applied. Epifluorescence microscopy and image analysis setups are used to enumerate and measure cell sizes to estimate biomass. Spearman Rank Correlation test is applied with ambient physical, chemical and biological parameters. The results indicate a sharp dichotomy prevailing between the nutrient-rich coastal areas and the nutrient-limited open sea with both the abundance and biomass of the organism groups studied peaking in the inner bay before tapering off towards offshore regions. Notably, heterotrophic bacteria emerge as dominant players throughout the study period, exhibiting marked seasonality characterized by pronounced fluctuations across different seasons, with peak abundance occurring during the warmer months of summer and fall. Conversely, *Synechococcus* and flagellates demonstrate significant albeit less pronounced seasonal variations. Spearman rank correlation analyses reveal significant correlations between microbial abundance and key environmental parameters. In conclusion, this study contributes to the broader understanding of microbial ecology at hot spots in oligotrophic marine ecosystems emphasizing the importance of its use in ecosystem management and conservation strategies particularly in the context of increasing anthropogenic pressures and climate change.

Keywords: Coastal ecosystems, eutrophication ecology, environmental dynamics, picoplankton responses.
Modelling and Scenario Testing for Ecosystem-Based Fisheries Management in the Regional Marine Ecosystems of Türkiye

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Abstract

Ecosystem-based Fisheries Management (EBFM) acknowledges the intricate interplay of ecological components, functional processes and anthropogenic stressors within marine ecosystems. Despite its complexity, the scientific community has increasingly embraced EBFM enhancing traditional management frameworks through multidisciplinary studies and ecosystem modelling tools. Notably, Ecopath with Ecosim (EwE) has emerged as a widely utilized platform facilitating comprehensive analyses of ecosystem structure, function and responses to fishing activities. This study presents a comprehensive modelling and scenario testing approach aimed at informing EBFM strategies in the regional Exclusive Economic Zones (EEZs) of Türkiye. Ecopath mass-balance modelling assesses the unique structure and function of these ecosystems and the effects of fishing revealing distinct dynamics such as trophic interactions and species roles across the Black Sea, Marmara Sea, Aegean Sea, and Mediterranean Sea. Temporal dynamic modeling with Ecosim allows simulation of various management scenarios, with reference scenarios replicating historical trends in abundance and catch, serving as a comparison baseline. Scenario testing reveals the potential impacts of different management strategies including economy weighted, ecology weighted and equally weighted scenarios on biomass, catch and economic value of target species across the regions. While short-term outcomes differ, ecology-weighted EBFM policies show long-term benefits for both ecological health and economic efficiency. In conclusion, this study provides insights into the dynamic nature of Turkey's marine ecosystems and offers a framework for the formulation of effective EBFM policies tailored to the unique characteristics of each region considering the differences in their responses to various management scenarios. It emphasizes the importance of balancing short-term socio-economic benefits with long-term ecological sustainability in fisheries management to ensure long-term ecological health and resilience in the face of ongoing environmental and societal challenges. Recommendations for future research include enhancing data collection, integrating diverse ecological and socio-economic data and developing adaptable modeling frameworks for local management units.

Keywords: Ecosystem-based fisheries management, ecological modelling, structure and functioning of marine ecosystems, ecosystem services.
A Comparative Literature Review of National Parks Management Plans: Insights from Four Continents

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Abstract

In today's world, the diversification of tourism activities and people's inclination towards nature-based tourism during their leisure time exert pressure on national parks, which we can define as natural areas providing recreation opportunities; it is crucial to identify approaches, challenges, and innovations regarding the management of national parks. This literature review examines the National Parks Management Plans of four geographically diverse countries from different continents –the United States, New Zealand, South Africa, and Albania– to discern commonalities, differences, and emerging trends in park management strategies.

The review highlights the unique approaches to national park management in four countries. In the United States, there is a focus on biodiversity conservation, recreational opportunities, and stakeholder engagement. New Zealand prioritizes indigenous rights, ecosystem restoration, and community involvement, aligning with biocultural conservation principles. South Africa adopts an integrative approach, combining conservation with socioeconomic development, and employs adaptive management strategies to address challenges like poaching. Conversely, with recent developments, Albania is transitioning its park management plans to balance conservation with tourism development and infrastructure enhancement. Despite differences, all countries face challenges such as funding constraints, visitor pressure, and the need for adaptive governance frameworks.

Synthesizing insights from diverse contexts, this literature review underscores the importance of context-specific approaches to national parks management, informed by interdisciplinary collaboration, cultural sensitivity, and adaptive governance mechanisms. It advocates for knowledge exchange and cross-border cooperation to foster innovation and resilience in the stewardship of globally significant protected areas. Through a comparative lens, this research contributes to a deeper understanding of the complexities of managing national parks amidst evolving environmental, social, and political dynamics across continents.

Keywords: National park management, tourism, biodiversity conservation, adaptive governance framework.
Nature Through the Artist's Eyes

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Abstract
Nature has always been a source of inspiration for artists. However, throughout history, the artist's perception and approach to nature have changed alongside scientific advancements, societal norms, and the transformations in both nature and humanity.

In the realm of creativity, the representation of nature began with the survival struggles of early humans depicted in cave paintings, evolving into landscape painting during the Renaissance period, where aesthetic beauty was emphasized. By the latter half of the 20th century, thanks to the awareness raised by the environmental movement, it became evident that nature was reaching a point of irreversible destruction, becoming a phenomenon in need of salvation. Faced with this urgent situation, artists began to address nature with a critical approach.

This study aims to examine the changes in the artist's perspective on nature, along with the changes caused by human influence on nature.

Keywords: Art, nature, ecological art
Calculation of the Gray Water Footprint of Cotton Production in Turkey

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Abstract

Water is one of the most critical building blocks of life and civilization on earth. After the agricultural revolution in human history, the need for water has increased exponentially due to population growth, industrialization and the expansion of agricultural areas. However, the amount of fresh water available on earth is very limited. Therefore, studies on the wiser and more efficient use of water as gaining importance. Water consumption statistics show that agricultural water use has the highest share among other sectors with 80%. It is known that a significant amount of water is allocated for agricultural irrigation in cotton growing regions in Turkey. This reduces the water allocated to other products and increases the opportunity cost. The main aim of the present study is to calculate the gray water footprints and virtual water contents of cotton production in Turkey for the year 2008-2018. In this context, the study modelled the fertilizer required for cotton production using the Tier-1 approach. As a result, the total grey water footprint of cotton production of approximately 2 Gton per year in Turkey was calculated to be 0.83 billion tonnes. It is thought that the extraction of high-resolution water footprint and virtual water content data of agricultural products within the scope of the present study will provide important contributions to national and international water management strategies for arid and semi-arid countries such as Turkey.

Keywords: Gray water, cotton production, water footprint, national, virtual water
Effects of Global Warming on Orchids and Possible Solutions

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Abstract

It is known that global climate change occurs due to global warming. In addition, it is generally accepted by the scientific community that global climate change is caused by increasing greenhouse gas emissions as a result of human activities. It is agreed that there will be an increase in temperature in Turkey in the 21st century. Orchids are found on all continents except Antarctica. It is the most complex, advanced and successful family of flowering plants on the planet. They show a wide diversity, with approximately 1000 genera and more than 28,000 species worldwide. Their ability to grow in soil in terrestrial form, on trees in epiphytic form, or on rocks in lithophytic form forms the basis of this diversity. International trade in orchids is so threatening that, according to the Convention on Intentional Traffic in Endangered Species of Wild Fauna and Flora, all species in the family Orchidaceae are subject to this convention and trade is restricted. Climate change poses a major threat to pollination and there is a need to protect the plant communities where orchids live. The combination of higher temperatures and lower precipitation can make forests more susceptible to fire and drive native species to extinction. The potential impacts of climate change on orchids are difficult to predict, and some ecosystems are likely to be more vulnerable to climate change than others.

Keywords: Climate change, orchids, plant protection
Toxic Effects of Glyphosate on Organisms in the Ecosystem

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Abstract

Productive agricultural lands have been destroyed due to global climate change, rapid population growth and industrialization. Therefore, the desire to obtain more products from less area has increased the use of pesticides in our country as well as all over the world. Glyphosate is a broad-spectrum organophosphate group herbicide, which is widely used in weed control. It is generally used in the production of agricultural products such as rice, corn and soy, in pastures, garden maintenance and forest areas. In recent years, with the development of glyphosate-resistant soy, canola, cotton and corn strains, its use has increased further in order to increase the amount of product. In addition, the resistance of weeds to glyphosate over time caused the dose used to increase. Insecticides and herbicides, known as pesticides, are among the most important toxic substances that threaten ecosystems today. It has also been reported that these chemicals mix with water resources, soil and air, and therefore have toxic effects on organisms at all levels of the food chain. These toxic effects are observed by disruption of cell membrane permeability and increased oxidation of cell membrane lipids. It causes physiological and morphological changes in wildlife, fish, birds and insects, causing biodiversity to gradually decrease. It has toxic effects on the immune, reproductive and nervous systems in humans. Many studies have shown that glyphosate causes DNA and chromosomal damage, hepatoxicity in the liver and oxidative stress in the testicles in rats. For a sustainable ecosystem, appropriate biological control methods must be developed to reduce the use of chemical substances such as glyphosate, which is known to have toxic effects on organisms.

Keywords: Pesticide, glyphosate, toxicity, rat
Abstract

In recent years, we have seen many negative effects of global environmental problems on ecosystems. Microplastic pollution, which constitutes one of these problems, emerges as a new threat to the world today. Plastics, which have become an indispensable part of our daily lives with the industrial development process, rapidly accumulate in ecosystems due to insufficient recycling. Accumulated plastic wastes break down into millions or even billions of micron-sized particles over time as a result of wind, waves, ultraviolet radiation, sunlight and human activities, forming microplastics. Microplastics do not remain stable in the ecosystem and can be moved from one habitat to another. In addition, it increases its dangerous effect by absorbing toxic substances such as heavy metals and pesticides and adding them to its structure. It is transmitted to organisms in the aquatic ecosystem through the food chain and negatively affects many living species, from fish to birds and marine mammals. Today, microplastics are found in the air we breathe, the water we drink, many foods we consume, and breast milk. Many studies conducted in recent years have revealed the toxic effects of microplastic pollution on aquatic organisms and mammals, and many more effects continue to be investigated.

Emergency precaution plans must be developed for this pollution, which will obviously cause major problems for life if precautions are not taken in the future, and the measures to be taken to reduce plastic use must be determined.

Keywords: Microplastic, toxicity, pollution, ecosystem
Abstract

Ecological destruction, which is one of the urgent issues for humanity, is widely discussed in art together with the mission of today's understanding of art to awaken consciousness and attract attention. As the German sociologist Ulrich Beck mentioned in his book The Risk Society, this destruction, which began with industrialization, has brought with it a society dominated by anxiety instead of need. While Beck defines the risk society in which these concerns take place, he emphasizes the ecological destruction caused by pollution, nuclear, chemical and genetic production forces. Antony Giddens, similarly to Beck's views, has expressed that modern society is being dragged into a new model and has defined this model as “high modernity”.

This new “high modern” society reflects a model that is aware of the global dangers that nuclear war and ecological disasters will bring. In a society where the need is decreasing and the desire is increasing, previously ignored risk situations have become more visible and discussed in almost every medium. Ecological destruction is also attached to the lens of art, which is one of these mediums. With the ecological destruction that has taken place, environmental problems that may turn into dangers in the future have begun to attract the attention of artists and find a place in their art practices. This study aimed to examine how artists take ecological destruction as a topic in their works and how they discuss it on the axis of art. The study using the qualitative research method is important in terms of understanding how ecological destruction, which is a current problem, is seen through the eyes of artists. In the study, it was concluded that the artists revealed the consequences of the destruction experienced in a visible way and shed light on possible future problems.

Keywords: Ecological art, risk society, contemporary art
Ecology of Goji Berry (Lycium barbarum L.) a case study from Nigde (Turkey)

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Abstract

*Lycium barbarum* L. have economic importance because of their food product and medicinal properties. Thus, this study has aimed to investigate some heavy metal and mineral nutrients (Al, Ba, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn contents of Goji Berry (*L. barbarum*). Plant and soil samples were collected from Mehmetcik neighbourhood in Bor district of Nigde province. Heavy metals and mineral nutrients were analyzed in the plant by using ICP-MS. In addition XRF device was used for measurements in soil. The determined values of the elements (in mg/kg were within the ranges of 46000-48800 for Al, 314.60-351.10 for Ba, 185.40-204.70 for Cr, 9.60-12 for Co, 29.6-42.9 for Cu, 32800-35800 for Fe, 800-1100 for Mn, 47.2-56.9 for Ni, 57.90-78.80 for Pb, and 81.00-124.80 for Zn in the soil. In the study, the concentrations of Fe, Ni, and Zn which were within optimal values in the soil. But, Al, Cr, Co, Cu, Mn, and Pb values were above the optimal. The values (mg/kg for Al, Ba, Cr, Co, Cu, Fe, Mn, Ni, Pb, and Zn in the plant samples were 49.05-508.16, 1.8-82.58, 0.62-2.56, 0.11-1.05, 6.57-32.91, 43.49-334.69, 9.05-170.35, 1.24-7.76, 0.16-3.66 and 15.89-62.27 respectively. The concentrations of Al, Cu, Fe Mn, Pb, and Zn in the plant were around the optimum values, while Cr, Co, and Ni were above. In the future, more detailed information about the ecological and habitat characteristics will be obtained by monitoring the heavy metal and mineral nutrient contents of the plant in different environments.

**Keywords:** *Lycium*, heavy metal, mineral nutrients, goji berry
Determination of Natural Resistance of Chestnut (Castanea sativa Mill. Wood in Contact With Soil in Different Geographical Regions and Climate Types

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Abstract
In this study, 60 chestnut wood samples with dimensions of 20x20x300 mm were exposed to the soil (half buried) field test by EN 252 for 3 years in the provinces of Trabzon, Muğla, Çanakkale, and Elazığ to determine natural durability. At the end of the period, the visual rot rating, weight loss, and density values were examined. Climate index and soil structure of the provinces were determined. The highest climate index was detected in Trabzon and the lowest in Muğla. The highest total water holding capacity (TWHC) in the soil was found in Çanakkale and Trabzon and the lowest in Muğla. The most organic matter was seen in Trabzon and Çanakkale, and the least was in Elazığ. The amount of organic matter and TWHC are very effective in the decomposition of wood in contact with the soil. The best visual decay was in Elazığ, with a degree of 1,0 and the worst was in Çanakkale, with 3,6. In the study, the highest weight loss was in Çanakkale with 35.96%, while the least was in Elazığ with 4.71%. The reason for the high weight loss in Çanakkale province can be explained by the termite attack. Weight losses in Muğla and Trabzon are close to each other. As the exposure time increases in temperate climates, wood samples become vulnerable to all pests (fungi, insects, rain, moisture, heat, UV, etc.). Chestnut wood, which has good natural strength, can experience serious weight losses. In the study, the highest density was in Elazığ with 0.54 g/cm³, while the lowest was in Çanakkale with 0.39 g/cm³. When the chestnut wood test samples were compared to the control samples, lower density losses were detected compared to other tree species in the literature. Chestnut wood lost density by 4% in Trabzon, 10% in Muğla, and 24% in Çanakkale.

Keywords: Chestnut, wood, natural resistance, EN 252, wood properties.
First record of *Cedecea neteri* with multiple antibiotic resistance from seagull droppings

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**Abstract**

Our current problem is indicated by the worldwide issue of microorganisms becoming more resistant to antibiotics. It follows that the designation of this time period as the "antibiotic era" is indisputable. Within this framework, several studies focus on identifying the origins of this resistance, tracking down the locations of resistant microbes, and implementing preventative measures. A seagull (wild bird) sample from Sinop, Akliman, in April 2021 was used for this investigation. The goal was to extract microorganisms from the sample and investigate antibiotic resistance. Mannitol Salt Agar was used for isolation, and classical microbiological tests of the selected colony were performed with API 20E and API 20NE kits and then Vitek 2 (biomerieux, France). In addition to the antibiotic tests performed by Vitek 2, antibiogram tests against some antibiotics were performed by Mueller Hinton Agar method according to Bauer's technique. Moreover, the biofilm formation capacity of the isolate was performed according to the tube test. The isolate obtained within the scope of the study was reported to be *Cedecea neteri*, a Gram-negative bacterium of the *Enterobacteriaceae* family according to the Vitek 2 device. In addition, it was determined that the results obtained according to API tests were compatible with this bacterium. It was also observed that the isolate had the capacity to produce biofilm according to the tube test. According to the antibiogram results, 18 (60%) of the total 30 antibiotics were resistant (colistin, amikacin, gentamicin, levoflaxacin, ciproflaxacin, cefotaxime, cefuroxime, cefazolin, cefepim, ceftazidime, carbapenem, erapenem, streptomycin, cephalixin, erythromycin, rifampcin, teicoplanin, clindamycin, daptomycin and linezolid), 1 (3.3%) was moderately susceptible (Meropenem), 1 (3.3%) was not detected according to Vitek (Tigecycline) and 10 (33.3%) were susceptible. Especially colistin resistance, which is one of the identification criteria for *C. neteri*, was helpful in identification. When these results were calculated according to the MAR index suggested by Krupperman, which has a limit value of 0.2, it was found to be 0.6, which once again showed the importance of this isolate with multiple antibiotic resistance. These results show how unconscious use of drugs and/or antibiotics can disrupt the ecological balance. This study also highlights the need of taking action in this area and the threats that wild bird droppings represent to ecosystems beyond pollution.

**Keywords:** Antibiotic resistance, *Cedecea neteri*, seagull, Sinop, Vitek 2
The First Record of *Carassius carassius* (Linnaeus 1758) in Çıldır Lake, Northeastern Türkiye

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Abstract

Anatolia occupies a highly significant position globally in terms of biological diversity due to its numerous closed lake basins and independent river systems. So much so that three of the globally identified 36 hotspots (Mediterranean, Irano-Anatolian, and Caucasus) intersect in Anatolia. Hosting many native and endemic species of freshwater fish, Anatolia has also seen the introduction of alien species, some of which have successfully established populations in our waters, exhibiting invasive traits. Çıldır Lake, one of our largest freshwater lakes, holds immense value both for the Turkish ecosystem and for the local population. Located within the Aras River drainage basin, the lake harbors numerous native fish species, among which the crucian carp (native *Cyprinus carpio*) stands out as the most prized by fishermen. Through stocking efforts, the lake also hosts the common carp (*C. carpio*, alien), and the Prussian carp (*Carassius gibelio*), a species that has colonized nearly every aquatic ecosystem in our country. Upon examining records reported in the region to date, no evidence of the presence of the crucian carp (*Carassius carassius*) has been found. In this study, the morphological distinguishing features of an individual captured with a trammel net in Çıldır Lake were examined, and it was determined that this individual belongs to the *Carassius carassius*.

Keywords: Crucian carp, new record, Anatolia, Aras River drainage, biodiversity.
Projecting White Pine Blister Rust Hazard Ratings Under Climate Change in Southwestern Oregon

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Abstract

White pine blister rust (WPBR), caused by a non-native fungal pathogen, Cronartium ribicola J.C. Fisch. in Rabh., has substantially declined populations of five-needled white pines in North America. Obligate parasite, cronartium, is climate-dependent, requiring mild temperatures and sufficient moisture to inoculate and spread. Random forest (RF) models were developed using climate conditions, site characteristics, and tree characteristics using ClimateNA to evaluate rust hazard ratings (RHRs). Next, RF models were used to project rust hazard and tree growth under climate change. In total, 13 climate scenarios consisting of 12 future scenarios and one based on the 1931-1990 climate were analyzed. The future climate variables were based on four Shared Socio-economic Pathways (SSPs), SSP1-26, SSP2-45, SSP3-70, and SSP5-85 and three 30-year time periods centered on 2025, 2055, and 2085. Percentage of trees with a stem canker (CANK%) and average number of cankers per tree (NUM_CANK) were the best rust traits for characterizing rust hazard compared to average height of the highest canker (HT_CANK) and rust hazard index (RI). CANK% and NUM_CANK were more strongly associated with environmental variables, and were less confounded with non-rust tree variables, indicating CANK% and NUM_CANK could be better to use in calculation of RHRs instead of RI. Correlations indicated that rust hazard was greater at sites with milder temperatures, sufficient moisture, and longer growing seasons. Rust hazard was also higher at sites with northern, eastern, and northeasterly aspects. Rust hazard was positively associated with tree growth and negatively associated with tree age, but had little relationship to tree height. According to the projections of rust hazard, WPBR will decline, but these changes will probably be small and uncertain. It is recommended accounting for the distributions of alternate hosts, the occurrence of specific wave years, and additional moisture-associated environmental variables to improve rust hazard prediction models.

Keywords: White pine blister rust, western white pine, sugar pine
Comprehensive Water Footprint Assessment Based on ISO 14046 in the Hotel Industry

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Abstract

Ecological problems have been increasing since the 1980s. With the increase in environmental problems, businesses have given importance to Water Footprint, Carbon Footprint and Energy Footprint studies caused by their own activities in this regard. In this context, the need to record, report and monitor the amounts and properties of water used, carbon emissions and energy consumption on a process and business basis and the create measures to improve the results has emerged. Hotels with high water usage are the sectors where the consumption needed in today's world is high. The increase in the population, the rapidly developing technology and the high sectoral use of water, which is humanity’s most natural right, have brought about reusability. The concept of water footprint, which is a multidimensional indicator that shows that water is selected according to the type of pollution, has been introduced. This concept, which emerged with popular culture, has become an important issue for institutions to contribute to increase their brand reputation and fulfill their responsibilities towards the environment.

The aim of this study is to propose a method that can be applied for Water Footprint, produce output and introduce an application example.

Keywords: Water footprint, hospitality industry, climate change
**Introduction**

Water which is essential for the continuity of life on Earth is a limited and strategic natural resource (HSE Department, 2023). Water which is vital for all living beings is irreplaceable. However, due to increasing population, production and consumption of goods, unplanned urbanization, unconscious and incorrect use, climate change, rising temperatures, and the adverse effects of floods and droughts, there is an increase in the demand for water resources while their supply is decreasing. While the amount of accessible and usable water resources is limited worldwide, modern science, which is searching for habitable areas on other planets, primarily investigates the presence of water there. Water scarcity is one of the most significant reasons why these researches are being carried out.

Climate change and water are closely related. According to scientists, the most crucial impacts of climate change are the disruption of the water cycle and changes in water quality. It can be said that the amount of water on Earth remains constant as a result of water cycle, but due to climate change, the location and timing of water resources on Earth are changing, making the management of water resources in many areas more challenging in terms of quantity and quality. Considering that daily life and plans are organized according to hydrological systems, understanding the effects of climate change on drinking water resources, sanitation, food, and energy production is of great importance. The impact of climate change on water resources also means that sectors related to water, such as agriculture, energy, livestock, and tourism, will also be affected. (Çapar, 2019)

When we look at our planet from space, we see that two-thirds of it is covered with water. While 97.5% of the Earth’s water reserves consist of saltwater, only 2.5% is freshwater. Of our freshwater resources, 70% is located in the Antarctic and Greenland regions, causing a significant demand for accessible water (Güler et al., 1999). Currently, humans have access to only about 1% of this freshwater. Water is a vital fluid for humans, yet its importance is still not fully understood. When we think of water, we often consider it a very cheap product. However, an increase of just two degrees in climate temperature could lead to water scarcity for 1 to 4 billion people. As the intensity of the climate-dependent water cycle increases, some regions will get more water, while others will lose some water. Changes in water resources will result in droughts or floods, significantly impacting human populations (Figure 1).

![Figure 1. Global Water Distribution](image)

Studies have determined that the current usable surface and groundwater capacity is an annual average of 110 billion cubic meters. Of this amount, 95 billion cubic meters come from rivers originating within
our own country, 3 billion cubic meters from rivers originating outside our country but entering our borders, and 12 billion cubic meters from groundwater sources (Başbakanlık Devlet Planlama Teşkilati, 2007).

According to the population of our country in 2022, the annual per capita water amount is 1,313 cubic meters, indicating that we are a water-poor country compared to some other countries and the world. According to the population scenarios of the Turkish Statistical Institute (TÜİK), Turkey's population is expected to reach 93,328,574 people in 2030, 100,331,233 in 2040, and 104,749,423 in 2050. With the increasing population, the annual per capita usable water amount is expected to decrease to 1,200 cubic meters in 2030, 1,116 cubic meters in 2040, and 1,069 cubic meters in 2050, making it clear that Türkiye will very soon approach the threshold of water scarcity and subsequently become a water-scarce country. Projections made by (TÜİK) on the impact of climate change on water availability in our basins indicate that water availability in Türkiye could decrease by up to 25%. Given that water is a shared resource among various sectors, strategies for resource efficiency in each sector are crucial for the sustainable management of water resources (Çevre Mühendisleri Odası, 2024).

Water resources have been integral to human life for centuries, fulfilling essential needs such as drinking, irrigation, transportation, and recreation. As a natural consequence, water resources are now extensively utilized in agriculture, industry, and the service sectors. Among these, the tourism sector stands out as one of the most significant users of water resources. With increasing prosperity and a desire to travel, people are encouraged to explore new places, whether individually or in groups, using various means of transportation. Tourists engage in consumption activities driven by their needs for food, drink, and accommodation. However, the COVID-19 pandemic, which emerged at the end of December 2019, led to an unprecedented global health, social, and economic emergency, altering consumption habits, disrupting global value chains, and hindering economic growth. As a result of travel restrictions and city lockdowns, the tourism sector was one of the most affected industries. (Chieh Lee at al, 2021)

Hospitality businesses within the tourism sector significantly contribute to carbon emissions due to their energy-intensive operations, high water consumption, waste production, and transportation requirements. As demand for travel and accommodation continues to rise, it is crucial for the hotel industry to recognize the environmental impact of its actions and take steps to reduce its effects related to water usage. By adopting sustainable practices, hotels not only contribute to global efforts to combat climate change but also enhance their reputation, attract environmentally conscious guests, and potentially lower operating costs.

Water is a critical resource in the hotel industry. Hotels need water for various purposes, including guest room services, swimming pools, laundry services, landscaping, and food preparation. However, extracting, treating, and distributing water consumes energy and contributes to carbon emissions. To minimize water usage and conserve this valuable resource, hotels can implement water-saving practices. Installing low-flow fixtures for showerheads and faucets can significantly reduce water consumption without compromising guest comfort. Similarly, efficient irrigation systems and landscape designs can optimize water use for outdoor areas. Rainwater harvesting systems can capture and store rainwater for non-drinkable uses, further reducing the demand for freshwater. (Balaban, 2023) In this context, it is important for the hospitality sector to conduct water footprint assessments.

The concept of the "Water Footprint" was first introduced in 2002 by Prof. Dr. Arjen Hoekstra at the UNESCO-IHE Water Education Institute. It was further developed by the University of Twente in the
Netherlands and the Water Footprint Network. The water footprint measures the amount of freshwater required to produce a good or service throughout its entire supply chain, from raw material processing to direct operations and consumer use. This concept takes into account both direct water use and indirect water use during the production process (Hoekstra et al., 2011).

The water footprint not only indicates the volume of water used but also details related to the type of water (green, blue, grey), as well as when and where it is used. It is measured by the volume of water consumed (including evaporation) and/or polluted over a given time period. The three main components representing water use and water quality in a water footprint are blue, green, and grey water footprints. Blue Water Footprint refers to the total volume of freshwater from surface and groundwater sources required to produce a product. This is what traditionally comes to mind when we think of freshwater. Green Water Footprint represents the total amount of rainwater consumed in the production process. The rainwater in this context does not disappear or mixes with groundwater but is stored in the soil or on the surface temporarily. Climate change and variability affect the supply and demand of green water, making it crucial to consider these factors when evaluating the green water footprint of a region. Grey Water Footprint is a pollution indicator that measures the volume of freshwater required to assimilate pollutants and maintain water quality standards. The concept of Grey Water Footprint is associated with population and industrial growth, reflecting the amount of water needed to dilute pollutants. In this sense, a product's water footprint is a multidimensional indicator. On the other hand, virtual water content and embedded water solely refer to the volume of water used. For instance, producing a cup of coffee consumes 208 liters of water (Figure 2). However, this amount represents only one aspect of water usage. The location and time of water usage, as well as the type of water used, are also critically important.

![Figure 2. Amount of water used to make one cup of coffee](image)

The first water footprint studies were conducted on a national scale to determine the amount of water resources a country needs for its direct production requirements. Water footprint studies, which are becoming increasingly popular, are now also conducted for specific products, companies, or commodities. These studies have started to be used by the private sector to examine supply chains.
The "Water Footprint" is a concept that helps understand the role of water in the economy and its use as a tool in economic development processes. Examining a country's water footprint provides information that forms the basis for planners, decision-makers, and investors regarding allocation, trade, competitive advantage, and ecosystem support. In this context, efforts to protect and efficiently use water resources in production process and consumption should be supported, and considerations related to the component of water usage should be integrated into economic and social development goals (WWF, 2014).

**Methods**

**Studied Area**

In addition to its natural beauty, ecological aspects, historical significance, and cultural elements, Sinop was home to notable figures of the era and is the birthplace of a significant Turkish literary author. The University Board of Directors decided on April 2, 2013, to rename our Practice Hotel "Ahmet Muhip Diranas," after the significant Sinop writer. Furthermore, this hotel will be the first "Literary-themed Practice Hotel" in Türkiye. The Practice Hotel at Sinop University is located in close proximity to Turkey's 22nd National Park, which is well-known for its diverse array of flora and wildlife. It also boasts an amazing view of Sinop city and the peninsula where the blue and green meet. The Practice Hotel features 63 rooms overall, including 5 suites, and 141 beds total. This study was evaluated within the scope of “AHMET MUHIP DIRANAS” practice hotel with a door-to-door approach.

**Water Footprint Methodology**

In this study, the water footprint methodology defined in ISO 14046: 2014 was adopted to calculate the baseline values for hotel industry. This approach divides the water footprint into three categories: blue, green, and gray. The components of the water footprint are as follows: (i) The amount of water drawn (and consumed) from a surface or groundwater source is shown by the blue water footprint. In other words, a facility's annual blue water footprint is the total amount of freshwater that it uses throughout the year; (ii) its green water footprint is the amount of rainwater that is used during production but isn't taken from water sources; (iii) its grey water footprint is a measure of the pollution that comes with activities. Therefore, the greywater footprint can be estimated as follows:

\[
WF_{\text{grey}} = \frac{L}{c_{\text{max}} - c_{\text{nat}}} = \frac{(Q_{\text{effl}}) \cdot (c_{\text{effl}}) - (Q_{\text{abstr}}) \cdot (c_{\text{nat}})}{c_{\text{max}} - c_{\text{nat}}}
\]

WF grey, grey water footprint of the pollutant released into receiving water (volume/time); L, Pollutant load (mass/time); \( c_{\text{max}} \), the maximum permissible concentration of the pollutant in the receiving water (mass/volume); \( c_{\text{nat}} \), Natural concentration in a receiving water body (mass/volume); \( Q_{\text{effl}} \), effluent flow (volume/time); \( c_{\text{effl}} \), the pollutant concentration in the effluent (mass/volume); \( Q_{\text{abstr}} \), abstraction water volume (volume/time).

All water-related consumption and output data is generated from monthly measured data in 2023 and is based on original sources supplied by hotel’s department. Water that is removed from freshwater and enters the system (i.e., passes the system border) without causing human impact on the water body,
departs the system, and is subsequently released into the receiving water is included in the inventory data, as per ISO 14046. The data for this study were gathered and examined in light of this criterion. In this hotel, only municipal water is used as blue water, and the daily water use of the staff and guests (toilet, shower, etc.), the water used during the three meals in the kitchen, the use of water (toilet, etc.) in organizations such as weddings, conferences, etc. constitute the blue water of the hotel.

Furthermore, the wastewater treatment plant treats all of the generated wastewater. The pollutants for which the grey water footprint value is primarily considered and high results are obtained are Chemical Oxygen Demand, Suspended Solid, and Biological Oxygen Demand, which are the parameters measured in this organization. The maximum permitted concentrations (Cmax) that apply to the discharge of certain materials into natural water bodies are set by national legislation that is implemented by the Turkish government and the values listed in the "Water Pollution Control Regulation" table for domestic wastewater. Table 1 lists the parameters measured and the analysis techniques employed.

Table 1. Parameters measured and their analysis methods in this organization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Water Pollution Control Regulation (Table-21.1)</th>
<th>Analysis methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Oxygen Demand</td>
<td>mg/L</td>
<td>50</td>
<td>SM 5210 B</td>
</tr>
<tr>
<td>Suspended Solids</td>
<td>mg/L</td>
<td>60</td>
<td>SM 2540 D</td>
</tr>
<tr>
<td>Chemical Oxygen Demand</td>
<td>mg/L</td>
<td>160</td>
<td>SM 5220 B</td>
</tr>
</tbody>
</table>

Biological Oxygen Demand, suspended solids, and chemical oxygen demand is accepted as zero in receiving water in this study. It is necessary to analyze the flow rate of the wastewater treatment plant and the discharge conditions of the pollutants in order to calculate the pollutant load in the grey water calculation. The wastewater treatment plant flow rate and pollutant concentrations discharge to the receiving environment were collected on a monthly basis from the company's documentation department for use in the calculations in 2023.

Results and Discussion

Uses of Water at the Hotel

In this hotel, only municipal water is used and the daily water use of the staff and guests (toilet, shower, etc.), the water used during the three meals in the kitchen, the use of water (toilet, etc.) in organisations such as weddings, conferences, etc. constitute the blue water of the hotel. In addition, 850 units of 19 L plastic bottled water, 1550 units of 1.5 L plastic bottled water and 1750 units of 0.5 L plastic bottled water were purchased to be used for drinking water in 2023. The detailed consumption of water sources is presented in Fig. 3.
The total consumptive municipal water by the hotel in 2023 to operate its activities is 4356.05 m³

**Grey Water Footprint Assessment for the Hotel**

The grey water footprint is a pollution indicator at the organizational level. In accordance with current water quality standards, it refers to the volume of freshwater utilized to remove or lessen the pollutant load. The pollutant load that the receiving environment is subjected to must be determined before the grey water footprint can be computed. The pollutant concentration in the wastewater released is multiplied by the flow rate of water consumed in the pollution load calculation. The trend of the pollutant load as assessed by biological oxygen demand, suspended solids, and chemical oxygen demand is shown in Table 2.

**Table 2.** The effluent concentrations of pollution loads generated in the facility's wastewater treatment plant.

<table>
<thead>
<tr>
<th></th>
<th>Parameter</th>
<th>Unit</th>
<th>Analysis Results</th>
<th>Water Pollution Control Regulation Table 21.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Suspended Solids</td>
<td>mg/L</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Biological Oxygen Demand (BOD)</td>
<td>mg/L</td>
<td>8.13</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Chemical Oxygen Demand (COD)</td>
<td>mg/L</td>
<td>21.4</td>
<td>160</td>
</tr>
<tr>
<td>March</td>
<td>Suspended Solids</td>
<td>mg/L</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Biological Oxygen Demand (BOD)</td>
<td>mg/L</td>
<td>9.2</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Chemical Oxygen Demand (COD)</td>
<td>mg/L</td>
<td>24.9</td>
<td>160</td>
</tr>
<tr>
<td>May</td>
<td>Suspended Solids</td>
<td>mg/L</td>
<td>4</td>
<td>60</td>
</tr>
</tbody>
</table>
When the table is analysed, it is seen that all three pollutants do not exceed the allowable limit values compared to Table 21.1. The entire graywater footprint in 2023 was also determined every two months to assimilate pollution in accordance with the concentration of the water supply, based on the water standards in the organization’s manufacturing process. Table 3 lists the organization's overall grey water footprint data for 2023.

**Table 3.** Grey water footprint data for 2023.

<table>
<thead>
<tr>
<th>Month</th>
<th>Grey Water Footprint</th>
<th>COD(m³/month)</th>
<th>SS(m³/month)</th>
<th>BOD(m³/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td></td>
<td>582.62</td>
<td>290.4</td>
<td>708.29</td>
</tr>
<tr>
<td>March</td>
<td></td>
<td>677.91</td>
<td>290.4</td>
<td>801.51</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td>596.23</td>
<td>290.4</td>
<td>714.39</td>
</tr>
<tr>
<td>July</td>
<td></td>
<td>408.38</td>
<td>290.4</td>
<td>432.12</td>
</tr>
<tr>
<td>September</td>
<td></td>
<td>549.95</td>
<td>290.4</td>
<td>644.7</td>
</tr>
<tr>
<td>November</td>
<td></td>
<td>416.55</td>
<td>290.4</td>
<td>479.17</td>
</tr>
</tbody>
</table>

As can be seen from the results, when the grey water footprint is examined in the two-month period, suspended solids represent the lowest footprint and do not change monthly. COD values also vary between 416.55 and 677.91 m³/month. The lowest grey water footprint was obtained in July and the highest grey water footprint was obtained in March. Table 4 presents annual grey water footprint amounts calculated based on pollutant loads.
The pollutant producing the biggest grey water footprint in the plant is BOD, while suspended solids is the pollutant causing the lowest grey water footprint, according to the results of the water footprint inventory analysis. The entire gray water footprint of this plant is expressed as the water footprint of the BOD pollutant since the water footprint of this parameter is higher than that of other pollutant components in other words, 630.03 m³/year of freshwater are needed overall to dilutionally lower the pollutant concentration in the plant's wastewater to the limit values.

Water footprint studies can be conducted at various scales, including at the level of a country, sector, industry, factory, individual, product, or watershed. In this context, conducting more detailed water footprint studies for the hospitality sector, which holds a significant place in the Turkish economy, would be beneficial.

Furthermore, such a study would prepare for compliance with the Water Efficiency Regulation, which is soon to be implemented in our country and is currently under development.

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Abstract

Dyes are used worldwide in every field, from small-scale industries to large-scale industries, mostly in the textile industry, but also in the food, paper, pharmaceutical and cosmetics industries. It is an important source of water pollution that poses a threat to both water resources and living life. For this reason, dyed wastewater must be treated before being discharged into the aquatic environment. Research continues on the best technique for removing toxic dyes from dyed wastewater. Adsorption technology is still one of the widely researched topics in the removal of pollutants from aqueous media, especially textile wastewater and dyes. Therefore, within the scope of this study, we investigated whether it can be evaluated as an efficient adsorbent by modifying an aquatic plant (Typha latifolia found locally in ditches, swamps and wetlands to remove Crystal Violet dye from aqueous solution. To improve the surface properties of the adsorbent, detergent (sodium dodecyl sulfonate) was used as a modification agent.

In the studies carried out, basic operating parameters such as adsorbent amount (0.5-2 g/L), dye concentration (5-20 mg/L), pH (5-8) and contact time (0-360 min) were investigated. The optimum parameters were pH 8, adsorbent dosage: 0.5 g/L, adsorption time: 240 minutes. The non-linear fit of the experimental data to the kinetic and isotherm model equations was examined. Data obtained from 3 different isotherms (Freundlich, Langmuir and Temkin) and 2 different kinetic models (pseudo first-order and pseudo second-order) were evaluated. The Temkin isotherm model explained the adsorption process best. Langmuir monolayer adsorption capacity was calculated as 20 mg/g. When we looked at the kinetic data, it was seen that the model called the pseudo second-order kinetic model fit the study results better. It was concluded that the adsorbent prepared by modifying with surfactant would exhibit successful performance in the treatment of dyed wastewater.

Keywords: Adsorption, Typha latifolia, modification, crystal violet
Effects of Natural Adsorbents Added to Broodstock Fish Feed on Some Water Parameters

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Abstract

In the study, the effects of zeolite and leonardite, which are found in different amounts (2, 4, 8%) in broodstock fish feed with approximately 50% protein value, on water parameters were investigated. The experiment was conducted in 7 groups with 3 replications. There is no adsorbent in the control group. When the experimental groups in the study were examined in terms of TAN (Total Ammonium Nitrogen) values in water, it was determined that there was no statistical difference between the groups containing 4% zeolite, 4% leonardite and 8% leonardite (P>0.05). When a general evaluation was made of the study, it was determined that as the amount of adsorbent in the feed increased in the leonardite groups, the decrease in ammonia and TAN values in the water increased. The highest TAN value among the experimental groups was found in the Control group (16.78 mg/l), the lowest TAN value was determined in the L4 group (8.38 mg/l) and the value obtained was determined to be statistically different (P <0.05) from the other experimental groups.

Keywords: Aquaculture, leonardite, total ammonium nitrogen, zeolite
The Seasonal and Locational Variation of Fatty Acid Composition of *Engraulis encrasicolus* (Linnaeus, 1758 Muscle Captured in Turkish Waters

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Abstract

Seasonal and locational changes in the fatty acid content of the muscle tissue of European anchovy (*Engraulis encrasicolus*) captured from the Black Sea and Marmara Sea in Türkiye were investigated. Fish muscle samples taken monthly from each location during the fishing season were analyzed by gas chromatography (GC). The capturing dates were November, December, January, February, March, and May in 2020 and 2021 for the Black Sea and November, December, and March in 2020 for the Marmara Sea. Notably, palmitic acid emerged as the predominant SFA across all fishing months in both populations. Total SFA ratios exhibited significant monthly fluctuations for both the Black Sea and Marmara Sea populations. Similarly, variations in MUFA percentages were observed, with dominant species differing between the two populations and months. Crucially, the analysis revealed substantial quantities of DHA and EPA in European anchovy across all seasons and locations. DHA levels consistently surpassed those of EPA in both the Black Sea and Marmara anchovy throughout the fishing months. Further analysis indicated significant differences in PUFA percentages among the Black Sea population during specific months, while the Marmara population showed no such variation. On average, Marmara anchovy exhibited higher PUFA percentages than their Black Sea counterparts. Additionally, PUFA and n-3 PUFA percentages were found to be directly proportional to seawater temperature in both seas. In the Black Sea population, a correlation was noted between Fulton’s condition factor and n-3 PUFA percentages, particularly in months with higher condition factors. Moreover, the study identified statistically varying n-3/n-6 ratios throughout the entire fishing season in the Black Sea. This research provides valuable insights into the relationship between environmental factors, geographical locations, and seasonal variations in the fatty acid composition of European anchovy, thereby contributing to a deeper understanding of its nutritional value and health implications for consumers.

Keywords: *Engraulis encrasicolus*, fatty acids, seasonal variation, locational variation, muscle tissue
Graphitic Carbon Nitride Synthesis and Investigation of the Photocatalytic Performance

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Abstract

Today, when industrial establishments are compared, it is seen that the textile industry causes excessive wastewater generation and these wastewaters contain dyestuffs that cause pollution. The characterization, treatment, and reuse possibilities of wastewater caused by these dyestuffs encountered at high concentrations gain great importance. Today, the most commonly preferred dyestuffs that provide sufficient purity are reactive dyes and although these dyes are advantageous in terms of durability in the textile industry, treatment difficulties are also a big problem. During this study, Reactive Orange 122 dye removal studies were carried out and a photodegradation treatment with graphitic carbon nitride (g-C3N4) was applied. The fact that it is non-metallic and absorbs in the visible region causes g-C3N4 to be preferred as an environmentally friendly material and to be the subject of photocatalysis studies. Structural analyses of the obtained g-C3N4 were performed using X-Ray Diffraction Spectroscopy (XRD), Fourier Transform Infrared (FT-IR) Spectroscopy, Elemental Analysis, Multipoint Bet Analysis, and Scanning Electron Microscopy (SEM-EDS). As a result of photocatalysis of Reactive Orange 122 dyestuff, the best removal efficiency was found as 96% as a result of photocatalysis performed at 0.3 g g-C3N4 and 10 mg/L Reactive Orange 122 concentration.

Keywords: Graphitic carbon nitride (g-C3N4), photocatalysis, dyestuff, environmentally friendly material.
Potential Impacts of Anthropogenic Pressures in Sinop Province

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Abstract

Sinop is one of the most important fishing and tourism center of our country. With its historical and natural beauties, Sinop attracts visitors during the summer season. Sinop ranks 72nd among 81 provinces in our country according to the population. Despite this, in 2019, it was noted that the number of tourists visiting Sinop, one of the smallest cities in Türkiye with a population of approximately 68 thousand, exceeded one million in July and August. In parallel with the inputs coming into the Black Sea from large rivers, pollution caused by large ships and oil tankers, untreated domestic wastes, fishing, harbour activities, and the increasing population in summer months, the coastal area of Sinop province is exposed to intense pollution concentrations. The use of Sinop coastal waters as a receiving environment for the discharge and disposal of wastes brings the pollution of water to significant dimensions.

In this study, demographic and touristic data of Sinop for the years 2011-2023 and some pollution indicator parameters such as increased marine litter amounts and microplastics, reducing seawater quality, destruction of coastal biodiversity etc. were synthesized together to evaluate potential impacts. The results obtained, it is aimed to provide insight into the complex interaction between human activities and environmental sustainability. Considering the data, addressing the challenges faced by Sinop requires a holistic approach that prioritizes environmental conservation, infrastructure development, and community engagement.

This research was carried out at Pilot Site 7 Sinop Station under the sub-title heritage/tourism within the European Union’s Horizon 2020 Project “BRIDGE-BS: Advancing Black Sea Research and Innovation to Co-Develop Blue Growth within Resilient Ecosystems” with Grant Agreement number: 101000240.

Keywords: Sinop, pollution, human pressures, tourism.
Detection of Microplastics in Whiting (Merlangius merlangus, Linnaeus, 1758) Fish Tissues from the Central Black Sea

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Abstract

Recently, in the light of the importance of "Food Safety", which is the way to access clean food, and in the light of the "One Health" approach of the World Health Organisation (WHO), it is very important to investigate the presence of microplastics (MP) in fish, which is an issue that should be addressed and creates pollution on a global scale. In this study, 25 specimens of whiting species caught from the coasts of Sinop province, one of the important fishing centers of the Black Sea, were taken by random sampling method. The muscle and liver tissues of the fish brought to the laboratory were dissected. Muscle tissues were treated with 10% KOH solution and incubated at 60 ºC for 24 hours. Liver tissue was lyophilized for 72 h and then digested in nitric acid (1 mL) at 70 ºC for 2 h and diluted to 5 mL. After all tissues were completely dissolved, the residue in the flasks was filtered with Millipore cellulose filters with a pore opening of 10.0 µm using a vacuum filtration set. The filters were then dried at room temperature in a desiccator for 24 hours and then counted under a stereomicroscope at 45x magnification to determine the amount of microplastics. All plastics recovered from the samples were identified by colour (blue, black, whitish, yellow, red/pink), and shape (fragments - irregular pieces; pellets - spherical and oval debris; fibers - thin and long pieces).

Keywords: Microplastic, fish, Central Black Sea

Funding This work was supported by Ankara University Scientific Research Project Coordination Office under Grant No: FYL-2024-3101
Dormancy and Germination of Orchids in Türkiye

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Abstract

The Orchidaceae family demonstrates significant diversity worldwide, comprising over 28,000 species and is among the plant groups facing extinction. In our country, orchids are under great threat due to habitat loss and excessive harvesting of their tubers. Natural propagation of orchids is challenging because their powdery seeds require a suitable fungus for germination, and many orchid species exhibit deep-dormancy. Storing seeds at 4°C for several months to years after harvest may effectively break dormancy and regulate optimal germination timing. Although research in our department is limited, viability for up to three years has been determined when stored at very low temperatures (-180°C in liquid nitrogen). Studies on cold storage duration and viability-germination rates of Anacamptis laxiflora, Dactylorhiza urvilleiana, and D. iberica seeds have yielded notable results, with A. laxiflora maintaining high viability after 30 years, while D. urvilleana and D. iberica seeds lose viability after 20 years. Positive results have been obtained in in vitro symbiotic and asymbiotic, as well as ex vitro symbiotic germination tests for some orchid seeds without applying any dormancy-breaking methods other than superficial sterilization. Seeds of 14 Ophrys, 5 Himantoglossum species, and some Anacamptis, Neottinea, and Orchids species were incubated for 3-6 months at constant temperatures (25°C) in vitro and ex vitro conditions, yet no germination occurred. Ex/in situ symbiotic germination tests have been prepared to determine the natural germination process, resulting in germination and seedling development in species, especially Himantoglossum species and others previously mentioned. Effective propagation techniques are necessary for conserving and improving the reproduction processes of threatened orchid species. Research on the dormancy-germination relationships of orchids is ongoing. These studies are considered the most effective measure for preserving orchid species before they become extinct in nature.

Keywords: Biology, dormancy, germination
Artists Who Created Their Own Green in the Age of the Anthropocene

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Abstract
The Anthropocene Age is a concept first used by scientist Stoppani in 1873 to describe the period in which humans' impact on the world's ecology is at its highest level. Different time periods are expressed by many researchers regarding the beginning of this process. The most common and supported of these views covers a period of approximately three centuries, from the Industrial Revolution to the present day. In this process, also called the Human Age, it is seen that humans have caused a devastating change in the Earth's biodiversity, climate and geomorphological structure. This situation, which today's people are afraid to face, poses a great threat to the future. For this, it is necessary to take action as soon as possible and take every precaution to protect nature. It seems that this situation affects many artists today. In this research, we tried to explain how today's artists give meaning to nature in their struggle against nature, their efforts to protect nature, through the works they create and the materials and techniques they use in their works. Document analysis technique, one of the qualitative research methods, was used in the research. Research data was obtained by scanning method from written and visual sources related to the subject. Within the scope of the research, the works of five artists selected by purposeful sampling method, who looked at today's environmental problems from a socio-political perspective from the industrial revolution to the present day and reflected this in their works with a critical perspective, were examined. The findings showed that the works of these artists were created through practices involving the use of environmentally friendly materials and techniques or by recycling waste materials. Likewise, it was concluded that these artists, unlike the works of art they had previously created inspired by the beauties of nature, turned to new forms of expression that expressed their concerns about questioning the human-nature relationship, and in this way, they acted to raise public awareness.

Keywords: Anthropocene age, ecology, nature, art, artist
Perception of Nature in Contemporary Turkish Printmaking

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Abstract

In this research, how today's Turkish printmaking artists give meaning to nature was evaluated through the works they created and the materials and techniques they used in their works. The research was carried out with the scanning model, one of the qualitative research approaches. Within the scope of the research, the works of artists who include the image of nature in their works were compiled, a chronological classification was made, and written sources such as criticisms, interviews, catalog texts, promotional brochures, art magazines were examined and analyzed using the content analysis technique. At the end of the research, it was seen that many printmaking artists included the theme of nature in their works. In addition, unlike their previous works, where these artists depicted the image of nature as very rich living spaces constructed in a symbolic order, it was observed that they were concerned about questioning the human-nature relationship and preferred to address these concerns with a critical approach by transforming them into forms of artistic expression with nature-friendly materials and techniques.

Key words: Contemporary Turkish art, original printmaking, nature
Treatment of Textile Wastewater with Fenton-Like Oxidation

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Abstract
The study aimed to assess the feasibility of treating wastewater from the textile industry for recovery using Fenton-like oxidation. Experimental investigations were carried out intermittently using samples collected from the outlet of a biological treatment system. In the initial phase, experiments were conducted under fixed conditions to determine the optimal pH level for oxidation, with pH 3.0 yielding the highest efficiency, in line with existing literature. Subsequently, as the Fe$^{3+}$ dose increased, removal efficiencies improved, with the optimal Fe$^{3+}$ dose identified as 4 mM. Likewise, while increasing the H$_2$O$_2$ dose did not lead to a significant efficiency boost, the optimal H$_2$O$_2$ dose was determined to be 10 mM. Removal efficiencies were assessed based on colour and COD parameters, revealing that after 60 minutes, treatments conducted at pH 3.0 with 4 mM Fe$^{3+}$ and 10 mM H$_2$O$_2$ achieved removal efficiencies of 95.48% for colour and 57.53% for COD.

Keywords: Advanced oxidation processes, fenton-like oxidation, textile wastewater
Thornthwaite Water Balance Sheet Changes with Meteorological Data of Kastamonu, Sinop and Samsun Provinces (Many Years and Recent Climate Period)

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Abstract

Global warming and climate change are among the environmental problems that threaten the world. Potential effects of global climate change, which is expected to have some global and regional effects; It will focus on agriculture, forests, clean water resources, sea level, energy, human health and biodiversity. Climate is an evaluation that gives an idea about the general condition of the place under investigation as a result of observations made over a long period of time. Climate also shows the character of a region in terms of weather events and determines the vegetation.

Climate classifications have been developed using many different methods to distinguish different climate types in the world. One of these methods is Thornthwaite Climate Classification. In Thornthwaite Climate Classification, monthly average temperature, monthly average precipitation and monthly evapotranspiration values are used to determine the climate of a place, water accumulated in the soil during the year, monthly change of accumulated water, annual real evapotranspiration value, water deficiency and excess water, flow and humidity values, is available. Climate classification is made by using these values.

In this study, the climate of Kastamonu, Sinop and Samsun provinces was investigated according to the Thornthwaite Climate Classification over a long period and according to the last climate period (1990-2020). Water balance sheets were prepared according to 2 different periods for the places studied, the climate change of the provinces subject to research was presented according to the water balance sheet method, a climate map was prepared and the data obtained as a result of the study was presented.

Keywords: Water balance, climate change, Kastamonu, Sinop, Samsun
Introduction

Climate is one of the most important factors affecting the use and protection of sustainable natural resources. It especially plays a role in the formation of vegetation, soil formation processes and water resources in a particular region. Climate has a direct impact on living things and is a determining factor for the plant species to be grown in a region. (Anonyms, 2005).

Many of the major climate change impacts on Earth are related to precipitation and water availability. Climate change will be evident in lakes, river basins and waterways, particularly due to the impact of temperature on evaporation and increased rainfall variability. Decreased rainfall and water scarcity will have a significant negative impact on agricultural production and food security (Moghaddam, 2017).

It is very important to know the climate characteristics caused by climate change in geography (IPCC, 2014). Knowing the climate characters allows the detection of borders with different climate types; Continuing the sustainable use of regional resources contributes significantly to the effective handling of land use plans and use of property in a more planned and controlled framework.

Türkiye is mathematically located in the middle zone and in the temperate climate zone. Consisting of two peninsulas, Türkiye hosts many different ecosystems and climates due to its surroundings being surrounded by seas and its topographic features. Air masses affecting Türkiye and its immediate surroundings and their seasonal frequencies further increase this diversity. Türkiye is an area with high plant diversity with its herbaceous formations, shrub communities and forest cover (Karabulut, 2006). The effect of plant migrations that occurred during glacial periods continued in interglacial periods and biodiversity increased in Türkiye. The high biodiversity stems from the fact that it is an area that hosts many different ecosystems, and its geographical location and topographic conditions, both past and present, make Türkiye a very important part of the world's living composition (Demirsoy, 2002).

There are many reasons for the high environmental and biological diversity in Türkiye. Among these, factors such as mathematical location and topography such as latitude, degree of continentality, elevation, aspect, and factors such as geological structure and soil cover differences can be counted. Climate elements are also important as they are elements that are affected by these differences and determine the environmental conditions. To date, many maps, reports, articles and books have been published discussing the distribution of climate types in Türkiye and the factors affecting this distribution.

Determination of climate characters is carried out by defining climate classes. Climate classification allows distinguishing climate types and drawing climate boundaries by determining areas that are similar or dissimilar in terms of climate (MGM 2017). Many scientists working on climate have developed and used many climate classification methods in line with their studies. These methods first emerged with the classifications made by Kppen (1918) and were later developed by different scientists (Kppen, 1918). The existence of different climate classification methods is due to the differences in the algorithms generally used. Therefore, it is possible to describe the same region with different climate types. Some of these methods; These are Kppen
(1918), Thornthwaite (1948), Trewartha (1968), Aydeniz (Aydeniz, 1985), Erinç (1949), De Martonne (1942), Köppen-Geiger (1954) methods. Using these methods, both regional and local climate classification studies can be carried out. To date, in line with the needs arising both in academic research and in the international arena, studies have been carried out on climate classification using different methods and examining climate effects through regional comparisons.

In this study, the water balance sheet and climate types of Samsun, Sinop and Kastamonu provinces were determined according to the Thorthwaite method with long-term and recent climate period (1991-2020) meteorological data. There was no change in the climate type of Samsun, Sinop and Kastamonu provinces in both periods. However, there has been an increase in summer precipitation and temperatures, especially in all three provinces. Temperature increases, which are the effects of climate change, have begun to be recorded more frequently in the last climate period.

Methods

Although the definition of climate is simply the long-term average of weather events, the climate in an area is expressed either with quantitative values or their classification. While quantitative definitions directly specify a certain measurement and its distribution, the classification of measurements and averages constitutes the beginning of climatic evaluation. At first, climate definitions were made based on single variable classifications, then these were expanded and classifications created by using several variables emerged. These classifications are more complex and are obtained by evaluating and classifying quantitative values according to certain criteria. These classifications, first made by Köppen (1918), were developed and new ones were produced by many climatologists. The most used climate classifications are De Martonne (1942), Thornthwaite (1948), Köppen and Geiger (1954), Emberger (1955), Trewartha (1968) and Strahler (1970). Thornthwaite climate classification, which is more complex and includes many subclasses, is based on the calculation of evaporation-humidity and water budget in an area and is mostly used in hydrology studies.

In this study, long-term meteorological data of the provinces of Samsun, Sinop and Kastamonu and meteorological data of the last climate period between 1991 and 2020 of the same provinces were used as material. These data were taken from the website of the General Directorate of Meteorology. Thorthwaite Water Balance Sheet was calculated using the Microsoft Excel program containing macros on the data obtained. Calculations were checked manually and the resulting tables and graphs were interpreted. It was compared with previous studies.

Results

Findings from Samsun province

Meteorological measurements made by the meteorological station in Samsun city center between 1929 and 2023 are long-term data. The water balance table according to the Thornthwaite Method created from these data is shown in Table 1.
When Table 1 is examined, the climate of Samsun city center is semi-humid, medium temperature, water deficiency is very strong in summer and is close to the oceanic climate. Annual rainfall is 723.2 mm. and its average temperature is 14.6 °C. The three hottest months are June, July and August. The amount of precipitation in the hottest three months is 119.4 mm. while the actual evapotranspiration amount is 143.3 mm. is. The water shortage in summer is 246.2 mm. is. With these data obtained, drought is observed during the growing period of plants in Samsun province in the summer (June, July and August). A total of 69.5 days were determined as dry during the year.

Meteorological measurements made by the meteorological station in Samsun city center between 1991 and 2020 are data for the last climate period. The water balance table according to the Thornthwaite Method created from these data is shown in Table 2.
Table 2. Samsun province water balance table created with meteorological data of the last climate period

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<th>Blanço éléments</th>
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<th>Y</th>
<th>L</th>
<th>A</th>
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<th>Vejetoysan dönemi</th>
<th>Su Noksanı</th>
<th>Su Fazlası</th>
<th>Yüzeysel Akış</th>
<th>Nemlilik Oranı</th>
<th>Kurak gün Sayısı</th>
<th>Su Blançosu (D.KANTARCı)</th>
<th>İğne yapraklı ormanların vejetasyon dönemi aylık su açığı mm.</th>
<th>Faydalı su tutma kapasitesi (FSK) mm.</th>
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</table>

When Table 2 is examined, the climate of Samsun city center is semi-humid, medium temperature, water deficiency is very strong in summer and is close to the oceanic climate. Annual rainfall is 729.7 mm. and its average temperature is 15 °C. The three hottest months are July, August and September. The amount of precipitation in the hottest three months is 178 mm. while the actual evapotranspiration amount is 137.9 mm. is. The water shortage in the hottest months is 411.8 mm. With these data obtained, drought is observed during the growing period of plants in Samsun province in the three hottest months (July, August and September). A total of 66.8 days were determined as dry during the year.

Findings from Sinop province

Meteorological measurements made by the meteorological station in Sinop city center between 1936 and 2023 are long-term data. The water balance table according to the Thornthwaite Method created from these data is shown in Table 3.
When Table 3 is examined, the climate of Sinop city center shows semi-humid, moderate temperature, water deficiency is very strong in summer and is close to the oceanic climate. Annual rainfall is 691.4 mm. and the average temperature is 14.6°C. The three hottest months are July, August and September. The amount of precipitation in the hottest three months is 141.4 mm. is. The water shortage in the hottest three months is 226 mm. is. With these data obtained, drought is observed in the three hottest months (July, August and September) during the growing period of plants in Sinop province. A total of 70.2 days were determined as dry during the year.

Meteorological measurements made by the meteorological station in Sinop city center between 1991 and 2020 are data for the last climate period. The water balance table according to the Thornthwaite Method created from these data is shown in Table 4.
When Table 4 is examined, the climate of Sinop city center shows semi-humid, moderate temperature, water deficiency is very strong in summer and is close to the oceanic climate. Annual rainfall is 727.8 mm. and its average temperature is 14.7 °C. The three hottest months are July, August and September. The amount of precipitation in the hottest three months is 147.3 mm.

A total of 70.5 days were determined as dry during the year.

**Findings from Kastamonu province**

Meteorological measurements made by the meteorological station in Kastamonu city center between 1930 and 2023 are long-term data. The water balance table according to the Thornthwaite Method created from these data is shown in Table 5.
When Table 5 is examined, Kastamonu city center shows a semi-humid-semi-humid, medium temperature, excess water in the winter season and a moderate climate, close to the oceanic climate. Annual rainfall is 485.1 mm. and its average temperature is 9.9 °C. The three hottest months are June, July and August. The amount of precipitation in the hottest three months is 138.6 mm. While the actual evapotranspiration amount is 182.7 mm. is. The water shortage in summer is 165.4 mm. With these data obtained, drought is observed during the growing period of plants in Kastamonu province in the summer (June, July and August). A total of 68.8 days were determined as dry during the year.

Meteorological measurements made by the meteorological station in Kastamonu city center between 1991 and 2020 are data for the last climate period. The water balance table according to the Thornthwaite Method created from these data is shown in Table 6.
When Table 6 is examined, Kastamonu city center shows a semi-humid-semi-arid climate with medium temperature, excess water in winter and moderate climate, close to the oceanic climate. Annual rainfall is 525.3 mm and its average temperature is 10.1 °C. The three hottest months are June, July and August. The amount of precipitation in the hottest three months is 163.8 mm. The actual evapotranspiration amount is 210.4 mm. The water shortage in summer is 143.1 mm. With these data obtained, drought is observed during the growing period of plants in Kastamonu province in the summer (June, July and August). A total of 59.7 days were determined as dry during the year.

**Discussion**

Water availability is becoming an important consideration in the 21st century. Water balance sheets are tools that water users and managers use to measure the hydrological cycle. A water balance sheet is an accounting of the rates of water movement and change in water storage in all or part of the atmosphere, land surface, and subsurface. In this study, climate analysis was made according to the Thornthwaite water balance method from the long-term average meteorological data.
data of Samsun, Sinop and Kastamonu provinces and the last climate period (1991-2020) meteorological data.

As a result of the climate analysis conducted for Samsun province, no significant difference was detected in the total annual precipitation amount and annual average temperature values between the two periods. However, there is an increase of 58.6 mm. in the amount of precipitation in the summer season. There has been an increase of approximately 20 mm. in the real evapotranspiration value, which is a remarkable value, in the last climate period. There is no significant difference in water deficit values. In long-year meteorological data, 6 of the monthly highest temperature values occurred in the last climate period. These results show that the climate has started to warm up in the recent period.

As a result of the climate analysis conducted for Sinop province, the difference in total annual precipitation between the two periods was approximately 36.4 mm, while no significant difference was detected in the annual average temperature values. At the same time, there is an increase of 5.9 mm. in the amount of precipitation in the summer season. The real evapotranspiration value, which is a remarkable value, increased by approximately 5.9 mm. in the last climate period. With a difference of 54.3 mm. in water deficit values, drought is becoming increasingly severe in the summer season in the last climate period. In long-year meteorological data, 9 of the monthly highest temperature values occurred in the last climate period. These results show that the climate has started to warm up in the recent period.

As a result of the climate analysis conducted for Kastamonu province, the difference in total annual precipitation between the two periods was approximately 40.2 mm., while no significant difference was detected in the annual average temperature values. At the same time, there is an increase of 25.2 mm. in the amount of precipitation in the summer season. The real evapotranspiration value, which is a remarkable value, increased by approximately 27.7 mm. in the last climate period. With a difference of 22.3 mm. in water deficit values, drought is gradually decreasing in the summer season in the last climate period. In long-year meteorological data, 9 of the monthly highest temperature values occurred in the last climate period. These results show that the climate has started to warm up in the recent period.

As a result of the evaluations made in these three provinces; There was no significant difference in the climate evaluations of the last climate period with long-term data in Samsun province. In the last climate period in Sinop province, the severity and duration of drought in the summer are gradually increasing. In Kastamonu province, drought severity has been on a downward trend in the last climate period.

The effects of climate change are slowly starting to show their impact on water balance sheets in all three provinces. As a result of the increase in summer temperatures and summer precipitation, there is an increase in natural disasters such as heat waves and floods as a result of heavy rains in the provinces under study. More academic studies are needed to monitor climate change on a regional and local scale, predict change trends, and conduct the necessary risk analyses.

**Declarations**

We would like to thank the General Directorate of Meteorology for sharing the meteorological data of Samsun, Sinop and Kastamonu provinces.
References


Changes in the Temporal and Spatial Distribution of Anchovy Catch in the Black Sea According to Transport Document Records

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Abstract
Anchovy catch constitutes approximately half of the marine fish catch in Türkiye and is mostly caught in the Black Sea. Between 2010-2022, 73 per cent of the total marine fish catch was caught in the Black Sea. On average, 62 per cent of the marine fish catch in the Black Sea is anchovy. However, especially in recent years, anchovy catch has been fluctuating from year to year. Anchovy catch is highly affected by ecological factors as well as fishing pressure. Changes in the marine ecosystem with the effect of climate change affect anchovy catching time, catching area and catch amount. In this study, the temporal and spatial changes in anchovy fishery over the years were analyzed by using the transfer document records in the Fisheries Information System (SUBIS) for the years 2009-2023. Anchovy catch in the Black Sea during the fishing season between September and April was evaluated by dividing into months and 7 areas. In the fishing seasons between 2009 and 2023, anchovy fishing generally started in October. In this period, on average, 57% of the annual catch was made in November. However, in 2012-2013, 2018-2019 and 2022-2023 seasons, intensive fishing shifted to December, one month later. In this period, approximately one third of the annual catch was made in the coasts of Samsun-Ordu provinces. However, in 2014-2015, 2017-2018 and 2019-2020 seasons, the catch intensity was observed along the coasts of Rize-Artvin provinces. It is estimated that this change in the temporal and spatial distribution of the catch over the years is due to the differentiation in anchovy migration in the Black Sea with the effect of ecological factors and especially seasonal changes in sea water temperature.

Keywords: Anchovy, transport document, catching time, catching area, Black Sea
Forest Villagers' Views on the Future of Chestnut Forests

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Abstract

Sinop province has an important potential in terms of biodiversity due to its geographical location, soil structure and climate. There are various forest products that generate income. The most important of these is chestnut. When we look at the distribution of chestnut production amount in Türkiye by provinces for the period between 2006-2020, Aydın, İzmir, Sinop, Kastamonu and Bartın come to the fore. In recent years, some diseases have emerged in chestnut forests, causing intense drying. With this research, it was aimed to obtain the opinions and solution suggestions of forest villagers regarding the problems experienced in chestnut forests. In April 2024, 15 forest villagers participated in the study carried out by purposive sampling method in Ağaçlı and Abdülkadırköy of Ayancık district of Sinop province. 14 of the participants were male and 1 was female. The research was designed as "Case Study" from qualitative study methods. Semi-structured interview form prepared by the researchers for this research was used in the interview. The form, which was finalized after expert opinion, consists of two parts. The first part includes demographic questions and the second part includes four open-ended questions. Note-taking method was used in the interviews. According to the findings obtained from the research, it was determined that chestnut forests are a source of income for forest villagers. Among the reasons that threaten the existence of chestnut forests by forest villagers, woolly bee, chestnut cancer, lack of maintenance and excessive number of unnecessary trees and bushes were shown. The suggestions of the forest villagers for the protection of chestnut forests are to carry out studies to find solutions to diseases, to cooperate with forest villagers, and to clean dry trees and bushes. They mostly demand scientific studies and training from the Sinop University. From the Regional Directorate of Forestry, they demanded that villagers be given responsibility for forest maintenance and cleaning, regular maintenance and trust in forest villagers. The results of the study were discussed within the scope of the literature and recommendations were made.

Keywords: Chestnut forests, forest villagers, forests problems.
Nest Site Selection and Reproductive Success of Storks Breeding in Saraydüzü Sinop

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2 Saraydüzü Mehmet Akif Ersoy Anatolian High School, Sinop, Türkiye
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Abstract

The White Stork (Ciconia ciconia) is a breeding bird and passage migrant in Türkiye. It nests in rural areas, primarily on top of man-made structures such as electricity poles, roofs, chimneys, and even trees. In this study, we analysed data on White Stork breeding success in Saraydüzü, Sinop during three breeding seasons.

The White storks arrived at the study area on March 15, left on August 22, arrived on March 8, left on September 7, and arrived on March 6 in 2022, 2023, and 2024, respectively. The number of breeding pairs of White Storks was monitored and in 2022, 2023, and 2024, 52, 53, and 53 nests were found, respectively.

A total of 127 chicks hatched in 44 nests and 106 of these fledgings successfully left the nest in 2022. The average number of fledging per nest was 2.88. The fledging success was 83%. Of all nests, 61% were nests with 3 chicks. 4 of these nests did not succeed in fledging young.

A total of 144 chicks hatched in 48 nests, and 130 of these chicks left the nest in 2023. The average number of chicks per nest was 3. A fledgling success rate of approximately 90% was observed. Of all nests, 31% were nests with 3 chicks. 3 of these nests did not succeed in fledging young.

The White Storks build their nests mainly on electricity poles and roofs in Saraydüzü. This area is highly safe for breeding storks, although there are some risks due to the electricity transmission and distribution system as well as nests built on electricity poles. For safety reasons, artificial nests were placed and the White Storks are successfully nested in 27 of the 32 artificial nests in 2024. There have also been nest losses due to the construction of new buildings and tree-cutting.

Keywords: Breeding, nest, Sinop, Saraydüzü, white stork
Transformer Insulation Performance Analysis of C4F7N Gas

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Abstract

Gas insulated transformers (GITs) represent a revolutionary advancement in electrical power transmission and distribution systems. The concept of gas-insulated transformers emerged as a response to the ever-increasing demand for compact and reliable electrical equipment.

This paper offers a cleaner, more efficient, and environmentally friendly transformer design as a replacement for mineral oil. COMSOL Multiphysics environment was used for evaluation of a 50 kVA, 34.5/0.4 kV gas insulated distribution transformer. C4F7N is employed as insulation. In the COMSOL environment, the thermal characteristics of the C4F7N gas insulated transformer were examined. The performance of oil and SF6 gas insulated transformers was simulated using the same model, and the results were compared.

General distribution transformer C4F7N GIT model has ratings of 50kVA, 34.5/0.4kV, and all technical drawings are taken from a true 2-D model in mm. The model has every detail. COMSOL Multiphysics 5.5 is used for computer simulations. Five different materials are used to model C4F7N GIT in simulation environment. These are wood, copper, filled epoxy resin, soft iron and C4F7N. Time-dependent solutions are used for heat analysis. Low-voltage windings are considered as heat sources and expected to function at rated load (5). Hot spot temperature is calculated as 53.4440°C for 2D analysis.

The simulation results show the C4F7N insulated transformer compares well with SF6 (69°C), R410A (72.06°C) and oil (62.7°C), and has a strong potential as an insulator given it is environmentally friendly, cheap and low-maintenance.

Keywords: COMSOL, distribution transformer, insulated gas, hot point, C4F7N.
Seismic Signal Characteristics of 2n= 40 Cytotype of Nannospalax xanthodon (Mammalia: Rodentia)

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Abstract

In Anatolia, the blind mole rats underwent phylogenetic diversification into distinct lineages in accordance with the ecological diversity of the habitats in which they are distributed. Because of their specialization in their underground life, they have a distinct life story. One of the most intriguing characteristics of these stories is their mode of communication. In their underground habitat, where it is dark and sound transmission is limited, their distinct vibrations are a crucial means of communication. Although early studies have indicated that distinct cytotypes of Anatolian Blind Mole rats have diverse seismic communication signals, more research is needed on this topic. At the present study, seismic signals of 3 individuals from 2n= 40 cytotypes, which are grouped phylogenetically differently from other cytotypes, were examined. The Pu character, which is one of the variables examined and can also be considered as signal rate, appears to be specific for the 2n= 40 cytotype. The findings indicate that the 2n= 40 cytotype has its own signaling character. Thus, evidence continues to accumulate that different phylogenetic Blind Mole Rat lineages have unique seismic signal structures. Although the signaling structure of three individuals is a small sample, it still provides insight into the signal characterization of the 2n = 40 cytotype. Comprehensive research with a bigger sample size is going to reveal the seismic signal characteristics of this cytotype in more detail.

Keywords: Nannospalax xanthodon, seismic communication, vibrational communication, behaviour.
Analyzing the Effects of Climate Change on Protected Areas: A Case Study of Kızıldağ National Park

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Abstract

Climate change stands as one of the paramount environmental issues of our time. The adverse effects it imposes on natural ecosystems, such as increased temperatures and occurrences of extreme weather events, also impact protected natural areas. This study aims to identify the effects of climate change on protected natural areas and biodiversity, and to discuss potential measures to mitigate these effects. The Kızıldağ National Park, located in the Mediterranean Region and in the province of Isparta, is chosen as a case study area. The study will elaborate on the natural resource values of Kızıldağ National Park, provide insights into its biodiversity, and underscore its ecological significance. Within this scope, potential impacts of climate change on the area will be addressed, drawing from studies focusing on climate change and protected areas, and sustainable solutions will be proposed concerning the theme of sustainability.

Keywords: Climate change, protected areas, Kızıldağ National Park
Introduction

The advancement of industry, coupled with the rapid increase in the world population, has led to an escalation in the consumption of natural, renewable resources on Earth's surface, consequently contributing to the rapid escalation of climate change from past to present. As human activities intensify, the quantity of green areas within urban environments has decreased (Demirbaş and Aydin, 2020). Besides urban and rural areas, climate change adversely affects landscapes rich in natural values, such as forests, lakes, wetlands, and other scenic areas. The diminishing water resources and biological diversity, alongside the adverse impact on natural beauty and even the serious jeopardy faced by protected natural areas, are all consequences of climate change effects (Çolakdağ, 2019). National parks and nature reserves are designated as special natural areas protected by specific laws and regulations to sustain the sustainable relationship between humans and nature by safeguarding the natural and cultural ecosystems from human intervention (Akşap, 2018).

Despite being under surveillance by specific laws and regulations, as mentioned above, in recent years, climate change has disrupted the balance of natural ecosystems. The Lakes Region, which is one of the regions where the effects of climate change have become visible in our country, requires scientific research to be conducted, especially focusing on areas such as Burdur Lake and Eğirdir Lake, where the changes in water levels and shoreline have been particularly noteworthy, serving as tangible evidence of the region's susceptibility to climate change (Taş and Akpinar, 2021; Keskin et al., 2017). Besides being ecosystems themselves, lakes also regulate the climatic conditions of their surroundings. Freshwater lakes serve as drinking water sources, while saltwater lakes contribute to the production of chemical substances.

The subject of this study, Kızıldağ National Park (KNP), located in Isparta within the Lakes Region, is a protected area rich in biodiversity, bordered by Beyşehir Lake, which is the third largest lake in Türkiye and the largest lake in the Lakes Region. To observe the effects of climate change on protected areas, KNP, which was declared a National Park in 1969 in Isparta Province, has been selected. The aim of the study is to demonstrate how KNP is affected by climate change and to propose sustainable solutions to these effects.

Methods

The usage of fossil fuels and the increase in urban population contribute to the rise in greenhouse gas emissions and climate change (Demirbaş and Aydin, 2020). Climate change, in turn, leads to detrimental effects on ecosystems and biodiversity, such as droughts, depletion of water reserves, changing seasons, and occurrences of natural disasters (Korkmaz and Adıgüzel, 2021).

Climate change denotes the long-term alterations in temperature, precipitation patterns, and other atmospheric conditions on Earth. This phenomenon is predominantly driven by anthropogenic activities, such as the combustion of fossil fuels, deforestation, and industrial processes, which emit greenhouse gases like carbon dioxide and methane into the atmosphere. These gases retain heat, inducing a warming effect known as the greenhouse effect (IPCC, 2022).
The accepted effects of climate change are multifaceted and extensive, such as rising temperatures, altered precipitation patterns, rising sea levels (Pascual and Bauma, 2009; Trenberth, 2011; Hansen et al., 2016). On the other hand, it causes biodiversity losses and species extension (Grimm et al., 2013). It is also known that; climate change has impacts on human health and human well being especially children and elderly people who are susceptible against the life conditions (Manisadilis et al., 2020). Climate change impacts extend to the economy and all sectors such as tourism, agriculture, and lead to financial losses (Abeysekara et al., 2024).

Addressing climate change requires global cooperation and concerted efforts to reduce greenhouse gas emissions, transition to renewable energy sources, protect natural habitats, and build resilience to its impacts. Mitigation and adaptation strategies are crucial for minimizing the risks and safeguarding the planet for future generations.

Climate change poses a serious problem for human and societal health. In response to this issue, some countries have taken action to implement measures. In 1988, the Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to assess the scientific and socio-economic information aimed at understanding and mitigating the impacts of climate change that have occurred or are likely to occur. The United Nations Framework Convention on Climate Change (UNFCCC) was adopted to reduce greenhouse gas emissions and their impacts (Eggleston et al., 2006; Erkan, 2008).

According to Demirbaş and Aydin (2020), the main cause of climate change is population growth. It is noted that as the population increases, so do needs and consumption. The IPCC's Fifth Assessment Report indicates that the increase in temperature is caused by human activities, and it is stated that the impacts of climate change will be more severe than normal (IPCC, 2022). The effects of climate change not only affect urban populations but also impact forest ecosystems due to increasing temperatures, droughts, changes in seasons, and reduced rainfall (Flannigan et al., 2000; Canlı, 2010).

This study comprehensively assessed the impacts of climate change by examining the ecological, social, and climatic characteristics of Kızıldağ National Park.

**Kızıldağ National Park and the Effects of Climate Change**

KNP, located between the Şarkikaraağaç and Yenişarbademli districts in Isparta Province, encompasses the northern and western shores of Lake Beyşehir and was designated as a National Park in 1969. One of the most notable features of KNP is its abundance of oxygen producing *Cedrus libani var. libani* (blue cedar) trees. Additionally, KNP is recognized as the largest third national park in Türkiye, owing to its status as the country's only national park known for its high oxygen production (Akşap, 2018; Gözde, 2019; Örücü and Arslan, 2020). The geographical location of KNP is illustrated in Figure 1 below.
Figure 1. Study area

Being adjacent to Lake Beyşehir, KNP hosts vital water sources. Notably, Pınargözü Cave, recognized as Turkey's longest cave, is an active cave formed by tectonic fractures within the park. In addition to cedar trees, KNP boasts a rich flora comprising various species such as black pine, Taurus fir, juniper, oak, totaling 195 endemics and over 80 aromatic plants. A diverse fauna, including numerous mammal and bird species, populates the area. Moreover, Lake Beyşehir, Turkey's largest freshwater source, houses various fish and waterfowl species (Ministry of Agriculture and Forestry 6th Regional Directorate, 2012; Akşap, 2018).

As the impacts of climate change intensify, the significance of accessible water resources escalates. Benefits derived from Lake Beyşehir include potable water supply, agricultural irrigation, fisheries, and tourism. However, reduced rainfall and receding water levels due to climate change have led to significant alterations near Lake Beyşehir (Soyaslan and Hepdeniz, 2018).

Results and Discussion

Türkiye, with its water resources, biodiversity, and climatic characteristics, is among the countries most affected by global warming. Global warming has serious and irreversible effects on forest ecosystems and water resources. As evidenced by various studies in the Lakes Region, including Eğirdir Lake, Burdur Lake, and Lake Beyşehir bordering our study area, a decrease in water levels has been observed. Consequently, the fauna and flora of the lakes are adversely affected (Korkmaz and Adigüzel, 2021). Similarly, forest ecosystems and ecosystem services provided by forests suffer from damage due to forest fires and destruction.

Lake Beyşehir and KNP in the Lakes Region are significant areas for Türkiye due to their natural landscape features. Measures need to be taken to protect forest ecosystems, which contribute to
soil, air, and water renewal and preservation. Below are recommendation strategies for combating climate change within the scope of this study:

- KNP habitat acts as an ally against climate change. Therefore, conservation of plant species and erosion control measures should be implemented.

- The Lake Beyşehir surroundings and KMP are significant tourism resources. Tourism activities in the area should be conducted using sustainable practices. Proper guidance should be provided to visitors to promote environmental awareness.

- Awareness programs should be organized to educate the local community and visitors about the importance of both the national park and the lake for sustainable use.

- Monitoring should be conducted for water usage in the lake, and protective measures should be developed to conserve it.

- The water resources of Lake Beyşehir and Pınargözü Cave within KMP must be preserved, and users should be educated about their responsible use.

- Renewable energy sources such as solar and wind energy should be utilized for energy needs within KNP. These energy sources can contribute to reducing the carbon footprint of the area.

- Training and awareness-raising efforts on climate change should be provided not only to administrators and visitors but also to staff working in the area. They should be able to intervene in emergencies (such as forest fires, unauthorized tree felling).

- Interest groups should be formed in KNP and Lake Beyşehir to address climate change. Risk and loss maps should be prepared as a result of their efforts. Decision-makers should be informed based on these studies to develop sustainability strategies.

Climate change is currently at a level where it cannot be entirely prevented. However, it can be slowed down with proposed strategies and efforts. In this regard, it is crucial for the local community, visitors, relevant employees, and, most importantly, administrators to be sensitive and aware.

Declarations

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References


Determination the Water Quality of Gelendost (Afşar, Akçay) Stream Flows into Eğirdir Lake by Physicochemical Parameters

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Abstract
In this study, it was aimed to determine the water quality of Gelendost Stream (Afşar, Akçay), which is located in Isparta province, flows into Eğirdir lake and pointed out a pollution source for the lake. The stream is originated from southern slopes of the Sultan mountains, its water used for human and animal drinking in upper course and mainly for irrigation middle and lower courses. Based on physicochemical parameters, on-site instrumental measurements were made at 9 stations, water samples taken and laboratory analyses were performed to determine and evaluate water quality changes and pollution status of the stream.

Physicochemical water quality parameters of the stream were changed among sampling points and seasons. During the summer months, the flow is cut off at some points and the stream dries up. Water flow rate shows drastic declines and outflows seasonally, in high flow times flooding were occurred and it damages nearby settlements and agricultural areas. In low flow condition water quality negatively influenced. Hisarardı I, II and Akçaşar I points have water quality allows fish raising (trout) even drinking. However, as it flows from the upstream points to the downstream section, the quality gets low classes, even in some points the water can be considered as polluted. According to the Turkish Water Pollution Control Regulation criteria the stream’s water quality is compatible of I and II quality classes. As the distance from the sources increases, the use of water and waste discharge increases, the water quality decreases and classes fall to III-IV. In addition to contaminated water entering the stream bed, animal wastes, garbage are also seen to be stored in stream bank and nearby areas. For these reasons, pollution occurs at certain points that may affect water use, and when the stream flows into Eğirdir lake, it becomes an effective source of pollution for the lake.

Keywords: Water quality, physicochemical parameters, pollution, Gelendost stream, Eğirdir Lake
Community Structure of Mesozooplankton in Winter Season in Sinop Region, Southern Black Sea

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Abstract

In the present study, it was aimed to determine the taxonomic composition and abundance values of mesozooplankton in the Sinop marine area during the winter season. The data which is used in this study were obtained during the field studies of the project coded SÜF-1901-23-004 and entitled "Temporal and spatial changes of the larval fish assemblage in Sinop" supported by Sinop University for Scientific Research Project. Mesozooplankton samplings were performed from three stations located on the south coast of Sinop on December 2023, January 2024 and February 2024 with the "SUFAK-1982" research vessel. Samples were collected using plankton net with 0.2 m² mouth opening area and 112 µm mesh size from the bottom to the surface by vertical hauls. In total, 18 mesozooplankton groups/species including six Copepoda, one Cladocera, one Appendicularia and one Chaetognatha species were identified in the present study. The total abundance of mesozooplankton varied 743–3933 ind.m⁻³, with minimum at station 6 in December 2023 and a maximum at station 4 in February 2024 in Sinop marine area. Copepod was the most abundant of mesozooplankton community with a share of 89% (1377 ind.m⁻³). The species that contributed the most to mesozooplankton mean abundance were Paracalanus parvus (371 ind.m⁻³–24%) from Copepoda, Oikopleuro dioica (112 ind.m⁻³–7%) from Appendicularia and Bivalvia larvae (46 ind.m⁻³–3%) from Meroplankton in winter season. Compared with the previous data in Sinop region (2002–2009), it was determined that the contribution of Meroplankton to the mesozooplankton community structure decreased while the contribution of Appendicularia increased.

Keywords: Mesozooplankton, abundance, biodiversity, Sinop
In the Light of Ecological Understanding: The Natural Trail of Nezahat Gökyiğit Botanic Garden

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Abstract

Nezahat Gökyiğit Botanic Garden emerges as a sanctuary wherein biological diversity is conserved, and ecological processes can be observed in detail. Despite housing an array of diverse plant collections, the most remarkable facet is arguably the untouched Natural Trail protected against human interference. The principal rationale for the uniqueness of this locale resides in the organic proliferation of biological diversity, affording the opportunity to observe species seldom encountered within urban settings. The existence of this distinctive area enriches the diversity inherent in nature education activities conducted within the garden. Studies undertaken within the Natural Trail reveal the presence of various organisms, including liverworts and diverse moss species, which struggle to thrive in the cultivated soils of the garden. Additionally, this area boasts the highest diversity of mushrooms, with species numbers witnessing annual increments. Various workshops designed to facilitate students' comprehensive exploration of the Natural Trail, are meticulously orchestrated, covering a plethora of topics encompassing mushrooms, plants, and ecology. The need for undisturbed natural areas within urban environments is significant. Positioned at the heart of the metropolis, Nezahat Gökyiğit Botanical Garden stands as the sole center capable of fostering individuals' connection with the natural world. Consequently, endeavors undertaken within this realm are of paramount importance in instilling awareness among future generations.

Keywords: Nature education, biological diversity, botany, ecosystem
Bioremediation and the use of Actinobacteria in Bioremediation

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Abstract

Bioremediation is an important strategy that uses natural organisms or biological processes to reduce or eliminate environmental pollution. Heavy metal pollution, especially from industrial activities, is a common problem that seriously affects aquatic and soil ecosystems and poses a great risk to human health. This presentation highlights the role of bioremediation in combating heavy metal pollution and examines the contributions of actinobacteria, one of the most important actors in this field, in this process.

Actinobacteria are microorganisms that are widely found in nature and have a wide habitat. These bacteria have an important role in combating heavy metal pollution in bioremediation processes. The mechanisms used by actinobacteria in heavy metal bioremediation include various methods such as precipitation by binding metal ions, reduction by reduction, transport by forming metal complexes, and pushing through cellular membranes. The complexity of these mechanisms allows the development of effective bioremediation strategies to combat heavy metal pollution. The diversity and adaptation abilities of actinobacteria allow the development of effective bioremediation strategies in different environmental conditions. This presentation examines in detail the mechanisms and adaptation strategies of actinobacteria to understand how they are effective in heavy metal bioremediation. Understanding how actinobacteria adapt to environmental conditions and heavy metal concentrations helps optimize bioremediation processes and develop more effective strategies for reducing environmental pollution. These studies can play a critical role in achieving environmental sustainability goals.

In conclusion, this presentation highlights the importance of actinobacteria in heavy metal bioremediation, indicating their potential to provide innovative and sustainable solutions in reducing environmental pollution. Future research to increase the effectiveness of actinobacteria in bioremediation processes and reduce environmental pollution is of great importance. These studies can play a critical role in achieving environmental sustainability goals.

Keywords: Bioremediation, actinobacteria, heavy metal pollution
Comparison of Research Studies on Algal Flora and Water quality in Atatürk Dam Lake (Şanlıurfa, Türkiye at Different Times (2011 and 2012)

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Abstract
These studies were carried out monthly between November 2011 and October 2012 and seasonally between February 2020 and November 2020 on Algal Flora and Water Quality at different times between Atatürk Dam wall and Tunnel Entrance Area (Şanlıurfa, Türkiye). As a result of the taxonomic study between November 2011 and October 2012, a total of 120 taxa belonging to different divisions of Bacillariophyta (57), Cyanophyta (19), Chlorophyceae (19), Charophyta (15), Dinophyta (5), Euglenophyta (3), Xanthophyceae (1) and Chrysophyceae (1) were identified. In the taxonomic study conducted between February 2020 and November 2020, a total of 263 algal taxa, including Bacillariophyta (170), Cyanobacteria (31), Chlorophyta (27), Charophyta (23), Miozoa (10), Euglenophyta (1), Ochrophyta (1), were identified. Diatom Index 1 was calculated as oligotrophic; Cyanophyceae Index and Composite Index as eutrophic; Stockner Diatom Index, Total Phosphorus, Total Nitrogen, Chlorophyll-a and Secchi Disk Depth as mesotrophic in Atatürk Dam Lake. According to these data and calculations, we can conclude that the trophic state of Atatürk Dam Lake is mesotrophic.

Keywords: Atatürk Dam Lake, algal flora, phytoplankton, benthic algae, water quality
Detecting Speciation and Subspeciation using the Kimura 2-Parameter Model: an example with *Sorex* sp.

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Abstract

In the field of molecular biology and genetics, understanding the variations within and between species is crucial for studying their evolutionary relationships, population dynamics, and ecological interactions. The Kimura 2-parameter (K2P) model is widely used to analyze nucleotide substitutions and it has been shown to be effective in distinguishing intra and interspecies variations. This model takes into account both transitional and transversional substitutions, providing a more accurate representation of evolutionary distances between species. In this study, the effectiveness of K2P in demonstrating interspecific and intraspecific differences was elucidated using *Cytb* sequences of *Sorex* species. Genetic distance values between *Cytb* sequences of five species belonging to the genus *Sorex* (*S. araneus*, *S. raddei*, *S. mimitus*, *S. volnuchini*, and *S. satunini*) registered in GenBank were compared using the Kimura-2 parameter in the MEGAX program. It was revealed that interspecific K2P genetic distance values were significantly different from intraspecific genetic distance values. The results of this study have shown that the Kimura 2-parameter can be effectively used to differentiate between different species and subspecies within species.

**Keywords:** Kimura 2-parameter, genetic divergence, taxonomic discrimination, *Sorex* sp.
New Discoveries for Local Endemic *Lilium akkussianum* Gamperle Habitats

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Abstract

More than 10,000 of the approximately 13,000 plant species identified so far in Europe are found in our country, and approximately 3,500 of them are endemic. When evaluated from this perspective, our country has the characteristics of a continent in terms of biological diversity and is an important gene center. Environmental problems, which have been the main agenda topic in recent years, increase the pressure on ecosystems day by day. Many endemic plant species are consumed uncontrollably for food, ornamental and cosmetic purposes, and their populations are rapidly decreasing. In order to prevent this and similar destruction, it is important to determine the habitats and species densities of endemic species and critically endangered species, and to determine conservation strategies.

In the study, the natural habitats and habitat types of the local endemic *Lilium akkussianum*, known as Mis Lily and Akkuş Lily, which has medicinal and economic potential and spreads to the border of Akkuş District of Ordu Province and Tokat Erbaa, were determined. A total of five new habitats were identified: one in the Seferli neighborhood of Akkuş District, one in the Çamalan neighborhood, one in the Çaldere neighborhood, one in the Argan plateau location, and one in the Perşembe plateau location in the Aybastı District. Although the species densities vary in these habitats with different altitudes and topography, the common feature of all of them is that they consist of open areas within the forest.

Keywords: *Lilium akkussianum*, Akkuş Lily, local endemic
The Impact of Microplastic Pollution on a *Lyciasalamandra atifi* Population from Antalya Province

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Abstract

Amphibians have a low tolerance to environmental pollution levels due to their ecological and biological characteristics. Microplastics, one of the environmental pollutants, have contaminated the habitats of many organisms in nature for many years due to their durable and biologically non-degradable structure. In this study, the effect of microplastic pollution on Atif’s salamander *Lyciasalamandra atifi*, a terrestrial salamander species living in Antalya province, was investigated. In this context, the gastrointestinal tract (GIT) of 10 individuals including males, females, and juveniles whose morphological measurements were taken was removed using a stainless steel dissection set. GIT samples were placed in conical flasks and 150 mL of 30% H₂O₂ was added and kept at 65 °C for three days. Completely dissolved samples were passed through a Whatman GF/C filter using a vacuum pump. The types of possible microplastic particles remaining on the filter were examined by FT–IR spectroscopic analysis to detect. When the average amount of MP per individual was calculated, a total of 5 MP particles were detected in 10 individuals (average per individual = 0.5). The chemical components of these microplastic polymers were polyethylene terephthalate (PET, 40%), Polycyclohexylenedimethylene terephthalate (PCT, 20%), Ethylene vinyl acetate (EVA, 20%) and Polystyrene (PS, 20%), and fibers were the dominant shape (80% fiber and 20% fragment). The average size of MPs was 357 μm (range: 25–665). When the results of the study are evaluated, it can be concluded that microplastics can be found in living things regardless of whether they are females, males, or juveniles.

Keywords: Antalya, amphibians, environmental pollution, salamander, terrestrial
Scanning Electron Microscopy of the Palp Sense Organs and First Leg of the Solifuges *Gluviopsilla discolor* (Arachnida: Solifugae: Daesiidae)

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Abstract

Solifuges navigate their surroundings by extending their pedipalps, similar to how insects use their antennae. By maintaining physical contact with the female and utilizing his pedipalps, the male ensures a successful mating process. With the help of a unique organ, solifuges can securely grasp their prey and climb even the smoothest and steepest surfaces. In this study, the setal types on the palp and first leg of the solifuges *Gluviopsilla discolor* were thoroughly examined using scanning electron microscopy. The setal types serve as sensory organs that function both as contact chemoreceptors and mechanoreceptors. On segments of palps and first legs, there are bifurcated setae, blunt setae, cavitate baton setae, truncated setae, simple setae, clubbed setae and papillar setae. It has also been confirmed that the pore structures are located at the apex of the pedipalp tarsus.

Keywords: Solifugae, camel spiders, SEM, setal types, sensilla.

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Abstract

The objective of this research endeavor is to analyze the concentrations and spatial distributions of potentially hazardous elements (PTEs) in the surface detritus of the Abdal River System, which is in close proximity to the Çakmak Dam. The dam serves as an essential water supply for the province of Samsun in Türkiye. The examination of PTE concentrations, expressed in milligrams per kilogram, reveals considerable heterogeneity. Fe exhibits the maximum concentration, followed by Mn, Cr, Zn, Ni, Cu, Pb, As, Cd, and Hg. Seasonal fluctuations were noted, with significant increases in levels of As, Cd, and Pb occurring during the summer (p<0.05). Moderate to low contamination levels were indicated by ecological risk indices, demonstrating the possibility of ecological impacts. Sediment PTEs pose minimal health hazards to humans, according to risk assessments, indicating that they pose a relatively low threat to human health. The incorporation of the coefficient of variation (CV) into statistical analyses improved the characterization of sedimentary environments and the identification of contamination sources. A range of anthropogenic and natural activities, including rice and hazelnut cultivation, were identified as contributors to the contamination levels of PTEs. The present study sheds light on the level of contamination in the Abdal River System, underscoring the criticality of implementing focused management approaches to alleviate pollution and protect public and environmental health. The insights presented provide policymakers and environmental managers with valuable guidance as they develop effective strategies for sustainable water resource management and environmental protection.

Keywords: Human health risk evaluation, pollution source tracing, toxicological assessment, ecological risk assessment
Discovering the Value of “Water” via Paula Hayes' Terrariums

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Abstract

Nature has been a source of inspiration for artists in every period throughout the history of art, but after the 1960s, it began to produce a much different meaning for the artist than before. The danger posed by industry on nature has forced artists to rethink and question the human-nature relationship. They have produced work that draws attention to problems in order to spread awareness towards nature and raise social awareness. Paula Hayes is one of these artists. Among Hayes’ works, terrariums in particular attract much attention. With terrariums of his own design, the artist makes the life process of plants traceable and focuses on the idea that nature should be approached with care.

Hayes’ terrariums inspired the practice that is the subject of this study. In the 2018-2019 academic year, terrarium designs were carried out with students in the visual arts teacher training, art teaching practices course. Each student purchased a ready-made terrarium and created their own piece of nature with succulents of various shapes, colors and sizes. They arranged the plants by taking into account the principles of design, thus not ignoring the aesthetic value. The fact that succulents need very little water to survive has turned this plant type into a metaphorical means of expression in designs. Until the end of the semester, students were given the responsibility of observing and maintaining the life process in their own terrariums. They watered the plants according to the moisture content of the soil and maintained their designs. With this practice, students realized the reasons for using water as much as necessary and how excessive water use threatens life. They also created solutions to sustain and beautify life in their terrariums. Moreover, they showed an attitude of transferring this practice to their teaching lives.

Keywords: Saving on water, industrialization, ecological art, Paula Hayes, art teacher training
Ecological Art Practices in Visual Arts Teacher Education

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Abstract
The threat that industrialization poses to the ecosystem has led artists, as well as many professionals, to rethink and question the human-nature relationship. Art alone does not have the power to provide solutions to industrialization-related problems that threaten the ecosystem, such as the decrease in water resources, the pollution of the seas and soil, and the endangerment of biodiversity. However, it is a very effective tool in creating social awareness by making the problem visible. Art has the potential to create a social impact in dealing with ecological problems and creating a more livable future, as it involves reasoning, criticism, questioning and new discoveries combined with imagination. The aim of the artists to spread sensitivity towards nature and create social awareness has brought art-based ecology education to the agenda. Thus, it was aimed to raise awareness of nature in students through art.

This study includes ecological art practices carried out with students in the visual arts teacher training, art teaching practices course in the 2019-2020 academic year. Before the practice, artists with ecological art productions were introduced to the students, and environmental problems were examined through the artists' works. As it coincided with the beginning of the Covid-19 pandemic process, the lessons were held online. Therefore, students practiced artwork in their own homes. After examining examples of ecological art, each student developed thoughts on an ecological problem. They have produced artwork that draws attention to ecological problems such as the destruction of green areas in the world, the destruction of trees, pollution in the seas and oceans, and pandemics. With this practice, students experienced how to make an ecological problem visible through art and realized the necessity of transferring ecological art practices into their teaching lives.

Keywords: Industrialization, ecological problems, ecological art, art teacher training
**Inhibition Profile of Lactoperoxidase Enzyme on Sulfamate Derivatives**

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**Abstract**

Myeloperoxidase (MPO, EC 1.11.1.7) is an oxidoreductase and one of the major antimicrobial system enzymes in mammalian neutrophils. It is believed that human MPO, along with active NADPH oxidase, produces H2O2, which has antimicrobial functions in neutrophils and Kupffer cells. Due to the reaction of reactive species generated during the catalytic action of myeloperoxidase with normal biomolecules, the enzyme also contributes to cell and tissue damage in various inflammatory diseases. MPO is considered one of the causes of atherosclerosis, disorders seen in the central nervous system, and different inflammatory diseases including some types of tumors. The I₅₀ values, Ki values, and inhibition types of compounds such as Methyl (2-bromobenzoyl sulfamate, Methyl (3-phenylpropanoyl sulfamate, Methyl (1-naphthoyl sulfamate, Methyl (2-methylbenzoyl sulfamate, Methyl (2-iodobenzoyl sulfamate, Methyl (2-phenylbutanoyl sulfamate, Methyl (4-isopropylbenzoyl sulfamate, Methyl (4-methoxybenzoyl sulfamate, and Methyl (isoquinoline-1-carbonyl sulfamate on myeloperoxidase enzyme have been determined. The most effective inhibitor, Methyl (2-phenylbutanoyl sulfamate, showed an I₅₀ value of 0.43 µM, a Ki value of 0.0084 ± 0.009 µM, and exhibited competitive inhibition.

**Keywords:** Myeloperoxidase, inhibition, kinetics
The determination of the binding capacity, optimum pH, optimum temperature, and ionic strength of lactoperoxidase enzyme purified from bovine and ovine milks onto 2-Chloro-4-sulfamoylaniline

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Abstract

The usability of 2-Chloro-4-sulfamoylaniline, a sulfanilamide derivative, was investigated in the purification of lactoperoxidase (LPO, E.C.1.11.1.7) enzyme from bovine and ovine milk. For this purpose, the kinetic parameters of the 2-Chloro-4-sulfamoylaniline molecule were determined using previously purified bovine LPO enzyme. The inhibitor concentration that reduces enzyme activity by half (IC50) was calculated as 346.50 µM, and the Ki values were determined as 283.32 µM, respectively. A competitive inhibition mechanism was observed for this molecule, and affinity gels were synthesized to purify LPO enzymes from bovine and ovine milk. Purification tables were prepared, and as a result of purification steps, the 2-Chloro-4-sulfamoylaniline molecule with bovine milk LPO enzyme was obtained in a single step with 12% yield and 453-fold purity, while with ovine milk, 13% yield and 869-fold purity were achieved. The purity of the enzymes was confirmed by SDS-PAGE, revealing a single band at approximately 80 kDa. For bovine LPO purified from the 2-Chloro-4-sulfamoylaniline column, the optimum pH was found to be 6.0; optimum temperature, 42°C; Km value, 0.14 mM; and Vmax value, 0.55 U/mL.min, whereas for ovine milk LPO, the values were optimum pH 5.5; optimum temperature, 60°C; Km value, 0.74 mM; and Vmax value, 0.05 U/mL.min. The binding capacity of LPO for the column of 2-Chloro-4-sulfamoylaniline was determined as 9.65 mg/g gel at 15°C, pH 8.5, and 0.35 M ionic strength concentration.

Keywords: Lactoperoxidase, inhibition, kinetics
Balancing Nuclear Energy and Ecology in Terms of Fisheries in the Black Sea

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Abstract

Energy generation does not come without environmental impact. Nuclear reactors are systems that produce energy efficiently with minimal carbon emission compared to fossil-fueled systems. They have high energy density and high-capacity factor compared to the other energy resources. Thermal discharge and nuclear waste are the main environmental impact that accident-free operating nuclear reactors may cause. To develop methods to reduce the environmental effects of nuclear reactors, it should be started by understanding the interactions with the ecosystem. Living organisms can be influenced by thermal discharge of the reactors. All nuclear reactors are located near an aquatic reservoir for cooling processes. For the reactors located by seaside, this may cause a change in fisheries and marine organisms’ behavior. Thermal discharge to the sea may alter the sea temperature, thus fish species. When the parcel temperature of sea increases, fish which prefers to live in warm waters may chose to increase their population in the parcel region. This effect can be considered as a direct effect. Furthermore, the thermal discharge can alter zooplankton and phytoplankton. As nutrient cycling of fish changes, the species migrates to comfortable living conditions. In fact, this consequence is not always a negative effect as it may invite new species and increase their population. During the construction stage (6-10 years) can create artificial reefs. Artificial reefs can assist in restoring and establishing new habitats for marine life to flourish in. Artificial reefs attract a diverse range of marine creatures, including fish, crabs, mollusks, and plants. By enhancing biodiversity, these structures can help to improve marine environments. In conclusion, the consequences of nuclear reactors on fishing require diverse and careful analysis. Negative consequences can be reduced while favorable outcomes are increased by establishing strong safety procedures and limiting environmental repercussions. The Black Sea is a closed body of water connected to the Mediterranean Sea. However, it is regarded as isolated from the oceans due to the lack of a direct link. This isolation has significant consequences for its ecology. As a result, cooling towers for the reactors that are expected to be built at the Black Sea Coast should be considered.

Keywords: Nuclear reactor, ecosystem interaction, marine biodiversity, fisheries.
Unveiling the Environmental Effects of Nuclear, Fossil, and Renewable Sources

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Abstract

The production of energy has an influence on the environment. In comparison to fossil fuel-fueled systems, nuclear reactors are efficient energy producers that emit the least amount of carbon dioxide. The first step in creating strategies to lessen the environmental impact of nuclear reactors should be comprehending how they interact with the ecosystem. Nuclear reactors require strong and reliable cooling systems for their safety and reliability. The main environmental impact of nuclear reactors consists of heat generation to the environment and radioactive waste. Nearby locations can be affected negatively due to the heat introduced to the environment. However, nuclear reactors are known for low greenhouse gas emissions. To produce the same amount of energy from fossil fuels, %6833 times more CO2 will be produced. The creation of CO2 causes both air pollution and climate change in countries where energy is generated by fossil fuel facilities. As a result, the production of power from nuclear reactors limits climate change and its effects on the ecosystem. Because of their nature, renewable energy sources are more ecologically friendly. Unfortunately, their energy density and capability are questionable. To generate the same quantity of electricity as nuclear reactors, a wide area would be covered by solar panels or wind turbines. This comparison shows that solar and wind energy could devastate the ecosystem. Wind farms threaten animals and produce low-level noise. Solar panels are made of hazardous materials for the environment, especially when they are nearing the end of their useful lives (20–30 years. However, to generate power, solar panels require daylight alone, whereas wind turbines require a steady supply of wind. As a result, nuclear reactors provide more long-term and worldwide environmental benefits.

Keywords: Environmental impact, climate change, ecosystems.
Evaluating the Impact of Climate Change on the Water Regime Potential of Freshwater Resources in the Ihlara Region

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Abstract

Global warming observed in recent years has been associated with large-scale changes in the hydrological cycle, such as changes in precipitation regimes, densities and frequencies, reduced snow cover, and changes in soil moisture and runoff. As a result of these changes in the hydrological cycle, it not only affects freshwater resources in coastal areas, but can also cause salinization of groundwater. Globally, freshwater resources are the most important resources we need in all areas of life and life. Only 0.3% of the 35 million km³ of fresh water on Earth consists of freshwater resources suitable for ecosystem and human consumption. The most important effects of climate change are the disruption of the water cycle and the change of water quality. Increasing climate changes are causing the quantity and quality of freshwater resources to decrease and pose a threat to future generations.

Within the scope of the study, the consequences of climate change in Ihlara Province, in Türkiye were examined by models with backdated meteorological precipitation and current data for the selected region. One of the climate scenarios used in this study, HadGEM2-ES, is designed for the specific purpose of simulating and understanding the century-scale evolution of climate, including ecosystems and hydrological processes, in a completely consistent way. The other model is the GFDL-ESM2M global circulation model. The MPI-ESM-MR model, on the other hand, is a comprehensive climate model consisting of many components that integrate the atmosphere, ocean, sea ice, and terrestrial systems.

In this work, drought analysis was carried out utilizing meteorological 17192-Aksaray station data (2010–2022 and the SPI index. Using these data, the 2023–2098 regional climate change and drought scenarios of the HadGEM2-ES, GFDL-ESM2M, and MPI-ESM-MR models were analyzed.

It is anticipated that temperatures will rise and precipitation levels will fall in the Ihlara region of Aksaray when forward-looking estimates show that the region has experienced moderate to severe drought up to this point.

Keywords: climate change, HadGEM2-ES, GFDL-ESM2M, MPI-ESM-MR, drought analysis
Abstract

The scientific community seems to agree that our world is facing a climate disaster today. The fact that millions of people globally are faced with natural catastrophes such as extreme heat, excessive rainfall, drought, floods and hurricanes has led not only the scientific community but all humanity to seem to accept the existence of the global climate crisis. On the other hand, we are facing an inevitable consequence of people's passion for consumption and production, which is not just a climate disaster. Scientists insistently emphasize that successive climate changes are not just the normal flow of nature, but are an inevitable result of the greenhouse gases that humanity has created, especially since the industrial revolution, and the damage it has caused to our planet in general.

So how can the global climate crisis be resolved in this case? It is necessary to reduce existing energy use, and in order to reduce it, it is necessary to reduce commodity production. Controlling commodity production is a political problem, as is managing to neutralize fossil fuel companies. The solution to the political problem depends on reversing the balance of political power. Methods that will revitalize, green and financially support companies will lead to the maintenance of the current balance of political power in which capital is the determining force. By supporting capital groups in the forms of Producing fossil, renewable, clean energy, capturing and storing carbon, making money from emission trading, building insulated buildings, etc. the historically destructive ecological effects of capital are protected by the state.

In this context, the climate crisis is a result of capital's relationship with the state. Therefore, it is a political problem, and its solution requires the disintegration of that relationship and the dismantling of the corporate-state apparatus. The "Green New Deal" approach that is imposed to solve the problem does not treat the climate crisis as a political problem, but sees it as carbon emissions, a technical task. It aims to reduce these emissions with renewable energy, carbon capture technology, market mechanism and pricing. But it does not disrupt the functioning of capitalism, therefore it cannot restrain capital. It is not difficult to foresee that climate targets will not be realized because the "Green New Deal" approach cannot restrain capital.

Keywords: Green new order, climate crisis, green dyeing, commodity production, metabolic rift
The Introduction of the Invasive Pumpkinseed (*Lepomis gibbosus*) to Belevi Lake, İzmir

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Abstract

Anatolia holds a position of considerable global significance regarding biological diversity, attributable to its abundant closed lake basins and autonomous river networks, intersecting with three of the 36 globally designated hotspots (Mediterranean, Irano-Anatolian, and Caucasus). Anatolia accommodates a plethora of native and endemic freshwater fish species, alongside the introduction of non-native species, some of which have thrived and proliferated within Anatolia’s aquatic ecosystems, displaying characteristics indicative of invasiveness. Belevi Lake is a freshwater lake located in İzmir, western Türkiye. The lake is fed by the floodwaters of Belevi Stream, one of the tributaries of the Küçük Menderes River. Belevi Lake is recognized as one of the significant wetland areas in the region, serving as habitat, breeding grounds, and feeding areas for various waterfowl species. It is also a stopover point for migratory birds. However, the water level and ecology of the lake can be periodically affected by various factors. One of the most significant threats among these is the pressure exerted by invasive species such as *Carassius gibelio* and *Gambusia holbrooki* on the natural ecosystem of the Lake. In addition to the pressure from existing invasive species, the first record of *Lepomis gibbosus* entering the lake is presented for the first time in this study. This species, which exhibits acute effects in a short period, has spread extremely rapidly as observed by local fishermen and through personal observations during fieldwork in the lake.

Keywords: Invasiveness, Anatolia, Küçük Menderes drainage, biodiversity
Some Aspects of Environmental Conditions and Quality of Medicinal Plants

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Abstract

The important and complex environment problems are a pollution of fair, soil and water by xenobiotics for very longtime. There are inorganic (heavy metals) and organic components (pesticide residues), which are not the natural origin or their quantity in ecosystem can be effected from unhealthy to toxic conditions. The Chernobyl crash is one of the largest and the most complex disasters in the history of nuclear energy, which made impact on the environment in Ukraine, Belarus, Russia and many European countries. In regard to the cooperation with the Lviv Polytechnic National University in Lvov, Ukraine, the environmental radiation monitoring was given in the Chernobyl exclusion zone in 2014.

The health quality of medicinal plants is depended on the conditions of environment, which is influenced direct to grow on the place of an occurrence and cultivation. In regard to herbal market, it is very important to determine the hazard values of herb goods to domestic and foreign customers and compare with the regulation on the highest permissible toxic effects in food, which are notified by the Slovak and EU legislation. The aim of contribution is determination of heavy metal and pesticide residue contents and radioactivity into selected medicinal plants, which are collected and produced in Slovak Republic during last period. An important aspect of these quality control measures is the identification and documentation of the plant material from field to final distribution to pharmaceutical, cosmetic and food industries.

Key Words: environment, determination, herbs, heavy metal, pesticides, radioactivity
Invasive species *Sebastes schlegelii* rapidly spread along Turkish coasts

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Abstract

*Sebastes schlegelii* is a typical bottom dwelling boreal species, whose native distribution range includes Japan, Korean peninsula and China. This northwest Pacific originated species has recently been recorded from the Crimean and Caucasian coast (northern Black Sea), whose introduction was assumed by ballast waters. Two reports were given in different articles in the Central and Western Black Sea of Turkish coast in 2023.

This study we conducted includes reports from other regions of the Black Sea and the Marmara Sea. The unexpected presence of the species in the Sea of Marmara and Black Sea raises intriguing questions about its potential spread in the broader Mediterranean Sea basin. The adaptability of the *S. schlegelii* to diverse environmental conditions underscores its ecological resilience. The study emphasizes the need for careful monitoring and management due to potential threats posed by invasive species.

**Keywords:** Sebastidae, range expansion, invasive species, biological invasion
Pacific Oyster *Crassostrea gigas* is Rapidly Invading Black Sea Coast

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Abstract

The Pacific oyster *Crassostrea gigas* is a bivalve species with high commercial value. This species, which is cultivated in many parts of the world, is the most produced bivalve species in the world. Its distribution has extended to many different saltwater systems due to its high adaptability to changing environmental conditions, rapid growth ability and strong reproductive potential. This species was known to exist in natural environments of the Mediterranean and Aegean Sea basins. The existence of *C. gigas* in the Southern Black Sea coasts is also known for many years. The species is thought to be introduced in the Southern Black Sea region via maritime transport (either by ballast water or by sticking to the ship body). It is predicted that the Black Sea ecosystem and water properties provides a comfortable environment for the reproduction of *C. gigas* species and it spreads successfully over the region in a quite short time with its high adaptation ability. Besides its economic importance, *C. gigas* is also an ecologically important species. This species is distributed in the lower intertidal zone, adhering to rocks, debris, crusts and hard floors. In the regions where *C. gigas* invades, it can negatively influence other native species including the Mediterranean mussel due to the competition for habitat and food. The actual distribution and density of this invasive species on the Turkish coasts of the Black Sea have not been investigated yet. Potential influences of this species on native species of the Black Sea ecosystem (Mediterranean mussel, sand mussels, etc.) and the interaction between other invasive species (*Rapana venosa, Scapharca inaequalvis* etc.) have not been investigated, as well. It is thought that the species has begun to intensively invade the Turkish coasts of the Black Sea. Therefore, it is of great importance to investigate how this species will be distributed in the Black Sea in the near future, its spreading potential in this region and its impact on the ecosystem. In this study, the distribution of the species in the northern Black Sea was evaluated.

Keywords: Pacific oyster, *Crassostrea gigas*, Black Sea, invasive species
The Effect of Climate Change on Trout Reproductive Behaviors and Population Dynamics: Temperature Variations, Spawning Behaviors, and Conservation Strategies

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Abstract

As a global threat, climate change affects environmental variables and habitat features of aquatic organisms. In particular, global warming adversely affects the reproduction, physiology, growth rates, migration and spawning behaviors and capacity the stability of food webs and chains of aquatic species. Trout are ecologically and socioeconomically species important and are adversely affected by climate change. Climate change threatens the survival of trout with clean, cold and abundant water in natural habitats. Life-history modifications and changes on the physiology and distribution of trout occur through temperature-dependent variation. In the literature, the impacts of climate change have been documented and emphasized on trout. Due to the warming effects of climate change, salmonid productivity is predicted to rise in high latitudes and altitudes (particularly >60° and >1500 m) while it will decline in regions experiencing warmer and drier growing seasons. Additionally, non-native salmonid populations are expected to surpass native ones, and there may be a decrease in lentic blooms compared to lotic ones. Furthermore, climate change will impact the production or survival of salmonid pelagic eggs or larvae, as well as the quality and quantity of nursery habitats, due to alterations in reproduction and spawning behaviors. Overall, encouraging large-scale and long-term management initiatives is crucial to predict the impacts of climate change and enhance the viability of species.

Keywords: Climate change, trout, reproductive behaviors, conservation strategies
Climate Change and Freshwater Snails: Adaptation Strategies and Ecosystem Interactions

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Abstract

As an universal threat, climate change in consequence of increasing anthropogenic CO₂ emissions is an important environmental problem for the future of our planet. Unless natural populations are able to adapt evolutionarily to changing environmental conditions (e.g. increasing average temperatures, occurrence of extreme weather events), climate change will be a serious problem for aquatic organisms. Life history traits and defensive features against natural enemies influence the adaptation of organisms both directly and through species interactions. Freshwater snails feed with detritus, periphyton, phytoplankton, and macrophytes, and are preyed upon and consumed by fish and other aquatic animals, thus playing key roles in energy transfer, nutrient cycling, and food webs in aquatic ecosystems. The decrease in oxygen concentration and changes in precipitation patterns resulting from global warming as a result of climate change adversely affect the reproduction, physiology, growth rates, spawning behavior and capacity of freshwater snails. In addition, changes in temperature and precipitation, the abundance and distribution of aquatic plants and algae being important food sources, predator-prey relationships, or the introduction of invasive species can negatively affect freshwater snail populations and their adaptation to the aquatic environment. To prevent the extinction of the species, it is necessary to understand and predict how climate change affects the community structure, behavioral mechanisms, and spatial distribution of freshwater snails with encouraging large-scale and long-term management initiatives and strategic protection of key areas.

Keywords: Freshwater snail, climate change, macroinvertebrate.
Abstract

Everyone has the right to universal and equal access to safe and accessible drinking water. It is an important indicator for social and economic development. Treatment plants are designed to remove pollutants and undesirable components or reduce their concentration in water reaching the consumer. During the operation of these facilities, we encounter problems such as malfunctions, operating errors or excessive energy consumption caused by chemical, mechanical and electrical equipment. Regular monitoring of the facility every month, making analysis in accordance with the legislation and training of the personnel play a major role in solving these problems. Operation and managing the facility by taking these issues into considerations minimizes the possibility of encountering problems. In addition to such routine issues a good management plan should be presented when environmental problems such as climate change, decrease or even disappearance of water resources arise. Budget planning to financially support to facility should be made accordingly, and possible difficulties into account when additional resources can be used. With regular monitoring of the facility, risks can be predicted and solution can be found more easily when complications arise.

In this study, the efficiency of the Suluova Drinking Water Treatment Plant, which was put into operation in 2023, will be evaluated, considering the above-mentioned issues. In this context, it is planned to monitor the existing inlet and outlet water measurements and analyzes in the facility every month. By comparing the design report, with the data obtained during the activity period, it will be evaluated whether the water coming out of the facility meets the expected criteria. In this process, the problems encountered, solution suggestions for the identified problems, and the unsolvable problems will be determined. Excessive energy consumption, the effects of climate change on the facility and the existence of situations requiring excessive chemical use will be examined and solution proposals will be evaluated. As a result, the problems of the drinking water treatment plant will be clearly identified, and the solutions produced for the current problems will be discussed. The data obtained as a result of this research will enable the recording of examples of treatment plants with similar features throughout the country.

Keywords: Drinking water treatment plant, efficiency, solution proposals.
Introduction

Even though 70% of the Earth is covered with water, our freshwater resources, that we use for drinking, sanitation, and agricultural irrigation, are extremely limited. Only 3% of the world's water is freshwater, and two-thirds of it is trapped in glaciers or is extremely difficult to access (Paraschiv et al., 2022).

Ensuring and maintaining water purification is a fundamental factor in the development of settlements. Initially, the adequacy of water quantity was the focus, but increasing population has created more demand for limited high-quality surface sources. Pollution of these sources with urban, agricultural, and industrial wastes has adversely affected water quality. With the tightening of water quality regulations, the analytical methods used for detecting pollutants have become more sensitive. This has led to greater public awareness and selectivity in water supply (Crittenden et al., 2012).

Therefore, the quality of water sources cannot be ignored in the development of water supply. In fact, almost all water sources require some form of treatment before being used as drinking water (Crittenden et al., 2012).

The primary goal of water treatment in municipalities is to protect public health. Water can contain various components that can make people sick and/or spread disease to large groups of people (Howe et al., 2012).

Water treatment processes can also be applied in cases such as the improvement of contaminated groundwater and the recycling of treated wastewater for new uses (Howe et al., 2012).

Designing an effective water treatment facility is a complex process because there are many unwanted components that could be present in source water. Even waters considered "innocent" may contain some components that need to be removed. The specific components found in water, their relative concentrations, and other water quality parameters that affect treatment are largely dependent on local conditions such as geology, climate, and human activities. Therefore, each treatment process must be tailored to the necessities of its specific water source. These specific treatment challenges are heavily influenced by the type of source water, which can include groundwater, lakes and reservoirs, rivers, seawater, and wastewater-affected waters. The fact that each type of source requires different treatment processes presents different challenges to the water treatment engineer (Howe et al., 2012).

Water in rivers may have less mineral content than groundwater but can dissolve natural materials during rainfall or interaction with groundwater. Surface waters can include suspended and floating materials such as sediment, leaves, branches, algae, and other plants or animals during surface flow. The primary difference between all surface waters and groundwater is the potential presence of pathogenic bacteria and other microorganisms that must be eliminated to make drinking water safe. The necessity of removing pathogenic organisms makes surface water treatment dramatically different from groundwater treatment; nearly all surface water treatment plants have filtration systems designed to physically remove microorganisms and contact basins designed to disinfect the water. In contrast, in groundwater treatment plants, processes focused on the removal of dissolved pollutants (Howe et al., 2012).

Water treatment can be defined as the processing of water to achieve a quality that meets specific goals or standards established by regulatory agencies, local communities, or specific industrial processes. Goals and standards may include requirements set by regulatory agencies, additional requirements set by local communities, and requirements related to specific industrial processes. The evolution of water treatment practice has a rich history filled with empirical and scientific developments, as well as challenges encountered and overcome (Crittenden et al., 2012).
The most common treatment plants for surface waters are rapid sand filtration and lime-soda softening plants. Groundwaters are generally of better quality than surface waters and therefore the most common treatment processes are gas stripping and lime-soda or ion exchange softening plants. Slow sand filtration processes may also be used in some cases for surface waters. In some cases of surface water treatment, pretreatments such as screening, pre-sedimentation, aeration, absorption, and pre-chlorination may be required (Reynolds et al., 2011).

The treatment process continues with coagulation and flocculation units. At this stage, the aim is to settle solid matter and bring it together before passing through a rapid sand bed. Among the most used chemicals are aluminum sulfate, iron (III) sulfate, and lime. The amount of coagulant varies depending on the turbidity of the water and the effectiveness of coagulation, usually ranging from 5-90 mg/L. Additionally, materials such as active silica and clays may be used as coagulation aids. Polyelectrolytes, as coagulation aids, may also be added after rapid mixing if necessary. Following the coagulation-flocculation units, gravitational settling is used to separate suspended solids. To remove fine suspended solids as much as possible, water is passed through a porous medium or porous material. After the filtration process, water undergoes disinfection and is then distributed to the distribution network (Reynolds et al., 2011).

The role of the engineer is to characterize the quality of the source water entering the facility and to develop treatment plants to produce water that meets drinking water standards. The measurement point for drinking water standards is the final water obtained at the outlet of the plant. Today's engineer must not only see the water treatment plant as an important component in a multi-step treatment process but also consider how the process should be planned considering where the water has traveled before entering the facility and the transportation and distribution system elements after the facility. Changing water quality must be managed with new regulations and requires that drinking water standards be the same as standards for water flowing from the tap. A water system designed today must be flexible enough to meet potential changes. Regulatory uncertainties also include other important environmental concerns from the perspective of water treatment plant design, including waste management practices, chemical storage and feeding practices, and workplace safety (McGraw-Hill Companies, 2012).

Trends in the addition of new pollutants to regulations, the tightening of existing standards, and the expansion of regulatory enforcement should continue, along with the identification of new health issues and the need for treatment research and potential solutions. Water treatment plant designers may also encounter the possibility of unusual biological and toxic pollutants entering the water source. Water treatment plants must now not only meet changes in regulatory requirements but also changes in raw water quality. As regulations tighten, addressing rapid changes in quality due to natural reasons such as heavy rainfall and runoff will become more difficult. Addressing "introduced" pollutants will be even more challenging as they are an unknown factor. Once introduced pollutants are discovered, water treatment plants may need to be temporarily shut down (McGraw-Hill Companies, 2012).

The tightening of regulations and the risk of unexpected contamination require that water quality monitoring facilities play an even more fundamental role in the planning, design, and operation of water treatment. (McGraw-Hill Companies, 2012).

This study presents a performance and water quality evaluation conducted on a drinking water treatment plant located in the Suluova district. The research examines the quality of the plant's water, operational data, and overall performance. At the conclusion of the study, recommendations are provided to optimize the plant's performance.
Methods
This study was conducted on a drinking water treatment plant located in the Suluova district. During the design phase, a water demand of 8640 m$^3$/day was accepted as the design flow rate by the authorities. The majority of water supply is sourced from the Derinöz Dam. The turbidity value of the raw water was reported as 20.7 NTU in accredited laboratory results, and the project was designed based on this value.

Data throughout the monitoring process were obtained from laboratory analyses, operational records, and the facility's automation system. Significant parameters for water quality were examined, and operational data were evaluated.

Chemical and microbiological qualities of the water were examined through laboratory analyses. Key parameters included pH, turbidity, iron, manganese, chloride, sulfate, nitrate, and microbiological pollutants. Operational data were analyzed to evaluate the quantity of chemicals used in the facility, flow rates, backwash frequencies, and energy consumption.

Using the obtained data, the performance of the facility was assessed. This evaluation focused on the effectiveness of water treatment processes, ensuring water quality, operational efficiency, and the effective use of energy/chemicals.

Results
To monitor the treatment efficiency of the drinking water treatment plant serving the Suluova district, which commenced operations in 2022, the following parameters were tracked on a monthly basis: the incoming water flow rate to the facility, the flow rate of treated water, the quantity of chemicals used, and the number of backwash operations conducted at the facility. Figure 1 illustrates the monthly variation in average daily flow rate values.

![Figure 1. The Variation of Average Daily Flow Rate by Months](image)

After being put into operation, it was observed that the highest flow rate occurred on the day the plant was commissioned. As of January 2023, the Drinking Water Treatment Plant, which was monitored, experienced the highest water inflow in March. When evaluating the months of January, February, March, and April for the years 2023 and 2024, a decrease in the daily average water inflow to the facility was observed. It can be assumed that there was less precipitation and a shorter duration of snow cover in the district compared to the previous year. This decline may be indicative of a decrease in both surface and groundwater levels.
The variation of average daily energy consumption following the operation of the plant is shown in Figure 2. The highest energy consumption required for operating the plant was observed in February 2024, reaching 229.17 kWh/day. On the other hand, in April 2024, it was 80.97 kWh/day.

![Figure 2. The Variation of Average Daily Electricity Consumption by Months](image)

Due to the significance of seasonal transitions in Drinking Water Treatment Plants, calculations for the Influent Raw Water Flow Rate and Turbidity Values were made based on seasons. The assessment based on seasons was prepared according to date ranges based on the duration of sunlight in the sky, considering that the effect of sunlight on the water surface throughout the day could affect the calculations.

According to the Regulation on Waters Intended for Human Consumption, if surface water is treated, the Institution should ensure that the turbidity of the treated water does not exceed 1.0 NTU. Figure 3 illustrates the seasonal variation in the average turbidity values observed at the inlet and outlet of the drinking water treatment plant. Based on the calculations, it was observed that the outlet water turbidity was 0.29 NTU between 06.03.2024 and 04.04.2024.

![Figure 3. Seasonal Variations in Average Turbidity of Raw and Treated Water](image)
Due to the importance of seasonal transitions in Drinking Water Treatment Plants, calculations were made for the Influent Raw Water Flow Rate and Turbidity Values based on seasons. Date ranges were prepared based on the duration of sunlight in the sky, considering the potential influence of sunlight on water surface throughout the day.

For the Drinking Water Treatment Plant designed based on a Turbidity value of 20.7 NTU, Seasonal Evaluations were conducted. According to these assessments, it was observed that the average daily turbidity of the inlet water reached an average of 28.30 NTU between 22.06.2023 and 23.09.2023, yet the outlet water turbidity did not exceed the regulatory limit.

When evaluating the compliance of the plant with drinking water standards, an overall positive picture is observed. Conductivity values remain within regulatory limits and show a tendency to decrease over time, indicating the effectiveness of the processes. pH values consistently remain within the specified range, indicating the maintenance of chemical balance in the water.

Upon examining the quantities of iron and manganese, it is observed that the levels in the outlet analyses are below regulatory limits. However, particularly in the case of iron, values close to the regulatory limit are found in the inlet analyses, indicating the need to consider potential sources of contamination. In microbiological analyses, although pollution indicators in the outlet analyses are below regulatory limits, it is noteworthy that some microorganisms in the inlet analyses are close to regulatory limits.

Although turbidity values are below regulatory limits in the outlet analyses, a certain increase is observed in the inlet analyses. This emphasizes the importance of potential contaminations originating from the water source.

Operational data such as the quantities of chemicals used, flow rates, backwash frequencies, and energy consumption were analyzed. The performance of the plant appears generally stable. Although inlet flows vary seasonally, the treated flow generally remains at a stable level, indicating the adequacy of the plant's overall capacity. Backwash frequencies show consistency, indicating regular cleaning of the filters.

When examining chemical usage, the use of FeCl₃, Poly Aluminum Chloride, and Liquid Chlorine is generally stable. However, some fluctuations are observed in certain months, especially in the use of Liquid Chlorine. The reasons for these fluctuations should be investigated, and chemical usage should be optimized.

Energy consumption is generally stable, but increases are observed in certain months. These increases may indicate energy efficiency issues or equipment malfunctions; therefore, careful monitoring of energy consumption and corrective measures when necessary are important.

The problems encountered during the commissioning of the plant and their solutions are as follows:

During the commissioning of the plant, the issue of providing the existing backwash pipe from the top of the Lamella tank was re-evaluated during the temporary acceptance and attempted to be resolved by increasing the holes in the pipe inside the tank. Additionally, steel pipes used at the FeCl₃ dosage point were replaced with HDPE pipes due to corrosion.

The issue of water coming from the Lamella settling tank hitting the sand filter was resolved by lowering the level of water coming to the filter with the help of an elbow in the pipe.

The problem of highwater discharge from the bottom of the sand filter was resolved by taking the filter tank out of service and renewing the bottom base.
The problem of bubbles occurring in the Lamella settling tank negatively affects the settling efficiency by lifting the flocs upwards. Low-pressure water supply or alternative solutions should be explored to address this issue.

It has been noted that backwashing is performed too frequently after commissioning. There is a problem of filters exceeding the maximum water level and excessive backwashing due to filters clogging frequently. This situation may reduce the effectiveness of the filters and increase operating costs.

**Discussion**

When the performance of the facility is examined in more detail through comprehensive analyses and research, important findings emerge. Firstly, it has been determined that conductivity, pH, iron, manganese, and microbiological analyses comply with drinking water standards. This indicates that the facility fulfills its basic functions and that the overall quality of the water is at acceptable levels.

However, there are some concerns and issues at certain critical points, particularly focusing on chemical usage and energy consumption. While it is positive that the facility operates below the planned flow rates according to the design report, this has raised concerns due to the potential health risks associated with the use of PAC. Therefore, FECl₃ is used instead, leading to more waste than planned based on the sludge amount. Due to concerns among institutional officials regarding this issue, chemical selection has been re-evaluated, and potential alternatives are being considered.

Furthermore, some difficulties have been identified regarding energy consumption. Especially, high energy consumption and solutions focusing on alternative energy sources such as micro-hydroelectric power plants have been explored to meet this consumption. This could be a significant step towards increasing energy efficiency of the facility and reducing operating costs.

Another significant issue encountered is the problems observed in December and July. Literature research indicates that the source of these problems could be the high presence of O₂ from lakes and rivers and the transfer of agricultural waste into the water. Therefore, it is necessary to determine how fertilizer activities and potential pollutants from water sources affect the system and find appropriate solutions to these problems.

As a result of the analyses conducted, it has been determined that the water of the facility complies with drinking water quality standards in terms of certain parameters. Additionally, when the operational data of the facility is examined, it is observed that the operation is effective and efficient. However, some areas for improvement have also been identified.
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Ecological Assessment of Örümcek Forests (Gümüşhane-Kürtün)

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Abstract
In order to secure the future of human societies, natural resources need to be researched, protected and developed. To do this, detailed information about natural resources is needed. Among these resources, the forest has a special place. Because the forest spreads over larger areas compared to other terrestrial resources and has a great effect on all living things, especially humans. The increasing need for forest products and the decrease in forest areas pose many problems. In order to solve these problems and to use forest resources at full capacity and rationally, all elements of the forest existence must be systematically and continuously investigated. If the natural characteristics of the forest are well known, only then can this important asset be utilized in the best way and to the highest degree. It is not correct to perceive the term "forest" as just a group of trees. It is necessary to accept the forest as a system, a natural unit, formed by trees and other natural factors such as other plants, fauna, microorganisms, soil, air, water and climate, which have mutual effects and relationships between them. Therefore, when examining the character, development and increase of the forest, the features, functions and mutual relations of the mentioned environmental factors with the forest should also be examined. This is why; In this study, Örümcek Forests, which are of great importance for the Gümüşhane-Kürtün region, will be examined and evaluated in terms of climatic, edaphic (soil properties) and physiographic (altitude, aspect, slope, land surface shape) factors.

Keywords: Ecology, Gümüşhane, Kürtün, Örümcek Forests
The Importance Forest Growth Environment in Terms of Forestry

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Abstract

Forest growth environment means determining all the climatic, edaphic and biotic factors of a place whose geographical location is known. Since these factors will differ all over the world, it can be said that there are a wide variety of growing environments. For this reason, a lot of labor and money is needed when making a forest growth environment. On the other hand, a one-time Forest growth environment will be a guide especially for foresters for many years. Within the scope of this study, it is aimed to define the Forest growth environment, its importance and evaluate it in terms of forestry. For this purpose, Forest growth environment studies conducted in Türkiye in previous years were examined. In addition, it is aimed to touch upon the issues that need to be taken into consideration when making a Forest growth environment under different headings. As a result of the study, it was revealed that Forest growth environment studies are few and their number should be increased. Especially when making forest management plans, integrating the Forest growth environment into the plans will ensure that activities such as silvicultural interventions, afforestation and rehabilitation are carried out more accurately.

Keywords: Forest growth environment, forest management, forest ecological management
An Example from History for Preventing Pollution of Fountain Waters: Ottoman Empire Anadolu Sadareti Court Decision

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Abstract

Among the most important reasons for the Ottoman Empire's survival with its societal structure hosting different cultures for centuries can be said to be its governance and legal understanding. The evidence of this governance and legal understanding is found not only in court decisions but also in the shari'a registers, which contain information about the political, economic, social, and cultural history of the period. Therefore, Istanbul shari'a registers are a mirror of the social history of the Ottoman Empire.

Today, among the duties of the General Directorate of Environmental Health of the Ministry of Health of the Republic of Türkiye are 'to participate in necessary research and development efforts for providing sufficient and healthy drinking water to settlements, to ensure the necessary measures are taken, to regulate, to implement training for implementers, and to carry out or commission them' and 'to conduct studies on water sources, drinking water, natural mineral waters, pool waters, swimming areas, and spa waters, and to determine national standards'.

Within the scope of the Istanbul Qadi Registers Project conducted by ISAM (Center for Islamic Studies, 100 of these registers have been made accessible. In the study, the 114th Decision of the 2nd Register of the Anadolu Sadareti Court, which was found to be related to the subject, has been evaluated. In the decision titled 'Demolition of buildings on the land near Üsküdar Sultantepe belonging to the Abdullah Ağa Foundation due to harm to fountain waters', it is stated that in 1840, upon the application of the neighborhood, the waters of five fountains in two neighborhoods were polluted by the sewage of buildings constructed on the foundation land, and it is ruled that the buildings on the land should be demolished and the land should be converted into agricultural land.

Today, conducting studies related to drinking water is one of the services of the Ministry of Health. An example of measures taken in history to prevent the pollution of fountain waters has reached the present day through shari'a registers, which reflect the social life of the Ottoman Empire, shedding light on one of the practices in this regard.

Keywords: Environmental health, Ottoman Empire Court, Istanbul Shari’a register
Evaluation of Watersheds in Sinop City in Terms of Landslide Production Potential

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Abstract
Although landslides in Türkiye are overshadowed by earthquakes, they are a natural disaster that causes a lot of loss of life and property. Landslides, especially in the Black Sea region, threaten many fertile lands and settlements. This study covers the analysis of landslides in Sinop Province with classical landslide susceptibility methods. In this context, the areas where landslides frequently occur were determined and the formation mechanisms of landslides, affecting and triggering factors were investigated by conducting a literature review on the subject. In the light of this information obtained, topographic features, geological structure, vegetation, rainfall and drainage conditions were evaluated in terms of landslide susceptibility of the basins in Sinop Province. As a result of the study, in regions where landslides are concentrated, areas with potential risk have been revealed with classical landslide susceptibility methods, and a basis has been created for determining the zones where precautions should be taken. This study is of great importance to evaluate the possible effects of landslides, to understand the areas with landslide potential and to take the necessary precautions, taking into account the risks of people living in the region and the infrastructure. In addition, it provides important findings that will help decision-makers and local governments to be informed in terms of managing landslides and reducing possible risks. In addition to all these, this study forms an important basis for future research in similar regions.

Keywords: Landslide susceptibility analysis, triggering mechanisms, Sinop city
Optimization of Cofferdam Height and Derivation Conduit in Dams and Determination of the Water Amount Draining to the Stripping Excavation

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Abstract
Türkiye has been exposed to intense migration in recent years, and this has created a significant demand for water. Due to the insufficient existing water resources, many dams and ponds have been designed in Türkiye. Ground permeability problems have been encountered in a significant part of these water structures, especially planned for agricultural irrigation purposes. In dams, an injection curtain is generally constructed along the dam axis to prevent groundwater leaks from upstream to downstream. However, high hydraulic conductivity in water structures may cause a possible groundwater flow in the upstream and downstream direction and cause the dam not to hold water, and may also cause the stripping excavation and cutoff excavation opened during the construction of the dam to be filled with water. The design of the diversion conduit that discharges the water accumulated upstream of the cofferdam, which was built temporarily to protect the stripping and cutoff excavations in dams and ponds from floods, is of great importance for the protection of the excavation area. However, since construction of a grout curtain is an expensive process, it is not used to prevent groundwater flow that may occur from under the cofferdam to the excavation area. For this reason, it is of great importance to determine the water flow rate that may come to the stripping and cutoff excavations at the planning stage and to discharge the water in question with appropriate pumps. In this context, the upstream cofferdam was planned, taking into account the 100-year flood flow that may come from the drainage basin of the dam, and in order to discharge the water that will accumulate in the cofferdam upstream, a diversion conduit, 8.5% slope, 0.8 m diameter, 176 meters long, with a concrete liner on the left slope, was designed. In the light of these data, it was concluded that pumping equipment with a minimum pumping flow rate of 2 m³/h should be used for the discharge of groundwater to the stripping and cutoff excavations during the construction of the dam.

Keywords: Permeability in dams, cofferdam-diversion relationship, water flow calculation to the excavation area
Predator-prey interaction in an invaded marine system: Does net profitability explain the foraging decision of a native predator over invasive prey?

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Abstract

According to optimal foraging theory, predators often prefer prey species based on their caloric income per unit effort. Previous laboratory studies indicate that Eriphia verrucosa, as a native generalist predator, can efficiently feed on invasive Rapana venosa, the rapa whelk. However, the reason why this native predator has not been able to act as an effective biocontrol species against the rapa whelk is unknown. Therefore, we have applied two different laboratory studies to understand whether; (1) E. verrucosa prefers the native prey species (Patella caerulea and Mytilus galloprovincialis) over the invasive rapa whelk or newly introduced non-native oyster (Crassostrea gigas), (2) size of the prey species influences the foraging decision of the crabs. We further measured various energetic and mechanistic characteristics of the species including variations in claw pinching force of the native crabs, in shell strength and caloric values per gram in prey species to determine the potential causative drivers behind the prey selection of the native crab. We found that crabs mostly preferred the native species over invasive and non-native species, and this preference did not depend on the prey size. Regardless of their claw-pinching force, crabs preferred P. caerulea, which was followed by the mussel, M. galloprovincialis. Shell strength significantly varied between prey species. P. caerulea had the lowest shell strength. We further found that caloric values were significantly different between prey species. Overall, this study suggests that the net profitability of the prey items is an important determinant of foraging decisions for the predators, which may explain why E. verrucosa does not act as an effective biocontrol for the invasive rapa whelk, R. venosa.

Keywords: Black Sea, caloric values, diet, Eriphia verrucosa, Rapana venosa.
Do Man-made Structures Influence the Characteristics of Microplastics on Sandy Shores?

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Abstract

Microplastics are an important threat to marine ecosystems including sandy beaches. Sandy beaches serve as sinks for microplastic contamination originating from both land and sea. Previous studies conducted on microplastics on sandy beaches often examined the presence and sources of these contaminants. Sandy beaches are dynamic systems in which seaward and landward forces act in concert, which makes these ecosystems highly erosional. Various man-made structures including jetties and breakwaters have been built to reduce the intensity of wave actions and therefore to protect the sandy shores by decreasing the rate of erosion all over the world. However, the influence of those man-made structures on the characteristics of microplastics on sandy shores is unknown. Therefore, 6 sandy beaches with 3 different structures were examined in terms of the abundance, size, color, shape, and polymer type of microplastics in the Ordu Region on the Turkish Coast of the Black Sea. Beaches were examined in April 2023 just before the tourism season and regular beach cleaning started as these are important determinants for the microplastic characteristics on sandy shores. Examined beaches had either no man-made structures, jetties, or breakwaters. The results of this study indicated that man-made structures altered the abundance and the size of the microplastics on sandy shores. Further, characteristics including color, shape, and polymer type of microplastics significantly varied between beaches with different man-made structures. This study shows important results for managers and environmental planners to protect sandy shores from these global pollutants.

Keywords: Beach, Black Sea, breakwater, jetty.
Determining the Potential of Cultural Ecosystem Services in Aydın

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Abstract

Assessing the Cultural Ecosystem Service (CES) values, which express the intangible benefits provided by natural ecosystems through planning and management processes, entails significant values and features that need to be considered. In this study, aimed at determining the CES value, a group of 10 experts consisting of academics working in landscape architecture departments in Turkey were surveyed using an online questionnaire, focusing on Aydın province, the chosen study area, and utilizing photos obtained from the social media platform Flickr. The CES values queried in this context included recreational and sports value, tourism value, aesthetic/scenic value, inspirational value, cultural heritage value, and spiritual values. The expert group was asked to evaluate each photograph in terms of these six values. Multiple values could be assigned to a single photograph, allowing for the assessment of the potential of certain points to embody multiple CES values. Areas identified by experts as having CES value were spatially mapped and analyzed by relating them to their natural and cultural landscape values. The findings of this study are considered particularly useful for effective planning of natural resources.

Keywords: Cultural ecosystem services, Flicker, Aydın
Essential Oil Compositions and the Site Characteristics of Sideritis condensata

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Abstract

Medicinal and aromatic plants are endangered due to direct collection from nature. Sideritis condensata Boiss. & Heldr. is one of these species. In the present work, natural populations of S. condensata from 10 different localities in Turkey have been investigated with taking into consideration the site factors and phytochemical composition and yield of the essential oils. The essential oils were obtained by the hydrodistillation of the aerial parts of plant samples. The chemical compositions of the essential oils were analyzed with GC-FID and GC/MS techniques. The main chemical compounds were evaluated with the Principal Component Analysis. The relationship between the oil yields, main chemical constituents, and site factors were determined by correlation analysis. A total of 116 compounds and 6 main constituents were detected in the essential oils of S. condensata. The oils were mostly constituted by monoterpene hydrocarbons, oxygenated monoterpenes, sesquiterpene hydrocarbons and fatty acids. The main compounds of essential oils are hexadecanoic acid (0.80–45.60 %), β-pinene (0.60–41.0%), caryophyllene oxide (1.30–28.40%), β-caryophyllene (0–26.70%), α-pinene (0–26.0%) and germacrene D (0–21.10%), respectively. The essential oil yield of the species varies between 0.32 mL/100g and 0.005 mL/100g. S. condensata grows in soils that vary from slightly acidic to slightly alkaline, from slightly calcareous to very calcareous, and are sometimes poor and mostly medium and rich soils inorganic matter. Some relationships have been identified between oil yield, chemical compounds and habitat characteristics. As the Cu, Zn, Mn, Na and silt amount in the soil increased, the ratio of α-pinene, β-pinene from the monoterpene hydrocarbons and essential oil amount increased, too, but germacrene D and β-caryophyllene and bicyclogermacrene from the sesquiterpene hydrocarbons decreases. There are inverse relationships between these chemical compounds and elevation, clay in the soil, Ca and pH. These studies result could provide useful information for conservation, cultivation, clone selection and for chemotaxonomy.

Keywords: Endemic, mountain tea, site factors, essential oil
Relationships Between the Development of Naturally-Distributed Pure White Birch (Betula pendula) Stands and Site Characteristics in Turkey

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Abstract

In this study, it was aimed to determine the relationships between height growth and site characteristics of the white birch stands that are most widely distributed in the Eastern Black Sea (Giresun, Trabzon, Gümüşhane, Artvin) and Eastern Anatolia (Erzurum, Ardahan) regions of Turkey. The study was carried out in 46 sample areas of naturally grown white birch (Betula pendula Roth) stands in our country, differing in terms of site characteristics and stand development.

In the sample areas, three individuals in the upper canopy layer were measured. Of the trees, its height closest to the arithmetic mean height was cut, measured in height with cm precision and age was counted on the bottom log.

One soil pit was dug in each sample area and 185 soil samples were taken from depth intervals of 0-30 cm, 31-60 cm, 61-90 and 91-120 cm. The bedrock, climate and physiographic characteristics of the sample areas were determined. Some physical and chemical analyses of the soil samples were carried out in the laboratory. The data obtained were evaluated by correlation and multiple regression methods.

As a result of the study, it was aimed to determine the site characteristics that affect the development of natural white birch stands. The results can be used to decide on appropriate site selection for birch plantations.

Keywords: White birch, afforestation, site characteristics, height growth, yield capacity

Project Number: Esk-39 (6328)/2019-2023 (Ministry of Agriculture and Forestry/General Directorate of Forestry/Directorate of Forest, Soil and Ecology Research Institute)
Influence of the se of Vermicast on the Development of Containerized Cedar (*Cedrus libani* A. Rich. Seedlings (Eskişehir Nursery Example))

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Abstract

In this study, it was aimed to reveal the effect of vermicompost use on the development of containered cedar seedlings in Eskişehir forest nursery conditions. In the study, cedar seeds originating from Afyon-Çay (Sultandagi) were used for seedling production. Worm-containing growing media were created with 6 treatments (10-20-30-40-50-60%) and a total of 7 operations, including growing media(control) used in the production of tubed seedlings in the nursery.

A total of 420 cedar saplings were used, using 20 saplings in three replications. The effect of vermicompost doses on the quality parameters of cedar seedlings was determined by measuring the morphological characteristics of the seedlings. The obtained data were evaluated by analysis of variance and duncan tests.

According to the results of the research, suitable seedlings were obtained according to TSE seedling standards from all applications including control. According to the analysis of variance, while significant differences were determined between the robustness index values of tuberous cedar seedlings, no significant difference was found between other morphological characteristics.

Keywords: Vermicompost, seedling growing media, cedar, seedling quality

Project Number: Esk-38 (1203)/2018-2021 (Ministry of Agriculture and Forestry/General Directorate of Forestry/Directorate of Forest, Soil and Ecology Research Institute)
Determination of Flammability Characteristics of Dominant Tree Species in Forest Fires in Kastamonu

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Abstract

Fire is the most important natural intervention type effective in the renewal and shaping of vegetation. Recent forest fires in ecosystems that are not prone to fire have highlighted the necessity of revealing fire behavior in other ecosystems as well as repeatedly burning ecosystems. The recent exposure to frequent fires of the plant species that make up the humid region vegetations that are not prone to fire have become an important issue that needs to be investigated in order to understand the reactions these plants develop against fire. Although the response of plant species in fire-prone vegetations to fire has been widely studied, studies revealing the flammability of plant species found in non-fire-prone vegetations are quite limited. Flammability is expressed as the ignition ability of the flammable substance during the fire and depends on the phenolic compounds it contains in the tissues as well as the functional properties of the plant. In this study, the flammabilities of dominant tree species (Pinus nigra, Pinus sylvestris, Pinus brutia) in non-fire-prone humid region vegetations were revealed at the species level and classified according to leaf functional traits (leaf moisture content, leaf dry matter content and specific leaf area) and total phenol content. Our research has unveiled considerable diversity across species concerning flammability component parameters. Upon scrutinizing the total phenolic compound levels and leaf functional traits, it became evident that Pinus sylvestris showcased a notable inclination towards flammability, in contrast to Pinus nigra, which exhibited the lowest susceptibility.

Keywords: Forest fires, fire ecology, plant flammability, leaf functional traits, phenolic compound
Assessing the Habitat Preferences of *Hyalomma marginatum* using CORINE Land Cover Classification

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**Abstract**

*Hyalomma marginatum* Koch, 1844 is the main vector of Crimean-Congo hemorrhagic fever (CCHF). This species distributes in Southern Europe, North Africa, and part of West Asia. Current data indicates an expansion of the distribution of *H. marginatum* to Central and Northern Europe as a result of climate change. *Hyalomma marginatum* also has a widespread distribution in Anatolia and is an important public health problem in the country due to high mortality rates of CCHF. The aim of this study was to determine the habitat preferences of *H. marginatum* using CORINE Land Cover habitat classification and to assess the relationship between these preferences and the risk of CCHF. The CORINE Land Cover Project has employed remote sensing technologies, specifically satellite imagery, to methodically categorize the various land cover features of Europe, including industrial zones, forests, agricultural regions, and wetlands. Local tick data for Türkiye (66 coordinates) were derived from published literature in last five years. Our results indicate that *H. marginatum* prefers to distribute in discontinuous urban fabric (%18.1); but non-irrigated arable land (%15) and complex cultivation patterns (%15) are also suitable for the distribution of the species. It was observed that habitats with diverse forest types (coniferous forests, mixed forests...) and fruit trees were not preferred by the species. Our findings can be helpful in developing tick and disease prevention methods in certain habitat types. However, other factors such as climate, vegetation cover, land structure, host species, and human activities should also be considered in such prevention strategies against CCHF in future studies.

**Keywords:** Tick, vector, *Hyalomma marginatum*, CORINE Land Cover Project
Ecological Divergence and Phylogeographic Patterns in genus *Dryomys*: Unraveling the Speciation Dynamics of Anatolian Endemics

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**Abstract**

Dryomys laniger, a small rodent endemic to Anatolia, exhibits a highly fragmented distribution range, making it a subject of interest for phylogenetic and conservation studies. In this research, we present novel insights into the phylogeny, genetic diversity, and distribution patterns of Dryomys laniger, along with the discovery of a new species, *Dryomys anatolicus* sp. nov., arising from populations in the easternmost distribution regions. Through molecular analyses using CYTB and IRBP markers, we observed a deep genetic divergence between Dryomys laniger and Dryomys anatolicus sp. nov., surpassing established thresholds for species delineation. This divergence likely dates back to the late Oligocene, driven by geological events such as the uplift of Anatolia, isolating ancestral populations in high-altitude environments. Furthermore, our findings suggest a peripatric speciation scenario, with Dryomys anatolicus sp. nov. migrating eastward during the Messinian epoch, followed by allopatric divergence from Dryomys laniger populations in the Taurus mountains. The genetic diversity within Dryomys laniger indicates its role as the ancestral lineage, emphasizing its importance for the evolutionary history of genus Dryomys on Anatolia.

This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK) under the Grant Number 113R029. The authors thank to TUBITAK for their supports.

**Keywords:** *Dryomys laniger*, Phylogeography, speciation, ecological speciation, genetic divergence.
Effects of Laurel (Laurus nobilis) Essential Oil on the Chestnut Gall Wasp (Dryocosmus kuriphilus) Yasumatsu, Hymenoptera: Cynipidae

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Abstract

Chestnut gall wasp (Dryocosmus kuriphilus) is a pest that reduces the productivity of the chestnut tree by forming galls on the chestnut tree. It is thought to have spread from China to Japan and then to the world before the 1940s. Its annual spread rate is thought to be 25 km on average, and it is currently spreading in natural and artificial chestnut forests in the Aegean, Marmara and Black Sea regions in our country. Even though mechanical and biological control is made against this harmful insect, its spread is very rapid and it endangers especially the natural chestnut forests in our country. It is thought that the struggle with plant essential oils, which have lethal and repellent effects on harmful insects, will support biological control methods against this pest. In this study, the lethal and repellent effects of laurel essential oil on chestnut gall wasp were evaluated in the laboratory. In the lethality trials, 0.1%, 0.5%, 2.5% and 5% laurel essential oil was used, and in the repellent trials, 0.1%, 0.5%, 6.25%, 1.25%, 2.5% and 5% laurel essential oil was used. Solutions of different concentrations were prepared with distilled water. After the trials, the groups were checked at 1, 3, 6, 24 and 72 hours. The number of dead insects was recorded. As a result, in the lethality and repellent trials, it was observed that the groups treated with 5% laurel essential oil solution died within the first hour or went directly to the side with distilled water.

This work was supported by Sinop University Scientific Research Coordination Unit. Project Number: TTO-1901-23-001.

Keywords: Biological control, Castanea, Dryocosmus kuriphilus, laurel essential oil, mortality
Breeding Distribution of the Paddyfield Warbler (Acrocephalus agricola) in Türkiye

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Abstract

Within the Acrocephalidae family, the Acrocephalus genus is represented by 9 species in Türkiye, with 6 of these species breeding regularly. Paddyfield Warbler (Acrocephalus agricola) is one of these species and it is also a passage migrant in Türkiye. A. agricola subs. septimus breeds in limited numbers in a restricted part of Eastern Anatolia. The aim of this study is to reveal the breeding distribution of this narrow-ranging species that is difficult to observe, to determine its breeding sites and population, and to list the threats in its habitat. To identify breeding pairs, breeding behavior codes following the methodology of the European Bird Census Council (EBCC) have been used in the field. To determine the anthropogenic factors affecting the breeding sites and their impacts, the threat analysis methodology prepared by the IUCN Red List and adapted and presented for Türkiye in the Species Action Plans Preparation Guide has been utilized. Breeding distributions and population sizes have been mapped. Field studies were conducted between 2016-2017 and 2021-2023. The species has been recorded in its breeding habitat starting from mid-April. The highest recorded breeding code was C13. Breeding pairs were observed in various sizes and types of wetlands in the provinces of six provinces in Eastern Anatolia. All pairs were recorded in reedbeds. The breeding population is concentrated in the Van Lake Basin. The most significant threats listed include the expansion of agricultural areas, water usage for agricultural irrigation, reed fires, and small-scale livestock farming. The continuity of systematic monitoring studies is important for better understanding the population trend of the species.

Keywords: Paddyfield Warbler, reed warblers, summer visitor, breeding bird
Assessment of the Endangered Steppe Eagle (*Aquila nipalensis*) Migration in Türkiye

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Abstract

The Steppe Eagle has been listed as Endangered on the IUCN Red List at the global scale and as Critically Endangered on the European scale. In Türkiye, there exists a distinct breeding population isolated from its global distribution, along with transient migratory populations. Migration corridors were identified through the compilation of eBird records, literature reviews and analyses of wind farm monitoring studies. The threats have been identified using the Species Action Plan Preparation Guide and the IUCN Threat Classification Table. The first migration records in Türkiye were reported from Istanbul, with claims and evidence dating back to the 19th century. In the early 20th century, long-term migration monitoring studies recorded low numbers, often only one or two individuals, but consistently. The Bosphorus is the location where the highest migration records are obtained, with a maximum of 45 individuals recorded during spring migration of 2015. Systematic monitoring studies of soaring birds’ migration have not been conducted in Eastern Türkiye. Nevertheless, when comparing counts from the Batumi bottleneck migration in Georgia, which is connected to migration corridors from the Eastern Anatolian flyway, it is anticipated that migration corridors from the east are utilized more intensively compared to the Bosphorus. Threats faced by migratory populations include human pressure in stopover sites, electricity transmission lines, wind farms, poaching, illegal wildlife trade and risk of poisoning from toxic meats. Studies continue to track the hatched birds in Central Anatolia using satellite transmitters. Investigating juvenile survival rates, documenting mortality cases and causes during migration, and accurately defining the hotspot bottleneck migration corridors used by the species are critically important for planning international conservation strategies for the species. Therefore, systematic bottleneck migration monitoring and satellite tracking studies are crucial for filling knowledge gaps and planning the conservation activities.

Keywords: Steppe Eagle, endangered, bottleneck migration, migratory bird, conservation
Comparing the Microplastic Load of Water Bodies Under Urbanization Pressure in Istanbul (Büyükçekmece Reservoir and Küçükçekmece Lagoon) Using a Pelagic Fish Species

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Abstract

Today, which is called the plastic age, the negative impacts of microplastic pollution in aquatic ecosystems have become a threat to life, especially through the food web. In this study, it was aimed to compare the microplastic load of two water bodies with different characteristics using the pelagic feeding big-scale sand smelt (Atherina boyeri), which is also consumed as human food. Büyükçekmece Lake, which is protected from pollutants due to being a drinking water basin, and Küçükçekmece Lagoon, whose basin is under intense population and industrialisation pressure, were selected as the study area. The digestive tracts of a total of 119 A. boyeri specimens caught from both lakes during the autumn (2023) and winter (2024) seasons were analysed. During the analyses, the techniques described in the literature were applied in order to avoid any possible exogenous contamination with microplastic. The digestive tracts of the fish were subjected to organic matter removal using 35% hydrogen peroxide. The microplastics obtained were recorded in terms of shape/type and number. After the examinations under stereo zoom microscope, the frequency of microplastics was found to be 59.3% in A. boyeri population living in the Küçükçekmece Lagoon and 33.3% in the Büyükçekmece Lake. Two types of microplastics, fragment and fibril, were found in Küçükçekmece and Büyükçekmece populations and their ratios were calculated as 20.3% and 47.5% for Küçükçekmece and 6.7% and 28.3% for Büyükçekmece, respectively. When the microplastic types were evaluated numerically, it was determined that fibrils dominated with 76.3% in Küçükçekmece population and 81.5% in Büyükçekmece population. The results show that microplastic pollution is higher in the Küçükçekmece Lagoon, which is under urbanisation pressure, than in the Büyükçekmece Lake, which is a protected water basin, and also clearly demonstrate that a drinking water basin can be contaminated with microplastics.

Keywords: Atherina boyeri, digestive tracts, fibril, fragment, microplastic pollution
Artificial Wetlands in the Fight Against Global Warming: Reducing Carbon Footprint and Enhancing Biodiversity

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Abstract

Artificial wetlands have emerged as significant ecological assets in urban and regional frameworks, contributing to sustainability goals and climate mitigation strategies. These engineered ecosystems mirror the carbon sequestration capabilities of their natural counterparts by capturing and storing atmospheric carbon dioxide (CO₂, thereby serving as vital negative emission technologies in the fight against global warming. The process leverages anaerobic conditions to protect existing soil carbon while concurrently facilitating atmospheric CO₂ sequestration through vegetation. Despite the potential release of greenhouse gases such as methane (CH₄) due to anaerobic conditions, certain wetlands demonstrate a net greenhouse gas sink capability, where the carbon uptake substantially offsets climate-forcing emissions. This functionality underscores the importance of understanding carbon uptake drivers to optimize wetland management as a natural climate solution. Moreover, integrating artificial wetlands into urban areas fosters community resilience, reconnecting people with their local ecosystems and enabling collaborative governance for environmental management. Through place-based approaches, artificial wetlands address carbon-zero ambitions and enhance local biodiversity, providing many ecosystem services. These systems' rehabilitation and sustained management are pivotal in preserving their role as carbon absorbers and fostering biodiversity amidst continuous climate change and urban development. In case studies, it has been observed that restored swamp areas rapidly turn into net CO₂ sinks after restoration. Site-specific factors such as land cover and vegetation development are essential in annual carbon budgets. Studies show that the impacts of previous land uses and hydrological changes are mitigated, highlighting the potential of wetland restoration to provide effective long-term carbon sequestration. In conclusion, artificial wetlands are promising for mitigating climate change impacts through carbon sequestration and biodiversity enhancement. Their success depends on careful design, management, and integration into broader sustainability and climate adaptation frameworks. Future research should focus on optimizing wetland restoration practices to maximize their ecological benefits and explore their scalability.

Keywords: Artificial wetlands, carbon sequestration, climate change mitigation.
Introduction

The impacts of global warming and the significance of negative emission technologies are paramount in the contemporary discourse on climate change, extending even to the extent that they will affect our food supplies (Haikola et al., 2021; Wiskerke, 2020). Global warming, attributed primarily to the increase in greenhouse gases such as carbon dioxide (CO₂) and methane (CH₄) due to human activities, has significantly increased Earth's average surface temperature, indicated in Figure 1 (Çelekli and Zariç, 2023b). The Intergovernmental Panel on Climate Change (IPCC) has underscored that the phenomenon is widespread, rapid, and intensifying, affecting every region on Earth in multiple ways (Srivastava et al., 2021). The consequences include but are not limited to, increased heatwaves, changes in precipitation patterns leading to more intense droughts and flooding, sea level rise, and the thawing of permafrost, all of which have profound implications for natural and human systems (Çelekli and Zariç, 2023c). Due to the severity of the consequences of climate change, efforts to colonize Mars are underway (Çelekli and Zariç, 2024a). The current state of global warming is such that human activities since the beginning of the Industrial Revolution have significantly influenced the pace and extent of climate change (Fleming, 2009). The IPCC's Sixth Assessment Report highlighted that the best estimate of the global average surface temperature increase between 1850 and 2019 was approximately 1.07 °C (Legg, 2021); Figure 1 indicated global temperature anomaly and atmospheric CO2 concentration (Shrestha, 2022).

Figure 1. Global temperature anomaly over 1959-2021 with CO₂ concentration (Shrestha, 2022)

Wetlands and oceans are known to be damaged by human impact (Çelekli and Zariç, 2024c; Zariç et al., 2024; Zariç and Çelekli, 2023). In this context, negative emission technologies that remove CO₂ from the atmosphere and ecological situations are analyzed with remote monitoring methods (Çelekli and Zariç, 2023a, 2024b; Haikola et al., 2021). Artificial wetlands represent a crucial strategy for carbon sequestration, leveraging the natural processes of vegetation to capture and
store atmospheric CO₂ (Yuan et al., 2023). Artificial wetlands mimic the carbon sequestration capabilities of their natural counterparts and provide a myriad of ecosystem services (Clifford and Heffernan, 2018). They play a significant role in enhancing biodiversity, improving water quality, and offering flood protection, contributing to urban and regional sustainability goals (Alikhani et al., 2021). The integration of artificial wetlands into climate mitigation strategies underscores a growing recognition of the need for holistic approaches that address both the reduction of emissions and the removal of atmospheric CO₂ (Were et al., 2019). By capturing and storing carbon, artificial wetlands serve as vital components of the broader effort to combat global warming, highlighting the interconnectedness of climate action, ecosystem health, and biodiversity conservation (Nyman, 2011). The urgency of addressing global warming and harnessing the potential of solutions like artificial wetlands is apparent. As we face increasing climate variability and the escalating impacts of climate change, the development and expansion of negative emission technologies (Table 1), alongside aggressive emission reduction measures, are critical to achieving global climate goals and ensuring a sustainable future for all. Figure 2 shows the carbon footprint context path (Çelekli and Zariç, 2023b).

![Figure 2. Carbon footprint context path (Çelekli and Zariç, 2023b)](image)

**Table 1. Summary of Negative Emission Technologies**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Description</th>
<th>Potential to Reduce CO₂</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial Wetlands</td>
<td>Engineered ecosystems mimic natural wetlands, capturing CO₂ through vegetation and storing it in soil.</td>
<td>High in localized areas</td>
<td>(Were et al., 2019)</td>
</tr>
<tr>
<td>Direct Air Capture</td>
<td>Technological process that captures CO₂ directly from the atmosphere for storage or use.</td>
<td>High, scalable globally</td>
<td>(Erans et al., 2022)</td>
</tr>
</tbody>
</table>
Bioenergy with Carbon Capture and Storage

Utilizes biomass for energy, capturing the CO₂ produced and storing it underground.

Potential to Reduce CO₂: Very high, scalable with energy production

References: (Babin et al., 2021)

Methods

This review synthesizes the current knowledge on artificial wetlands and their role in mitigating global warming through carbon sequestration and biodiversity enhancement. To gather and analyze the relevant literature, comprehensive searches were conducted in scientific databases such as Web of Science, Scopus, and Google Scholar. Keywords included "artificial wetlands," "carbon sequestration," "biodiversity," "water purification," "flood control," and "ecosystem services." Publications from the last two decades were prioritized to ensure the inclusion of the most recent findings and advancements. Studies were included based on specific criteria: those focusing on the design, implementation, and management of artificial wetlands, as well as research articles, review papers, and case studies discussing their ecological functions and benefits. Papers addressing the challenges and future directions for artificial wetland research and application were also considered. Relevant information was extracted from the selected articles, including methodologies, results, and conclusions. Data on carbon sequestration rates, biodiversity impacts, water purification efficiency, and flood control benefits were systematically reviewed and summarized. Comparative analyses were conducted to identify common themes, patterns, and gaps in the current knowledge. The gathered data were organized into thematic sections to provide a comprehensive overview of the topic. Key findings were highlighted, and their implications for the design and management of artificial wetlands were discussed. Future research directions and recommendations were proposed based on the identified gaps and challenges.

Results

Carbon Sequestration Mechanisms in Artificial Wetlands

Artificial wetlands capture CO₂ via photosynthesis, transforming it into organic matter that accumulates in soil (Rogerson et al., 2021). This process is enhanced under the anaerobic conditions that characterize these ecosystems (Were et al., 2019). Such conditions slow organic matter decomposition, preserving soil carbon and producing methane emissions (Mitra et al., 2005). This balance is influenced by site-specific factors such as vegetation type and historical land use, suggesting that artificial wetlands can significantly contribute to climate change mitigation with strategic management.

Impacts of Artificial Wetlands on Biodiversity

Artificial wetlands, constructed primarily for water purification, have emerged as valuable ecosystems for biodiversity conservation, compensating for the degradation of natural wetlands (Stefanakis, 2019; Zhang et al., 2020). These engineered ecosystems simulate natural wetland processes to optimize water purification but also provide sub-optimal habitats for various species, thereby contributing to biodiversity maintenance (Huang et al., 2022). However, the ecological processes in constructed wetlands can differ from those in natural wetlands, potentially promoting biological invasions or forming ecological traps for native species; despite these challenges,
constructed wetlands can support diverse flora and fauna with proper management, enhancing local biodiversity and environmental resilience (Zhang et al., 2020). In urban areas, artificial wetlands enhance biodiversity and play a crucial role in creating natural spaces and connecting communities with their environment (Alikhani et al., 2021). These wetlands serve as green corridors, improving the urban landscape's aesthetic and recreational value and providing educational opportunities for residents. By integrating these ecosystems into urban planning, cities can enhance community resilience, promote sustainable development, and support biodiversity. Such integration requires a multifaceted approach, including stakeholder engagement and incorporating wetlands into broader environmental and social strategies. Moreover, wetland restoration has been shown to recover biodiversity and ecosystem services significantly lost due to degradation (An and Verhoeven, 2019). However, the effectiveness of these efforts can depend on factors such as the ecosystem type and specific restoration actions. Restoring biodiversity in these ecosystems is critical, as it often correlates with the recovery of ecosystem services, suggesting that biodiversity may be a prerequisite for the entire functional restoration of these areas. This highlights the importance of considering ecological and social aspects in the management and restoration of wetlands. In conclusion, artificial wetlands are vital in enhancing urban biodiversity, connecting communities with nature, and contributing to global conservation efforts. Their successful integration into urban landscapes requires careful planning, management, and engagement with local communities to ensure they provide both ecological and social benefits (Erwin, 2009; Zedler and Leach, 1998).

Management and Optimization of Artificial Wetlands

Maximizing the carbon sequestration capacity of artificial wetlands requires a comprehensive understanding of the ecosystems' dynamics and effective management strategies. These strategies must focus on enhancing the natural processes of carbon uptake and storage while minimizing the release of greenhouse gases like methane (Bernal and Mitsch, 2012).

Strategies for Maximizing Carbon Sequestration

The design of artificial wetlands plays a crucial role in their ability to sequester carbon. Incorporating diverse vegetation and ensuring adequate water depth and flow can enhance the wetlands' primary productivity, thus increasing CO₂ absorption from the atmosphere (Salimi et al., 2021). The layout should mimic natural wetlands as closely as possible to exploit the inherent carbon storage processes (Were et al., 2019). Effective management practices are vital in maintaining the carbon sequestration potential of artificial wetlands. This includes regularly monitoring vegetation health, water quality, and soil conditions. Intervention measures, such as controlling invasive species and adjusting water levels, can help maintain optimal carbon capture and storage conditions. Restoring degraded wetland areas can quickly turn them into net CO₂ sinks (Valach et al., 2021). Restoration efforts should focus on re-establishing native vegetation and repairing hydrological functions to enhance carbon uptake (Collier, 2012). These efforts must consider site-specific factors like land cover, previous land use, and hydrology, as they significantly impact the carbon balance of wetlands (Valach et al., 2021).

Case Studies and Applied Research

Research has shown that peat-dominated ecosystems, including freshwater marshes, play a critical role in global carbon storage due to their long residence time and anaerobic conditions that protect soil carbon while supporting vegetation that sequesters atmospheric CO₂ (Lolu et al., 2020). Despite the potential release of methane, a greenhouse gas, some restored wetlands have been
immediate net greenhouse gas sinks in specific years, with their high net carbon uptake offsetting the climate-forcing effects of methane emissions (Turetsky et al., 2014). This highlights the importance of understanding the drivers of carbon uptake in freshwater wetlands to optimize their management as natural climate solutions.

Artificial wetlands contribute to carbon sequestration through vegetation and soil processes, particularly in peat-dominated ecosystems where long-term carbon storage is facilitated by anaerobic conditions that slow decomposition (Lolu et al., 2020). Despite their potential, artificial wetlands also face limitations, such as methane emission, a potent greenhouse gas, which can reduce their net climate mitigation benefits (Were et al., 2019).

Beyond their role in climate change mitigation, artificial wetlands enhance biodiversity and provide various ecosystem services such as improving water quality, providing habitat for wildlife, and supporting recreational activities (Semeraro et al., 2015). Integrating artificial wetlands into urban and community planning can also enhance social values by reconnecting people with nature and supporting community resilience.

Discussion

Artificial wetlands are crucial in mitigating global warming through their ability to sequester atmospheric CO₂ and enhance biodiversity. They replicate natural wetland functions, effectively capturing and storing carbon while supporting diverse species and improving water quality and flood control. Optimizing restoration practices is essential for maximizing these benefits, involving selecting suitable plant species, designing for optimal water flow, and managing invasive species. Future research should delve into the intricate interactions within these ecosystems to refine their design and management. Additionally, integrating technological innovations could boost purification efficiency under various environmental conditions. Expanding artificial wetlands into urban and rural areas, supported by robust policies, is vital for achieving carbon neutrality. However, scalability, economic feasibility, and social acceptance challenges need addressing. Future studies should assess the carbon capture potential across different wetland types, ensure long-term sustainability under changing climate conditions, and explore innovative integration methods into broader environmental and urban planning frameworks. As research progresses, artificial wetlands are set to become increasingly significant in global sustainability and resilience efforts.

Acknowledgments

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Author’s Contributions

Özgür Eren Zariç and Abuzer Çelekli designed the overall review work.

References


Determination of the Amino Acid Profile using LC-MS/MS of Economic Fish Species from the Black Sea, Türkiye

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Abstract

This study was conducted to determine the Amino Acid (AA) profiles of i) bottom fish species [Mullet (Mullus barbatus), Whiting (Merlangius merlangus) and Turbot (Scophthalmus maximus)], ii) small pelagic fish species: [Anchovy (Engraulis encrasicolus) and Horse Mackerel (Trachurus trachurus)] and iii) medium pelagic fish species [Bluefish (Pomatomus saltatrix), Bonito (Sarda sarda) and Garfish (Belone euxini)] from October 2018 to July 2019 in the Black Sea (around Sinop, Türkiye. Essential Amino Acid (EAA: Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine and Valine) and Non-essential Amino Acid (NEAA: Alanine, Aspartic Acid, Cysteine, Glutamic Acid, Glycine, Ornithine, Proline, Serine, Taurine and Tyrosine) analyses were performed at Sinop University Scientific and Technological Research Application and Research Center (SUBITAM) using Liquid Chromatography-Mass/Mass Spectrometry (LC-MS/MS device. i) Total AA amount was calculated as Garfish > Horse mackerel > Bonito > Anchovy > Bluefish > Mullet > Whiting > Turbot, ii) Total EAA amount was calculated as Garfish > Bonito > Horse Mackerel > Anchovy > Bluefish > Mullet > Whiting > Turbot, and iii) the total amount of NEAA amount was determined as Garfish > Horse Mackerel > Anchovy > Bonito > Red Mullet > Whiting > Turbot > Bluefish. It was determined that the amount of amino acids in the examined fish species varied depending on the species, breeding time, length of daylight (photoperiod), water temperature and therefore the amount and quality of nutrients in the environment. These factors were evaluated as factors affecting the amino acid composition of the examined fish species in the Black Sea (around Sinop province), Türkiye. These analysis results have been reported in detail for the Black Sea for the first time with the present study supported by Sinop University Scientific Research Projects Coordination Unit with the project numbered "SÜB-1901-18-02".

Keywords: Amino acid, fish, LC-MS/MS, Black Sea, Türkiye
Evaluation of Climate Change Impacts on Urban Areas with Its Social and Ecological Dimensions: An Example of Düzce

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Abstract
While climate change causes environmental and social problems at the global level, these impacts are felt more intensely in urban areas. Climate change impacts such as extreme heat waves, heavy rainfall, flood risks, forest fires and droughts cause ecological and social problems in urban areas. Climate change tends to increase the frequency and severity of natural hazards in cities. The aim of this study is to determine the vulnerability of urban areas due to climate change through the example of Düzce city, addressing both ecological and social dimensions and presenting strategies to mitigate this damage. The city of Düzce, which was determined as the study area, is located in the Western Black Sea Region. The methodology of the study includes steps such as field research, data analysis and literature review. The natural, cultural and social characteristics of Düzce were identified and data statistics were obtained on extreme weather events such as heavy rainfall, high temperatures, floods, floods, landslides, droughts, etc. as consequences of climate change. Changes in the ecological and social structure of the city and the effects of climate change were evaluated together. As a result, local governments, planners and other stakeholders need to act in cooperation in order for cities to become resilient to the impacts of climate change and to cope with increasing natural hazards. In order for the city of Düzce to become more prepared for future climate change-related hazards, strategies including infrastructure strengthening, early warning systems, green infrastructure, environmental citizenship and environmental sustainability, etc. are recommended.

Keywords: Transformation, climate change, climate resilience, urban landscape planning, social dimension.
Daily and Intradiurnal Variation of Dominant Airborne Pollen in Ankara during Early Spring Period

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Abstract
Airborne pollen grains are widely recognized as triggers of allergic rhinitis and asthma with symptoms closely tied to the pollination period of local species. While pollens are dangerous during the main pollen season as spring, they are also very dangerous outside the main season. Pollen seasons may vary from year to year due to meteorological factors and climate change. In our research, airborne pollen concentrations of Ankara atmosphere during the early spring period were evaluated and intradiurnal variations of pollen concentrations were detected. In the study, atmospheric pollen grains in Ankara were collected with a volumetric Burkard trap for 2-month period between 01.02.2024 and 31.03.2024. In the atmosphere of Ankara, a total of 15 pollen type belongs to different plants were detected within a 2-month period. The pollen levels of these 15 plant taxa have been determined on both daily and hourly basis. The most abundant pollen types in the Ankara atmosphere in study period were determined as Cupressaceae, Fraxinus, Acer, Corylus and Alnus. The concentration of Cupressaceae pollen was highest from 5:00 p.m. to 9:00 p.m., reaching its peak between 7:00 p.m. and 8:00 p.m. On the other hand, Fraxinus pollen was highest from 09:00 a.m and 12:00 a.m and reached the peak value from 10:00 a.m and 11:00 a.m. Overall, pollen levels were found to be very high for allergic individuals even during early spring.

Keywords: Airborne pollen, intradiurnal variation, early spring
Microplastic Contamination in Beach Sediments from the Sinop Coast of the Black Sea

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Abstract

Over the past years, contamination of marine environment with microplastic has become a growing concern. Plastics enter the marine environment in direct microscopic sizes or degrade over time with the influence of various factors (temperature, wind, etc.), and plastic particles between 5 mm and 1 µm are named as microplastic. The Black Sea is seriously affected by this pollutant and microplastics have been reported from seawater to the seabed, and also in many organisms. However, investigations on microplastic in beach sediments have been limited.

Sinop peninsula is located middle of the southern Black Sea coast. Sinop is a settlement with prominent fishing and tourism and no industrial pollution. In this study, the presence of microplastics in beach sediments was investigated at selected beaches along the coast of Sinop in May 2024. Sampling was carried out at 4 different stations on the Sinop coast. Microplastic samples for 1-5 mm were collected from strandline with used 50x50 cm quadrats and passed through 5-1 mm metal sieve and the particles remaining on the 1 mm sieve were evaluated. They were analyzed by the naked eye. Sediment cores were used for <1 mm microplastic samples, and samples were collected by strandline. Collected sediment was extracted in the laboratory by density separation and they were analyzed by stereo microscope. Sampling was performed in 3 replicates. Microplastic abundance was determined and samples were categorized. The results of the study showed that the microplastic abundance of the east coasts of Sinop was higher than the west coast. Microplastics generally consist of polystyrene pieces which commonly originate from polystyrene boxes especially used in fishing season. The most encountered color was found white. Microplastics cause harm to the marine environment and investigations on transportation, accumulation, and distribution of microplastics are important.

Keywords: Microplastic, sediment, Black Sea, pollution
Ornithological Evaluation of Some Drinking Water Basins in İstanbul

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Abstract

İstanbul is located on one of the most important bird migration routes of the world due to its geographical location. This important location in terms of the migratory birds and the variety of ecosystem creates a suitable habitat for different bird species. Among these habitats, İstanbul water basins are one of the most significant ecosystems in terms of the bird diversity.

Within the scope of the ‘Project for Determination of Flora, Fauna, Lichen Species and Ecological Risk Assessment by Soil Analysis of İstanbul Province İSKİ Drinking Water Basins, Urban Forests and Groves, ornithological monitoring studies were carried out for 70 days between March 2023 and February 2024 in Terkos Lake, Büyükçekmece Lake, Ömerli Dam, Elmalı Dam and Sazlıdere Dams in 5 drinking water basins. Monitoring studies were organized to cover all migration, breeding and wintering periods.

As a result of the studies carried out, a total of 218 bird species from 23 orders and 58 families were identified. The most numerous families recorded are Anatidae (17 sp.), Laridae (17 species), Accipitridae (15 species), Scolopacidae (15 species), Muscicapidæ (12 species). When the study areas are compared, 188 species were observed in Terkos Lake, 167 species in Büyükçekmece Lake, 154 species in Sazlıdere Dam, 123 species in Ömerli Dam and 88 species in Elmalı Dam. According to IUCN, 1 species is Endangered and 7 species are Vulnerable, 9 species are categorized as Near Threatened. According to literature data, 54% of the avifauna of İstanbul, which is home to 406 bird species, was observed in 5 drinking water basins within only 1 year study period, which clearly revealed the importance of these areas. It will be possible to reveal the richness of these areas more clearly with more long-term and comprehensive ornithological monitoring studies.

Keywords: Birds of İstanbul, avifauna, wetlands, avian diversity
Chromosomal Properties of *Alburnoides freyhofi*

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Abstract

The aquatic ecosystem has a great place in the ecological cycle. Fish are one of the most important components of the aquatic world. Nowadays, aquatic resources and freshwaters were exposed to pollution and this situation has been caused decreasing of fish populations. It is important to determine the genetic characteristics of fish that are endemic to our country before they disappear. For this reason, this study aimed to reveal the chromosomal characteristics of the *Alburnoides freyhofi* Turan, Kaya, Bayçelebi, Bektaş & Ekmekçi, 2017 species, which is endemic to the inland waters of our country. Metaphase chromosomes were obtained in the cell suspension obtained from fish tissue samples and the number of diploid chromosomes was found to be 2n = 50. When chromosome banding features were considered, constitutive heterochromatin banding and nucleolus organizer regions were determined.

Keywords: Chromosomes, Delice stream, chromosome banding.
Composition of Marine Litter Entangled in Turbot Gillnets and its Effect on Fishing Efficiency**

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Abstract

Increasing world population, developing industry, technology and increasing pollution are among the important factors threatening the world's seas and oceans. Especially the fixed or floating marine litters are a problem that negatively affects natural marine ecosystems and living biodiversity, and therefore has negative repercussions on other stakeholders in the system. Unfortunately, one of these stakeholders, the fishing industry, is also affected by marine litters.

This study was conducted to determine marine litter (ML) composition and its effects on turbot gill net fishing efficiency around the Sinop coasts in the Black Sea. A total of 10 fishing operations were carried out at depths of 49-92 meters between March and June 2022, with 4 km long and 400 mm mesh size (knot to knot) multifilament material nets. At the end of each fishing operation, ML was sorted and weighed. ML entangled in the nets was classified as plastic, cloth, metal, wood, fishing gear, glass, rubber and ceramic. The composition of this MLs were determined as 37.18%, 31.30%, 20.19%, 12.5%, 5.88%, 5.77% and 3.87%, respectively. The per unit effort of ML (MLPUE) were also determined as 0.306±0.109 km/day for plastic, 0.254±0.094 km/day for cloth, 0.163±0.060 km/day for metal, 0.110±0.051 km/day for wood, 0.057±0.032 km/day for fishing gears, 0.044±0.013 km/day for glass and 0.035±0.018 km/day for rubber. During the study, no ceramic marine litter was found entangled in the turbot gillnets.

More MLs was entangled in the nets used in the Northeast wind-NE than in the nets used in the Northwest wind-NW (1.254±0.878 km/day and 0.4435±0.183 km/day). Both direction and intensity of the winds and the currents have a significant impact on the increase and distribution of MLs. Increase in the amount of ML entangled in turbot gillnets caused a decrease in the amount of caught turbot (Scophthalmus maximus) and thornback ray (Raja clavata) (P<0.05).

Keywords: Marine litters, ecosystem, Turbot gillnets, Catch Per Unit Effort (CPUE)

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Effects of Climate Change on the Black Sea Ecosystem: Jellyfish and Fisheries

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Abstract

The world marine ecosystems are changing with global warming. This change show itself on all pelagic and benthic groups, starting from the primary producers of the food chain. Environmental factors, temperature differences, changes in food composition... etc. with factors, new species entering the ecosystem also affect the amount and life processes of native species in the seas. In the last 30 years, the abundance of gelatinous species, which have high tolerance to changes, has increased and in these ecosystems their negative effects have been observed. The Black Sea is one of the seas that respond quickly to these changes and experience serious problems, especially with the dominance of gelatinous organism species in the pelagic ecosystem. An increase in the abundance of barrel jelly (Rhizostoma pulmo), moon jelly (Aurelia aurita) gelatinous organism species, has been observed in the Black Sea in the last 5 years.

The increasing amount of gelatinous organisms in the Black Sea has negative effects on fishing activities, especially trawl and purse seine fishing. Among these species, moon jelly and barrel jelly species attract attention as a factor that reduces the catch amount and selectivity of fishing gears, especially with their blooms in autumn and spring. Especially when they enter large amounts of demersal trawl and pelagic trawls, they disrupt the standard structure and shape of the fishing gear, reduce the CPUE value of the target species, and also reduce the average length of the target species caught. With the increase of these species in the future due to climate change and global warming, there is a possibility that the biodiversity in the Black Sea will change greatly and our fisheries will be even more negatively affected. In this study, the effects of jellyfish species (moon jelly and barrel jelly) caught by fishing gear used commercial fishing activities covering the 2019-2024 fishing seasons were evaluated in terms of catch amount and statistics.

Keywords: Climate change, marine ecosystem, jellyfish, fisheries, Black Sea
Comparative Analysis of Multiple Approaches for Template DNA Purification from Microalgae Isolates

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Abstract

Global climate change and speciation are pivotal factors that profoundly influence the dynamics of marine ecosystems. In this context, the accurate identification of microalgae species and comprehension of their diversity are imperative for elucidating the health and functionality of ecosystems. In addition to traditional methods such as the bright-field microscopy and scanning electron microscopy, molecular studies are recognized to play a crucial role, particularly in the identification of cryptic species. While it is underlined that genetic analyses should be given more importance in the field of marine sciences, the lack of such studies in Türkiye is remarkable. The aim of this study was to obtain template DNA from the growth phase culture isolates belonging to the genera Coolia, Prorocentrum and Pseudo-nitzschia, using both manual methodologies and commercial isolation kits and to make comparative analysis of the DNA purity obtained. For DNA purification without the utilisation of commercial kits, both the salt mold DNA extraction protocol (1) and the ammonium acetate protocol (2) were employed. Similarly, for the same purpose, two commercial isolation kits, namely the Roche High Purity PCR Template Preparation (3) and the GeneALL Exygene Plant SV Mini (4), were utilized, and the effects of these four methods on DNA yield and quality were analyzed. In the measurements made with Nanopore in terms of DNA concentrations; 6.60–21.73 ng/µl with protocol 1, 0.53–69.69 ng/µl with protocol 2, 6.10–35.00 ng/µl with protocol 3 and 0.78–3.52 ng/µl with protocol 4. In terms of DNA/Protein ratio in the samples in terms of optical density, it was determined that protocols 2 and 3 had higher DNA purity than the others. After the PCR reactions, agarose gel electrophoresis, was performed to the samples and the template DNA products from protocols 1 and 3 of Pseudo-nitzschia isolate were formed a clear band, while bands were obtained in protocols 2 and 4 of Coolia isolate. For Prorocentrum isolate, only protocol 3 formed a bant. Accordingly, while protocol 3 was found to have higher functional coverage and DNA purity than the other protocols, it was revealed that protocols 2 or 4 should be preferred for Coolia isolate. These findings highlight the necessity of method selection in genetic analyses of microalgae and the need to take into account the differences between genera.

Keywords: Coolia, Prorocentrum, Pseudo-nitzschia, DNA purity.
A Seasonal Comparison of Coastal Water Quality and Eutrophication Status in the Black Sea, Sea of Marmara, and Aegean Sea

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Abstract

Coastal regions are particularly vulnerable to the impacts of climate change and human activity. Regular monitoring of these areas is crucial for early intervention and the development of effective solutions. This study aimed to compare water quality and eutrophication status across different regions. A total of 14 stations were selected along the coastlines of the Istanbul [the western Black Sea (BS) and northern Sea of Marmara (SM), and the Gulf of Saros [the northern Aegean Sea (AS), seasonally between May 2023 and February 2024. During the study, a multiparameter probe were used to measure temperature, salinity, dissolved oxygen (DO), and pH values, while spectrophotometric methods were employed for measuring chlorophyll-a (chl-a), total nitrogen and phosphorus (TN and TP), ammonium nitrogen (NH4-N), phosphate (PO4-P), and silicate (SiO4-Si). The Trophic Index (TRIX) value of each station was calculated based on the physicochemical variables obtained from the analyses. The calculated values ranged from 2.16 to 5.52 and were grouped according to TRIX values. The classification revealed that 48% of the values fell into the "good quality" category, 45% into "high quality, low production," 5% into "low quality," and 2% into "low quality, high production." Notably, Station 5 (Bakırköy, SM) consistently exhibited the highest total nitrogen and TRIX values during each sampling period, indicating poor water quality conditions. Furthermore, the results of study were evaluated according to eutrophication criteria established for coastal waters in Türkiye, showing compatibility with TRIX results. While the AS stations predominantly exhibited oligotrophic conditions, the SM stations demonstrated the highest eutrophic conditions in the study, primarily due to NO3-N stress. Additionally, a classification system developed to assess water quality with TP, NO3, and DO indicated that NO3 emerged as the primary determinant. Total phosphorus (TP values were classified as the first class in all samples, while a significant proportion of NO3 values (57%) fell into the second and third water quality classes."

Keywords: TRIX, water quality, eutrophication, Black Sea, Sea of Marmara, Gulf of Saros,
Monitoring Cetacean Strandings in an Important Marine Mammal Area: A Five-Year Study Along the Sinop Coasts of the Black Sea

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Abstract

Monitoring stranded cetaceans provide crucial information to implement effective conservation management and allows the collection of data that is normally difficult to access. In this study, records of cetacean strandings were collected between May 2019 and April 2024 along the Sinop coasts that was designated as Important Marine Mammal Area by IUCN. In addition to routine beach surveys, social media, local press and citizen notifications were also utilized in the data collection phase. Stranded cetaceans were photographed, measured and, where applicable, samples (such as teeth and skin) collected after the necessary information such as species, sex, location, date and probable cause of death was recorded. A total of 69 cetaceans were found dead stranded along the Sinop coast. Of these, 47 were common dolphins (Delphinus delphis ponticus), 19 were harbour porpoises (Phocoena phocoena relicta), 2 were bottlenose dolphins (Tursiops truncatus ponticus) and 1 was unidentified. The number of stranded individuals was the lowest in 2019 (6 cases) and the highest in 2022 (23 cases). 23 individuals including 16 common dolphins, 5 harbour porpoises and two bottlenose dolphins had fishing gear marks on their bodies thus indicating possible entanglement. In terms of sex, 16 individuals were female (5 common dolphin, 10 harbour porpoise and 1 bottlenose dolphin), 18 were male (16 common dolphin, 1 harbour porpoise and 1 bottlenose dolphin) and 35 were unknown. In general, the most common season for strandings was spring with nearly 70%, while the highest number of cases with 14 records occurred in March 2022. The reason for the increase in cases in spring is thought to be due to both the increase in the abundance of cetaceans in this season and the increase in the use of wide-mesh nets.

Keywords: Cetacea, stranding, Black Sea, Sinop, dolphin, porpoise
Effects of Hydrological Connectivity on Konya Closed Basin Fishes

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Abstract

Demand for freshwater has been increasing for decades. This demand, coupled with anthropogenic stressors such as pollution, water abstraction and climatic events such as droughts are threatening freshwater resources. The Konya Closed Basin is one of the largest basins in Turkey. The primary threats to the rivers and lakes in the basin are habitat degradation, drought, shrinkage and changes in hydrological connectivity. Even some of the wetlands have dried up. These factors threaten the freshwater biome and therefore fish.

The basin has a high number of endemic fish species, with 27 endemic species out of a total of 39. We hypothesize that fish distributed in the waters of the arid Konya Closed Basin are facing high rates of population decline and that anthropogenic impacts are important in this process.

Field work was carried out in April 2024 to determine how changes in river connectivity over time affect fish populations. We were able to collect fish from eleven selected sites out of a total of thirty. The species diversity of the sampling sites was compared from the available literature. In addition, we compared and examined the fish fauna from the available literature and re-evaluated the source with our findings.

This study was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under the grant number 123Y021. The authors are grateful to TUBITAK for their support.

Keywords: Climate change, river network, pathways, connectivity, catchment, spatial structure, fish
Examining Cultural Ecosystem Services in Rural Areas from The Perspective of Landscape Architecture Students

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Abstract

The culture and lifestyle of the industrial society and the information society that followed it resulted in people settling in cities, moving away from natural areas and confining themselves to building masses all over the World. In recent years, humans, who are a part of urban life, have begun to desire to return the nature, which is the source of existence, and as a result of this the number of daily and long-term activities from city to countryside has begun to increase rapidly. Rural areas (villages, pastures, parks, etc.), which are within the daily transportation network of some cities, have begun to be frequented by urban people and migration from the city to the countryside has begun. Cultural ecosystem services, which are provided through natural ecosystems and express the intangible benefits that people derive from these ecosystems, offer many values for the well-being of people in urban and rural areas. Therefore, determining these values will help in developing solutions to ensure their sustainability. This study is to determine the urban cultural ecosystem services provided by "z" generation landscape architecture students studying in the city of Sakarya through green space systems and to measure their awareness. In the survey to be conducted via Google forms, in addition to demographic questions, students will be asked questions about how often, in what time period and for what purposes they use green space systems in the city. In conclusion, the perspective of landscape architecture students with ecological knowledge on urban society and nature will be examined.

Keywords: Cultural ecosystem service, generation Z, ecology, rural area
Introduction

Because of urbanization leading to the migration of populations away from rural areas and their confinement within built environments, there has been a discernible yearning for a return to rural locales perceived as repositories of human assets. This has precipitated a notable surge in both short-term and long-term recreational activities from urban centers to rural expanses, with these accessible rural zones (including villages and pastures) assuming newfound significance as destinations for urban denizens. However, this transition, particularly exacerbated by unregulated influxes of non-local individuals, has exerted adverse ramifications on ecosystem sustainability and the carrying capacity of protected areas, thereby necessitating the formulation of novel solutions by scholars in the field. Academic discourse underscores the notion that humanity derives tangible and intangible benefits from ecosystems, denoted as ecosystem services.

Our inhabited environment manifests varied interactions between natural and cultural factors, thereby engendering landscape transformations. Alterations in the spatial configuration and utilization of natural and cultural landscapes are often reconfigured to better align with evolving demands. Recent transformations in rural settings have generally been met with disfavor and are perceived to contribute to shifts in landscape attributes such as diversity, coherence, and identity loss. Many contemporary challenges stem from human-environment interactions within cultural landscapes. Sustainable management necessitates long-term land-use planning that integrates social, economic, and ecological considerations under the rubric of conservation, facilitated by pluralistic land-use approaches. Social spatial data facilitate the comprehension of landscape utilization patterns by communities, mapping their environmental perceptions and experiences, discerning nuances in landscape social values, and elucidating discrepancies vis-à-vis nature-related scientific assessments.

The misuse of natural resources, mirroring population expansion and propelled by technological advancements, has engendered deleterious consequences within the supply-demand equilibrium. Globally, freshwater reservoirs are witnessing desiccation or diminution, concomitant with significant shifts in natural calamities and seasonal dynamics. Consequently, ecosystem services rendered to humanity have been compromised, precipitating a marked diminishment in life-support resources and opportunities. Landscape architects and allied disciplines have increasingly espoused ecologically grounded approaches to address environmental quandaries, conducting research endeavors predicated upon sustainability paradigms that correlate human well-being with ecosystemic provisions. This study endeavors to delineate significant swathes of rural territories within the purview of Sakarya Province that furnish ecosystem services via green spaces, offering numerical insights into the utilization and perception of these locales by landscape architecture students.

Methods

This study, encompassing landscape architecture students enrolled in Sakarya Province, elucidates the rural area usage perceptions, experiences, and expectations of these students. Focusing on prospective rural area users, the study examines which green spaces in the province students visit and the extent of their active engagement with these spaces. To this end, a survey was conducted using Google Forms with 110 participants comprising students from the Department of Landscape Architecture at Sakarya University of Applied Sciences, Faculty of Agriculture
It is noted that all participants possess fundamental knowledge and skills in landscape architecture. The collected data were processed using Microsoft Excel and expressed proportionally.

Results

An analysis of the survey responses from 110 participants reveals that there were 32 male and 78 female respondents. Regarding age distribution, 103 participants fell within the 18-24 age bracket, while 7 participants were aged 24 or above, indicating a demographic alignment with the typical age groups for university education in Turkey.

In terms of accommodation, 35 students reside with their families, 35 in government dormitories, 10 in private dormitories, 19 in student houses, 1 in a hotel or guesthouse, and 10 in other accommodations.

Examining population density data of the cities where the participants reside, 3 participants live in areas with less than 2,000 inhabitants, 5 in areas with 2,000-10,000 inhabitants, 8 in areas with 10,000-50,000 inhabitants, 17 in areas with 50,000-250,000 inhabitants, 23 in areas with 250,000-750,000 inhabitants, and 54 in areas with over 750,000 inhabitants.

Regarding beverage preferences, 54.5% of the students prefer coffee, while 45.5% prefer tea.

Concerning living arrangements, 17 students live alone, 15 share their room with one roommate, 51 reside in rooms with 3-5 occupants, 21 in rooms with more than 5 occupants, and 6 selected other options.

Analysis of satisfaction with being a student in Sakarya city reveals that 31 students are happy, 27 are unhappy, 48 are partially happy, and 4 did not express an opinion.

Regarding monthly expenses, 23 students spend less than 5,000 TL, 54 spend between 5,000 and 10,000 TL, 19 spend between 10,000 and 15,000 TL, and 14 spend over 15,000 TL.

Regarding pet preferences, 59 students prefer to own cats, while 51 prefer dogs.

When asked about their preference for rural life, 62 students indicated that they like rural life, 16 dislike it, and 32 are partially fond of it.

Furthermore, 59 students have never resided in rural areas, while the remaining students have varying durations of residency, with 8 for less than a year, 6 for 1-3 years, 10 for 3-5 years, 8 for 5-10 years, 11 for 10-20 years, and 8 for their entire lives.

Regarding rural area usage, 41 students prefer day trips, 17 prefer long-term visits, 29 prefer both, and 25 have not considered the matter. Among those who have had the opportunity to stay in rural areas, 31 prefer hotels or guesthouses, 33 prefer bungalows or wooden houses, 16 prefer tents, 2 prefer caravans, and 45 selected other options.

In terms of weekly rural area usage, 36 students spend less than 1 hour, 13 spend 1-3 hours, 20 spend 3-5 hours, 11 spend 5-8 hours, 5 spend 8-12 hours, 10 spend 12-24 hours, and 11 spend
more than 24 hours. In the binary preference between caravans and tents, 91 students prefer caravans, while 19 prefer tents.

Regarding visits to green networks providing ecosystem services, multiple selections were allowed. The Karagöl plateau was visited by 17 respondents, Dikmen plateau by 7, Sakarya River surroundings by 37, Sülüklü Lake by 6, Poyrazlar Lake and surroundings by 56, Provincial Forest and surroundings by 43, Sapanca Lake and surroundings by 89, Acarlar Marsh by 26, Maden Creek by 22, Keremali plateau by 9, İnönü plateau by 5, Doğançay waterfall and surroundings by 22, Açıle plateau by 3, and 24 respondents selected the "other" option.

Regarding purposes for visiting rural areas, while multiple options were possible, 80 participants indicated walking, 85 picnicking, 90 relaxation and entertainment, 66 exploring new places, 39 observations, 44 socializing, 40 accommodation, and 4 selected other options.

**Discussion**

Most of the survey participants are female respondents aged between 18 and 24 years old. The proportion of those living in government dormitories or with their families totals approximately 63%, constituting an equal share of the total, approximately two-thirds of the overall participation. It is evident from these findings that participants predominantly reside in urban areas, as only 3 participants reported living in rural or similar settings.

On the other hand, similar ratios were obtained for the questions regarding tea-coffee (45.5%-54.5%) and cat-dog preferences (53.6%-46.4%), aiming to determine cultural inclinations. It is well-known that accessing tea is much easier in rural areas, whereas coffee varieties, apart from a few, require comprehensive machines for consumption, making their procurement difficult in rural areas. Similarly, individuals who own cats can provide care for them without leaving their homes, regardless of their urban or rural location, while those who own dogs need to walk them regularly. Consequently, the preference for tea and dogs suggests a cognitive inclination towards rural life, while coffee and cats shed light on urban living tendencies.

Looking at the types of accommodation, the prevalence of bungalow and hotel stays also indicates a predominantly urban participant base.

In conclusion, considering the numbers of visits to green spaces and the activities engaged in during these visits, it can be inferred that people are increasingly turning to rural areas for day trips and long-term stays, likely due to dissatisfaction with urban life. Particularly, the significant visitation rates of rural areas by Generation Z, who predominantly spend their lives in urban areas, and their ability to observe rural life outside their usual living habits, may indicate a longing for rural life among the younger population.

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Analysis of the Change in the Coastal Area and its Vicinity in Sinop Province Based on Corine Data

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Abstract

From past to the present, coastal areas have been defined as the intersection of land and water. Coastal regions hold significant cultural importance due to the ecological values they harbor, alongside historical remnants, offering opportunities for entertainment, scenic views, and tourism. This study examines the temporal and spatial changes within a 1km distance from the coastline of Sinop Province. Numerical analyses were conducted using CORINE data (1990-2018) of the study area through the QGIS 3.28 program. Land classes were categorized into 7 groups: settlement, agricultural areas, forests, pastures, water surfaces, bare rock, and other areas, and were scrutinized accordingly. Consequently, it was observed that over the 28-year period, the coastal strip underwent changes in natural and ecological values.

Keywords: Coastal area, QGIS, CORINE, Sinop.
Carbon Footprint Calculation in a Textile Factory Performing Contract Manufacturing

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Abstract
Calculation, measurement and reporting of the impact of a product on the environment throughout its entire life cycle, from raw material procurement to processing, production, use and disposal after use, is carried out by "Carbon Footprint Calculation". Carbon footprint is expressed as the weight in tonnes of CO2 emissions resulting from human activities. CO2 is the most important greenhouse gas causing climate change.

The textile industry, one of the most important production areas of our country, can cause a wide variety of environmental impacts. In this study conducted on the textile sector, a textile factory engaged in contract manufacturing located in Sinop Organized Industrial Zone was determined as the study area. In the study, the corporate carbon footprint was calculated by evaluating the pollution load separately created by electricity, water, natural gas, fuel oil, air conditioning and service vehicles to be used in production and process. The method used in carbon footprint calculation and assessment is Tier approaches created by the Intergovernmental Panel on Climate Change (IPCC). In this study, the corporate carbon footprint of the facility was calculated using the IPCC Tier 1 method.

Keywords: Carbon footprint, textile, climate change.
Introduction

Calculating, measurement and reporting the environmental impacts of a product throughout its entire life cycle, starting from raw material procurement to processing, production, use and disposal after use, is carried out with the "Carbon Footprint Account" (Bak, 2019).

In order to save nature and have a good life, countries have signed various agreements and made international plans to reduce greenhouse gas emissions. These plans are: Montreal Protocol, Intergovernmental Panel on Climate Change, United Nations Framework Convention on Climate Change, Kyoto Protocol, Paris Agreement, EU Green Deal. With these studies, measures that can be taken to prevent the world's situation from worsening were brought to the agenda.

The word carbon footprint has become a well-known topic in the scientific world in recent years and is widely used in all countries, including Turkey. With climate change on the agenda, the demand for carbon footprint calculations is increasing. Carbon footprint reflects the location of greenhouse gas emissions in the life cycle of human activities. Carbon footprinting calculation is crucial for managing greenhouse gas emissions. Product-based carbon footprinting benefits low carbon consumption and direct society towards low carbon emissions. Studies on carbon footprint calculation for textile products are very valuable for regulating and calculating greenhouse gas emissions, ensuring the transmission of the necessary carbon information and using it in international trade (Aydoğan, 2019).

The textile sector is the sector with the largest volume in terms of the amount of carbon released into the atmosphere within the scope of the manufacturing industry. The textile sector is among the sectors with the widest scope and the highest product diversity. The process, which starts with the harvest of the raw material of product, consists of many processes including yarn production, fabric knitting and finished product operations. When all these process stages are evaluated, the textile industry affects the environment in many ways (Bak, 2019).

Our aim in this research is to reveal the environmental effects caused by a textile company that engages in contract manufacturing during its production. In the study, the pollution load created by the production process stages separately was evaluated and the carbon footprint was calculated. Content of the study; ISO standards, consist of carbon footprint calculation methods, the effects of carbon footprint on human health and climate changes, the textile industry and carbon reduction recommendations.

In a study conducted by Kirchain et al. In the USA in 2015, the carbon footprint value for a T-shirt made of polyester was calculated as 7.1 kg-CO$_2$ e/ T-shirt, which is corresponds to approximately 35 kg CO$_2$ e/ kg T-shirt.

In a study conducted by Hasanbeigi et al. On the textile production in Iran in 2012, the energy value of wool woven textiles was calculated to be between 73 and 132 kWh/kg-fabric.

In a study conducted by Yan et al. In China in 2016, the carbon footprints of fabrics produced from pure wool and wool-polyester mixture was calculated as 14 kg-CO$_2$ e/kg-fabric and 13.5 kg-CO$_2$ e/kg-fabric. The same study states that these values will increase by 70.8% when the yarn dyeing process is taken into account. In this case, the polyester wool blend would contain 23.1 kg-CO$_2$ e/kg-fabric. In additionally, weaving the clothes using the knitting technique will lead to a fabric value of 40.7 kg-CO$_2$ e/kg fabric, an increase of 76.2%. Carbon footprints resulting from the production of wool fibers and polyesters are not included in these values (Coşgun, 2023).

Mc Dougall et al. (2001), Referring to two different previous studies (Lowe, 1981; Ogilvie, 1992), is was concluded that a textile product made from virgin wool will create twice as much carbon footprint as those produced from recycled wool (Coşgun, 2023).
Woolridge et al. (2006) compared the energy consumption of textile products obtained by recycling clothing, which is common in England, and textile products produced with virgin raw materials.

In addition, research on technological developments to increase energy efficiency has attracted attention in recent years.

In a study presented by Dhayaneswaran and Ashokkumar (2013), examined the impact of equipment technology and the development of energy saving methods in a textile manufacturing industry.

When the studies in the literature are examined; carbon footprint calculations was made with the data collected in the province or district of the determined pilot region. Since the factors (type of energy use, consumption amounts) vary in each study, the analysis results are different. When we look at the social conditions regarding geographies and especially the state of awareness, it can be better seen where to start in order to take precautions and reduce carbon emissions. Evaluating each province/institution in this sense will lead to more accurate results.

In this thesis study, corporate carbon footprint calculation was made in a company operating in the textile industry that engages in contract manufacturing. According to ISO 14064-1:2018, category 1 direct greenhouse gas emissions, category 2 energy indirect greenhouse gas emissions, category 3 transportation indirect greenhouse gas emissions and other categories and indirect greenhouse gas emissions were calculated. For category 1 and category 2, data is processed as "kg", "L" or "kWh". For other category data, they are processed as "kWh", "L", "ton.km", ""km", "ton", "m3" and unit conversions are made for the relevant emission factors. Tier 1 method was used for electricity, natural gas, vehicle fuels and fire extinguishers. As a result of the calculations, the total emission amount was for the year 2023, which was chosen as the base year. Suggestions are presented to reduce the calculated emission amounts.

It is the carbon footprint caused by the CO2 concentrations that occur as a result of the activities of an institution on a yearly basis. Within the scope of ISO 14064, greenhouse gas emissions are examined under three different headings (EPA, 2022).

**Direct carbon footprint (Scope-1)**

Emissions represent the environmental impact of fossil fuels used in domestic vehicles in Scope-1 and biofuels used to heat or process products. The organization must calculate and report emissions and releases from facilities within its borders. Direct GHG emissions from electricity, heat and steam generated, exported or distributed by the organization may be reported separately, but should not be deducted from the organization's total direct GHG emissions. CO2 emissions from the combustion of biomass should be calculated separately.

**Indirect carbon footprint (Scope-2)**

Emissions caused by cooling water, hot water and steam supplied by an institution from another institution and emissions caused by the electricity used by the institution are covered by Scope-2.

**Other indirect carbon footprint (Scope-3)**

It is the most difficult footprint to calculate. The reason is that most of the necessary information needs to be provided by other organizations. Scope-3 includes emissions from the organization's leased vehicles, emissions from the energy used to carry out subcontracted activities, and emissions from all products used by organizations (Bekiroğlu, 2014).

**Methods**

**Textile Company Facility Data**

A textile factory engaged in contract manufacturing (garment) located in the Sinop Organized Industrial Zone was selected for the study. The company operates in the ready-made clothing industry.
with 294 people 300 days a year and has a production capacity of 1,883,443 pieces/year. All data used in the calculations belong to 2023. Cutting, sewing, ironing, packaging and shipping operations are carried out in the business. The facility includes dyeing, washing and printing processes. Products are included in the process within the facility according to customer request.

Natural gas, electricity and fire extinguisher data were obtained from invoices. Fuel utilization and generator data for company vehicles were obtained from accounting departments with charts. Natural gas boilers are used for heating purposes and in the ironing unit. There are 13 vehicles registered to the company, consisting of 2 automobiles, 7 minibuses and 4 buses. All of the company's vehicles are diesel fueled and travel 181,967 km per year. In 2023, greenhouse gas emissions from 2.6 kg and 1.12 kg fire extinguishers used for fire drills were calculated (Table 1).

Table 1. Facility Consumption Data

<table>
<thead>
<tr>
<th>Activity</th>
<th>Data</th>
<th>Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating (Natural Gas)</td>
<td>79,458</td>
<td>m³</td>
<td>Natural Gas Bills</td>
</tr>
<tr>
<td>Use of Company Owned Vehicles</td>
<td>29,931</td>
<td>lt</td>
<td>Fuel Plugs</td>
</tr>
<tr>
<td>Generator Use</td>
<td>900</td>
<td>lt</td>
<td>Accounting Schedule</td>
</tr>
<tr>
<td>CO₂ Storage in Fire Extinguishers</td>
<td>24</td>
<td>kg</td>
<td>Maintenance Bills</td>
</tr>
<tr>
<td>Purchased Electricity Consumption</td>
<td>612,670</td>
<td>kWh</td>
<td>Electric Bills</td>
</tr>
</tbody>
</table>

**Carbon Footprint Calculation Method**

In the study, carbon footprint calculations were made according to the calculation method shown in equation (1) using the Intergovernmental Panel on Climate Change (IPCC) Tier 1 Method.

\[
\text{Carbon Footprint (CF)} = \text{Activity Data (AD)} \times \text{Emission Factor (EF)} \quad (1)
\]

In this equation, carbon footprint (CF) is calculated in terms of CO₂ equivalent of emissions to the atmosphere due to heating (natural gas), transportation and electricity consumption. Activity data (AD) shows the amount of consumption caused by the process in the facility and the emission factor (EF) shows the average emission amount of the pollutant.

The carbon footprint created in 2023 is the amount of natural gas, transportation, etc. consumed per unit product. Activity data used emission factors published in the 2006 IPCC Guide for National Greenhouse Gas Inventories (IPCC, 2006) (Table 2). The activity data for the electricity purchase are derived from the monthly reading of electricity consumption. Greenhouse gas emission–related electricity was calculated using the national grid average emission factor that best characterizes the relevant grid.
Table 2. Scope-1 Emission factors

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Emission Factor (EF)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(kg of greenhouse gas per TJ on a Net Calorific Basis)</td>
<td></td>
</tr>
<tr>
<td>CO₂, CH₄, N₂O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>56100, 5, 0.1</td>
<td>IPCC, 2006</td>
</tr>
<tr>
<td>Company Vehicles</td>
<td>74100, 10, 0.6</td>
<td>IPCC, 2006</td>
</tr>
<tr>
<td>Generator</td>
<td>74100, 10, 0.6</td>
<td>IPCC, 2006</td>
</tr>
<tr>
<td>CO₂ Fire Extinguisher</td>
<td>1, -</td>
<td>IPCC, 2006</td>
</tr>
</tbody>
</table>

Results

As a result of the studies, according to the data calculated in the textile factory that carries out contract manufacturing, it was seen that the factor causing the most greenhouse gas formation was electricity consumption. The total carbon footprint of the business was calculated as 455,437 tCO₂eq. As a result of these calculations, 59% of the total emission amount is electricity consumption, 23% is natural gas and 18% is company vehicles.

The carbon footprint of the plant was calculated separately as scope-1 and scope-2 (Table 3). The total of emission factors directly affecting the carbon footprint was 185,862 tCO₂eq and the energy factor indirectly affecting the carbon footprint was 269,575 tCO₂eq (Figure 1, 2).

Table 3. Equivalent CO₂ Emission in 2023 according to IPCC Tier 1 Method (tons)

<table>
<thead>
<tr>
<th>Scope</th>
<th>Amount</th>
<th>Unit</th>
<th>tCO₂</th>
<th>tCH₄</th>
<th>tN₂O</th>
<th>tCO₂eq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>79.458</td>
<td>m³</td>
<td>103.24</td>
<td>0.23</td>
<td>0.055</td>
<td>103.525</td>
</tr>
<tr>
<td>Company Vehicles</td>
<td>29.931</td>
<td>lt</td>
<td>78.61</td>
<td>0.098</td>
<td>1.227</td>
<td>79.935</td>
</tr>
<tr>
<td>Generator</td>
<td>900</td>
<td>lt</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.378</td>
</tr>
<tr>
<td>CO₂ Fire Extinguisher</td>
<td>24</td>
<td>kg</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Total Scope-1 185,862

Scope-2 Electric 612.670 kWh

Total CO₂eq Emissions 455,437
Figure 1. Scope –1 and Scope-2 Emission factors of the facility (tCO2eq)

Figure 2. Carbon footprint percentages of the facility according to its activities in 2023

Discussion

The findings obtained as a result of the studies are similar to other studies conducted in the textile industry. Differences in the processes of each business also affect the amount of carbon footprint. Since contract manufacturing is carried out in the enterprise, it varies depending on the characteristics and quantity of the works given by the customer. It has been observed that the biggest causes of carbon footprint are electrical energy, natural gas and company vehicles.
Some business-based measures need to be taken to reduce the carbon footprint. In this context, the machines used in the business should be replaced with modern equipment technologies and renewable energy sources should be preferred. Energy-saving lighting equipment should be used and machines should be maintained regularly. Company vehicles should be replaced with vehicles less than 10 years old, and vehicles with gasoline, electric or hybrid fuel types should be preferred. Within the scope of sustainability, businesses should fulfill their necessary responsibilities in order to reduce climate change to some extent by aiming for a zero carbon footprint in 2050.

Declarations

I would like to thank Prof. Dr. Ayşe Kuleyin, Assoc. Prof. Dr. Hülya AYKAÇ ÖZEN and my dear husband Ömer Faruk DEMİR for their contributions to my study.

References


Phytoplankton Patchiness Around the Göksu River Estuary (North-Eastern Mediterranean)

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Abstract

Göksu river estuary was studied seasonally to reveal impact of contrasting water masses with varying trophicity on the phytoplankton distribution. Samples were collected from total 51 stations representing nutrient-rich Göksu river estuary, productive coastal, mesotrophic shelf and oligotrophic offshore waters. Total number of 246 phytoplankton species belonging to Bacillariophyceae (79 species), Pyrrophyceae (146), Prymnesiophyceae (16), Cryptophyceae, Chrysophyceae, Euglenophyceae, Ebriophyceae and Chlorophyceae were identified with a persistent diatom dominancy observed throughout. Community was found most diverse during spring followed by winter, summer and fall. Summer population abundances exceeded much the winter, spring and lastly fall population densities. Population was always found most species diverse and abundant in shallow coastal areas fed by nutrient-rich freshwater from the Göksu river and nearby Lamas creek. Maximum population densities were also retained in Taşucu Bay receiving direct freshwater inputs from the nearby Göksu river. Significant positive correlation between surface phytoplankton abundance and ambient temperature and negative correlation with surface salinity whereas almost no correlation with any of nutrient species were observed in fall. In contrast, highly significant positive correlations were only present with nitrate, nitrite and silicate in winter. Despite a highly significant negative correlation with salinity, highly significant positive correlations with phosphate, nitrate, nitrite were observed in spring. Lastly, in summer, a highly significant negative correlation between phytoplankton abundance and salinity & temperature and a significant positive correlation with phosphate were observed. Similar to Pielous' index values, Shannon diversity index values were found maximal during spring followed in decreasing order by fall, winter and summer. Multivariate analyses have displayed numerous patchy aggregations in fall (10 patches), winter (8) and few in spring (2) and summer (3). Despite the very complex affinities observed within various minor patches observed in fall and winter, surface flora has split into two majors, namely coastal - offshore, and east - west subpopulations in spring and summer.

Keywords: Phytoplankton, patch, factors, diversity, Göksu River estuary
Introduction

The eastern Mediterranean is a unique environment known for its distinct water characteristics and role in global circulation (Lacombe et al., 1981). Limited freshwater input contributes to generally low nutrient concentrations in the region (McGill, 1965). Phytoplankton communities play a vital role in the eastern Mediterranean food web, and understanding their dynamics, particularly near riverine inputs, is crucial for ecosystem health (Pomati et al., 2011). Existing studies often focus on specific areas within the eastern Mediterranean (Kıdeyş et al., 1989; Uysal, 2020), with broader examinations of seasonal patterns and river plume effects remaining limited.

The Göksu River, discharging freshwater into the northeastern Mediterranean near Silifke, Türkiye, is a major source of nutrients for the region (Turkish Ministry of Forestry and Water Affairs, 2013). Previous research suggests that phytoplankton abundance and diversity peak in spring and late winter, with blooms dominated by diatoms, near coastal regions receiving riverine inputs (Uysal, 2016). These findings highlight the potential influence of river plumes on phytoplankton dynamics.

This study investigates the impact of contrasting water masses, including the Göksu River estuary, productive coastal zone, mesotrophic shelf, and oligotrophic offshore waters, on phytoplankton abundance, composition, diversity, and patch formation within the Cilician Basin, eastern Mediterranean. By examining these factors, we aim to gain insights into the current state of the ecosystem and establish a baseline for future research. Given the study location within the Northern Levantine Basin (NLB) and its focus on riverine influence on surface waters, the primary emphasis will be on the Mediterranean's surface layers.

Methods

This section details the field sampling strategy, environmental parameter measurements, and data analysis methods employed to investigate the impact of contrasting water masses on phytoplankton dynamics around the Göksu River estuary.

Sampling Area

To investigate the impact of the Göksu River on phytoplankton dynamics, four seasonal cruises were conducted onboard the R/V Bilim-2, operated by the Institute of Marine Sciences at Middle East Technical University. These cruises took place in October 2017, February, April, and June 2018.

During each cruise, sampling stations were established around the Göksu River mouth following a gridded pattern encompassing both horizontal and vertical dimensions (Figure 1). This sampling design aimed to capture the spatial and temporal variations in phytoplankton abundance and composition, as well as associated environmental parameters, to the freshwater input from the river.
A comprehensive suite of physical, biochemical, and biological parameters was measured and collected at each station. Physical parameters included temperature, salinity, and density. Biochemical measurements focused on nutrients (unspecified in the original text, but likely including nitrate, phosphate, and silicate), dissolved oxygen, chlorophyll-a (a proxy for phytoplankton biomass), and particulate organic matter. Additionally, in situ fluorescence and Secchi disk depth were measured to assess phytoplankton activity and water clarity, respectively.

Field Measurements and Sample Collection

To comprehensively assess the environmental factors influencing phytoplankton distribution, a suite of physical, biochemical, and biological parameters was measured alongside phytoplankton sampling during the seasonal cruises.

Physical Parameters: High-precision measurements of depth (pressure), temperature, salinity, and density were obtained using a SEABIRD model CTD probe coupled to a 12-Niskin Bottle (12 L capacity) Rosette System (Sea-Bird Electronics, Inc., Bellevue, WA, USA). This system allowed for remote-controlled water collection at designated depths within the water column.

Dissolved Oxygen: Onboard dissolved oxygen measurements were performed using the well-established Winkler titration method (Grasshoff et al., 1983). Water samples were collected at specific depths during upcasts using the CTD-connected rosette system. To prevent air bubble
contamination, samples were carefully drawn into 100 ml glass bottles using Tygon plastic tubing. Following immediate addition of manganese (II) chloride and alkaline potassium iodide solutions, samples were shaken to ensure complete oxygen diffusion. After resting in darkness for at least 30 minutes to guarantee a complete reaction, dissolved oxygen concentrations were determined by automated titration with 0.02 M sodium thiosulphate solution (Strickland and Parsons, 1972; Grasshoff et al., 1983; UNEP/MAP, 2005).

**Nutrients:** Nutrient samples (nitrate + nitrite, reactive silicate, phosphate, and ammonium) were collected in pre-cleaned, high-density polyethylene bottles (HDPE) treated with 10% HCl and stored at -20°C until analysis (Grasshoff et al., 1983). Back at the laboratory, a Sea Analytical AA3 with XY3 Autosampler model four-channel Autoanalyzer (Sea-Bird Electronics, Inc., Bellevue, WA, USA) employing the standard colorimetric method (Grasshoff et al., 1983) was used to determine nutrient concentrations.

**Phytoplankton Sampling and Analysis:**

Phytoplankton samples were collected using Niskin bottles attached to the rosette during each cruise. One hundred milliliter aliquots were transferred into pre-cleaned borosilicate dark bottles, fixed with 2 mL of 25% glutaraldehyde solution, and stored in darkness at room temperature onboard (Murphy and Haugen, 1985).

Quantitative and qualitative analyses were conducted using an inverted phase-contrast microscope in the laboratory. Glutaraldehyde-fixed samples were allowed to settle in settling chambers (HYDRO-BIOS, total volume 25 ml) for a day. Following the settling period, the entire settling area of the chamber was examined for cell counts and species identification. Efforts were made to identify all encountered specimens, including diatoms, dinoflagellates, coccolithophorids, and other groups, at the species level. Locations of phytoplankton sampling stations can be found in Table 2.1 (not shown here). Cell counts were subsequently converted to cells/liter (Drebes, 1974; Pavillard, 1925; Rampi and Bernhard, 1978; Sykes, 1981; Trégouboff and Rose, 1957)

To assess phytoplankton community diversity in the study area, three common diversity indices were employed: Margalef's species richness (D), Shannon diversity (H'), and Pielou's evenness (J') (Pielou, 1966).

**Data Analysis**

To explore the relationships between physical, chemical, and biological variables in the study, a series of statistical analyses were performed.

**Normality testing:** The Index of Dispersion was initially applied to assess data normality (Field et al., 1982).

**Non-parametric correlation:** Since the data sets likely exhibited non-normal distributions, Spearman's rank-order correlation was employed to evaluate the strength and direction of associations between environmental parameters and phytoplankton cell abundances.

**Multivariate analysis:** Multi-dimensional scaling (MDS) was used to identify potential phytoplankton patches and the environmental factors influencing their formation. Root-root
transformations were applied to raw abundance data to normalize the influence of highly abundant species during similarity analysis using the Bray-Curtis coefficient (Field et al., 1982). Hierarchical clustering based on the Bray-Curtis similarity matrix further explored patterns within the data. Finally, non-metric MDS was used to visualize the relationships between samples in a lower-dimensional space, with stress values indicating the accuracy of the representation.

Results

Physicochemical Parameters

The surface water temperature displayed a clear seasonal pattern, with the warmest temperatures in summer (averaging around 26°C) and the coldest in winter (around 18°C). Winter temperatures were lowest near the Göksu River mouth and highest in the east. Spring continued this trend with the warmest water offshore from the Göksu River and the coldest at the offshore western station. Summer's warmest spot was station 1, while the coolest remained influenced by the Göksu River. Fall maintained high temperatures (around 26°C) but generally cooler than summer, with a decrease moving from east to west.

Surface water salinity showed the opposite trend of temperature, with the highest values in fall (around 39.75 psu) and the lowest in spring (around 39.16 psu). Spring displayed the lowest salinity near the eastern station ETS-4, while the highest was at station 30. Winter salinities were lowest at the shallow eastern station ETS-2 and highest at the offshore eastern station 12. Summer salinities were lowest at the eastern coastal station ETS-1 and highest at the deeper eastern station ETS-7. Fall had the lowest salinities near the Göksu River mouth and the highest at Taşucu Bay.

Surface water density followed a similar pattern to temperature, with the highest values in winter (around 28.48 kg/m³) and the lowest in summer (around 26.35 kg/m³). Winter densities were lowest at the shallow eastern station ETS-2 and highest at the offshore western station 48. Spring's lowest densities were observed near the Göksu River and the highest at the offshore western station 44. Fall had the lowest densities at the eastern station ETS-8 and the highest at the offshore western station 47. Summer displayed the lowest densities at the eastern station ETS-1 and the highest at station 30, located offshore from Taşucu Bay.

Phosphate concentrations displayed a decreasing trend across seasons, with the highest mean values in summer and spring (both at 0.04 μM) and the lowest in fall (0.03 μM). Winter values (0.03 μM) were similar to fall.

Nitrate concentrations exhibited the highest seasonal mean in winter (0.47 μM) and the lowest in fall (0.16 μM). Spring and summer had similar mean values (around 0.19 μM).

Silicate concentrations displayed a decreasing trend across seasons, with the highest mean value in winter (1.36 μM) and the lowest in summer (0.62 μM). Fall (0.86 μM) and spring (0.59 μM) had intermediate values.

N:P Ratio exhibited a clear seasonal trend, with the highest values in winter (mean: 14.7) and the lowest in summer (mean: 5.1). Fall (mean: 5.4) and spring (mean: 5.4) had similar intermediate values.
**Si: N Ratio** followed an opposite trend compared to N:P, with the highest values in fall (mean: 8.8) and the lowest in winter (mean: 3.5). Summer (mean: 5.0) and spring (mean: 3.9) had intermediate values.

**Dissolved Oxygen (DO)** concentrations displayed a seasonal trend, with the highest values in winter and the lowest in summer. The dissolved oxygen values in the surface waters showed decreasing values in their seasonal arithmetic means in the order spring > winter > fall > summer.

**Phytoplankton Distribution and Composition**

**Abundance**

Surface cell abundance exhibited a surprising seasonal trend, with the highest average densities observed in winter (122159 cells/liter) and the lowest in fall (25862 cells/liter). Spring and summer had intermediate average values (109421 cells/liter and 227333 cells/liter, respectively). Interestingly, specific locations within the study area showed much higher abundances than the seasonal averages. In the fall, station 22 had a significantly higher density compared to others. Winter saw the most dramatic fluctuations, with stations ETS-1, ETS-2, 24, and 25 holding abundances exceeding 1 million cells/liter. Spring presented elevated values at stations ETS-1 and ETS-5, while summer had extremely high densities at stations 25, 26, and 29, with the absolute maximum abundance recorded at coastal station 26.

**Species Variety**

Phytoplankton diversity exhibited a seasonal trend, with the highest number of species identified at the surface water stations in spring and the lowest in summer (ranging from 13 to 47 species overall). Fall saw a moderate diversity, with species counts between 16 and 34, averaging 24 per station. Stations ETS-7, ETS-9, and station 29 stood out with a richer community compared to others (Figure 2, Figure 3a). Winter displayed a similar range of species (16 to 46) with a slightly higher average (28 species). Stations ETS-1, 24, 25, and 29 hosted the most diverse phytoplankton assemblages during this season (Figure 2, 3b).

![Figure 2](image)

**Figure 2.** Number of phytoplankton species observed at stations during all sampling periods.

Inter-seasonal variations in phytoplankton species variety were evident. Spring exhibited the highest species diversity, with a mean of 37 taxa per station and a range of 27 to 47 (Figure 2c, 3). Station ETS-1 consistently displayed the greatest species variety across all seasons, including spring. Conversely, offshore station 15 harbored the lowest number of identified phytoplankton species during this period (15 species) (Figure 2, 3c). Summer witnessed a decline in species variety compared to spring. The number of taxa per station ranged from 13 to 39, with an average...
of 26. Notably, offshore ETS stations (along with offshore stations 14, 15, 17, 18, and 19) exhibited statistically significant reductions ($p < 0.05$) in species variety compared to the overall summer average. In contrast, coastal stations ETS-1 and station 39 maintained the highest species variety during summer (Figure 2, 3d).

**Figure 3.** Number of phytoplankton species present at stations for all seasons: Fall-October (a), Winter-February (b), Spring-April (c), Summer-June (d) (ODV).

**Phytoplankton Compositions**

Fall exhibited a distinct phytoplankton community composition. The class Prymnesiophyceae dominated, accounting for nearly 38% of the total abundance. Notably, the species *Emiliania huxleyi* from this class was the single most abundant species overall (38%). Bacillariophyceae (diatoms) were also prominent with a 24.6% abundance, with *Nitzschia* sp. (6%), *Nitzschia tenuirostris* (5%), and *Thalassiosira* sp. (7%) being the key contributors. Pyrrophyceae contributed 21.7%, with *Heterocapsa* sp. reaching 11% abundance. Cryptophyceae, represented by *Hillea fusiformis* (15%), made up 15.4% of the total abundance. Species with individual abundances below 3% were grouped as "others" and collectively contributed 18%. This data suggests a fall phytoplankton assemblage heavily influenced by Prymnesiophyceae, particularly *Emiliania huxleyi*, alongside significant contributions from diatoms and other flagellate groups (Figure 4, 5).
Winter displayed a clear shift in phytoplankton community composition compared to fall. Diatoms took center stage, comprising a dominant 77.3% of the total abundance. Key contributors within the diatom group were *Skeletonema costatum* (23%), *Chaetoceros socialis* (21%), *Chaetoceros curvisetus* (7%), *Nitzschia tenuirostris* (5%), *Pseudo-nitzschia delicatissima* (5%), and *Asterionella japonica* (3%). Prymnesiophyceae remained present, but at a lower level (15.7%), with the coccolithophore *Emiliania huxleyi* still contributing significantly (15% of total abundance). Cryptophyceae (3.7%) and Pyrrophyceae (3.2%) played minor roles, with *Hillea fusiformis* (4%) being the most notable representative of Cryptophyceae. Species with individual abundances below 3% were grouped as "others" and collectively contributed 18%. This data suggests a winter phytoplankton assemblage dominated by diatoms, particularly *Skeletonema costatum* and *Chaetoceros* species (Figure 4, 5).

Spring continued the trend of diatom dominance observed in winter, with this group accounting for an even higher proportion (78.93%) of the total phytoplankton abundance. *Pseudo-nitzschia delicatissima* (18%), *Chaetoceros* sp. (15%), *Proboscia alata forma gracillima* (14%), *Chaetoceros rostratus* (12%), and *Chaetoceros curvisetus* (6%) emerged as the most significant contributors within the diatom assemblage. Prymnesiophyceae (8.3%), represented primarily by *Emiliania huxleyi* (8% of total abundance), remained present but at a lower level compared to spring. Cryptophyceae (4.98%) and Pyrrophyceae (7.16%) continued to play minor roles, with *Hillea fusiformis* (5%) again being the most notable member of the Cryptophyceae. Species with
individual abundances below 3% were grouped as "others" and collectively contributed 20%. This data suggests a highly diatom-centric spring phytoplankton community, particularly driven by *Pseudo-nitzschia delicatissima* and various *Chaetoceros* species (Figure 4, 5).

Figure 5 Pie charts of phytoplankton species and abundance from all stations during four seasons; Fall -October [a], Winter-February [b], Spring-April [c], Summer-June [d]. The same colors for each chart reflect the same species. The other group contains the species that contribute less than 3 percent of the total abundance.

Summer witnessed a further intensification of diatom dominance within the phytoplankton community. Diatoms reached a staggering 91.3% of the total abundance, solidifying their position as the most prevalent group throughout the study. *Leptocylindrus danicus* emerged as the absolute leader, contributing a remarkable 77% to the total abundance. *Rhizosolenia stylliformis* (5%) and *Pseudo-nitzschia delicatissima* (4%) remained significant contributors within the diatom assemblage. Prymnesiophyceae (3.85%), represented mainly by *Emiliania huxleyi* (4% of total abundance), continued to be present but at even lower levels compared to spring. Cryptophyceae (1.36%) and Pyrrophyceae (3.53%) remained minor players. Species with individual abundances below 3% were grouped as "others" and collectively contributed 11%. This data paints a picture of a summer phytoplankton community overwhelmingly dominated by a single diatom species, *Leptocylindrus danicus*, with minimal contributions from other phytoplankton classes (Figure 4, 5).
Ratio of Diatom and Dinoflagellate Community

Seasonal variations were evident in the ratio of diatoms to dinoflagellates (Dia/Dino index) within the surface water. The index exhibited a decreasing trend across the year, with winter and summer sharing the highest value (0.96), followed by spring (0.92) and fall (0.53). This pattern suggests a shift in phytoplankton community dominance. Fall displayed a relatively balanced presence of both groups, whereas spring, summer, and winter witnessed diatoms becoming increasingly abundant compared to dinoflagellates. This trend is likely reflected in more detail in Figure 6.

![Figure 6](image)

**Figure 6** Diatom, Dinoflagellate, and total mean abundances (cells / L) from all stations for each season.

Identified Harmful Algal Bloom (HAB) Species

In the fall, as members of Bacillariophyceae class; *Cylindrotheca closterium* and *Pseudo-nitzschia delicatissima*, also as members of Pyrrophyceae class; *Dinophysis ovum, Gonyaulax spinifera, Phalacroma rotundatum* and *Prorocentrum lima* detected as HAB species. In winter, as the members of Bacillariophyceae class; *Cylindrotheca closterium, Pseudo-nitzschia delicatissima, and Pseudo-nitzschia multistriata*, also as members of Pyrrophyceae class; *Dinophysis fortii* were observed as HAB species. In spring, as the members of Bacillariophyceae class; *Cylindrotheca closterium, Pseudo-nitzschia delicatissima*, and *Pseudo-nitzschia seriata*, also as members of Pyrrophyceae class; *Cochlodinium polykrikoides* and *Karenia papilionacea* obtained as HAB species. In summer, as members of Bacillariophyceae class; *Cylindrotheca closterium and Pseudo-nitzschia delicatissima*, also as members of Pyrrophyceae class; *Cochlodinium polykrikoides* and *Karenia mikimotoi* detected as HAB species.

Biological Diversity Indices

Margalef (species richness D), Shannon (diversity H’), and Pielou (regularity J’) values were determined as diversity indices.

Fall exhibited a moderate species richness, ranging from 1.4 to 3.1 with an average of 2.2 across stations. Station ETS-7 displayed the highest richness, while coastal station 38 had the lowest. Winter saw a slight increase in richness (1.5 to 3.3, average: 2.4). Notably, coastal stations influenced by direct runoff from the Göksu River (ETS-1, 16, 20, 24, 25, 29, and 33) showed high richness. Spring emerged as the season with the highest richness (2.6 to 3.7, average: 3.2). However, offshore stations 15 and 43 displayed lower richness compared to other stations during this period. Summer mirrored fall in terms of richness (1.3 to 3.1, average: 2.2), with offshore stations 10 and 18 exhibiting the lowest values for the entire year. Interestingly, coastal stations 37 and 49 displayed a significant increase in richness during summer. These findings suggest a
spatial influence on phytoplankton diversity, with coastal areas potentially benefiting from riverine inputs and displaying higher richness throughout the year, except for summer.

The Shannon diversity index revealed spatial and seasonal patterns in phytoplankton communities. Fall displayed a moderate diversity range (1.0 to 2.5, average: 1.9), with higher values observed at stations ETS-1, 13, 21, 22, and 23. Interestingly, lower diversity was found at stations ETS-3, 4, and 5, located around the 100m depth contour on the eastern side of the study area. Winter followed a similar pattern (1.3 to 2.6, average: 1.9) with stations 29, 33 (located on the 50m depth contour), and 39 exhibiting high diversity. Conversely, offshore stations 13 and 14 showed considerably lower diversity compared to the seasonal average. Spring emerged as the season with the highest overall diversity (1.9 to 2.8, average: 2.4). Station 29 stood out with the year's highest diversity, while stations ETS-6, 17, and 21 displayed lower values. Summer exhibited the most significant spatial variation. Diversity values ranged from a low of 0.4 to a high of 2.4, with an average of 1.4. The area influenced by the Göksu River discharge, particularly the coastal regions, displayed the lowest diversity, with station 25 recording the year's minimum. In contrast, coastal stations 43, 44, 46, and 49 in the western part of the study area showed higher diversity compared to other summer locations.

Pielou's evenness index (J') revealed seasonal and spatial variations in phytoplankton communities. Fall displayed a moderate evenness range (0.3 to 0.7, average: 0.6) with most stations within normal limits. However, station ETS-4 stood out with significantly lower evenness compared to others. Winter followed a similar pattern (0.4 to 0.8, average: 0.6) with most stations exhibiting evenness within a reasonable range. Interestingly, stations 12 and 39 displayed the highest evenness for the entire year, with station 39 holding the top spot. Spring emerged as the season with the highest overall evenness (0.5 to 0.8, average: 0.7). While most stations maintained consistent evenness, station ETS-6 exhibited a noticeably lower value. Summer exhibited the most significant spatial variation in evenness. Values ranged widely (0.1 to 0.8, average: 0.5), with a higher degree of fluctuation between stations compared to other seasons. The area influenced by the Göksu River discharge, particularly the coastal regions, displayed the lowest evenness, with station 25 recording the year's minimum value.

**Statistical Analysis**

**Correlation Analysis**

A non-parametric statistical test revealed interesting relationships between phytoplankton abundance and various environmental factors across the seasons.

In the fall, phytoplankton abundance showed a positive correlation with temperature (p<0.01) but negative correlations with salinity and density (p<0.01). Interestingly, no significant link was found with nutrients (phosphate, nitrate, silicate) or dissolved oxygen (Table 1).

In winter, density (negative, p<0.01) and silicate (positive, p<0.01) emerged as the key factors influencing abundance. Temperature, salinity, and phosphate showed no significant correlations. However, a positive correlation (p<0.05) emerged between abundance and nitrate, N:P ratio, Si/N ratio, and dissolved oxygen (positive for nitrate and N:P ratio, negative for Si/N ratio and dissolved oxygen) (Table 1).
In spring, salinity, density, phosphate, nitrate, and Si/N ratio all displayed significant correlations (p<0.01) with phytoplankton abundance. The correlations were negative for salinity, density, and Si/N ratio but positive for phosphate and nitrate. Notably, temperature, silicate, and dissolved oxygen lacked significant relationships with abundance (Table 1).

In summer, salinity again played a significant role, with a negative correlation (p<0.01) with abundance. Additionally, temperature, phosphate, and dissolved oxygen exhibited significant correlations (p<0.05) with abundance, though the relationship with temperature was negative, while positive for phosphate and dissolved oxygen. Density, nitrate, and silicate showed no significant links with abundance in summer (Table 1).

**Table 1** Spearman’s rank-order correlation between phytoplankton abundance and environmental parameters.

<table>
<thead>
<tr>
<th>Variables</th>
<th>October-2017</th>
<th>February-2018</th>
<th>April-2018</th>
<th>June-2018</th>
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<tr>
<td></td>
<td>r</td>
<td>P-value</td>
<td>r</td>
<td>P-value</td>
</tr>
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<td>Temperature</td>
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<td>-0.04347</td>
<td>0.76620</td>
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<td>Salinity</td>
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<td>0.00562**</td>
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<td>0.40959</td>
</tr>
<tr>
<td>Density</td>
<td>-0.67759</td>
<td>0.00017**</td>
<td>-0.49143</td>
<td>0.00040**</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.11859</td>
<td>0.42720</td>
<td>0.28166</td>
<td>0.05043</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.08724</td>
<td>0.55980</td>
<td>0.58469</td>
<td>0.01027**</td>
</tr>
<tr>
<td>Silicate</td>
<td>0.25897</td>
<td>0.08122</td>
<td>0.49427</td>
<td>0.00031**</td>
</tr>
<tr>
<td>NO$_3$PO$_4$</td>
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<td>0.8544</td>
<td>0.35440</td>
<td>0.01247**</td>
</tr>
<tr>
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<td>0.6483</td>
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<td>0.95866*</td>
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<tr>
<td>DO</td>
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<td>0.01176*</td>
<td>0.71667</td>
<td>0.98687*</td>
</tr>
</tbody>
</table>

*Correlation is significant at P<0.05, **Correlation is significant at P<0.01.

**Multi-Dimensional Scaling (MDS) Analysis**

Fall phytoplankton communities exhibited distinct spatial patterns. Ten main groups were identified at a 57% similarity level (Figure 7). Group 1, encompassing the largest number of stations (spread across the western half of the study area), contrasted significantly with Group 10 in species composition (Figure 7b). The eastern portion of the study area was dominated by Group 3, while Group 1 showed a more central distribution. Interestingly, the distribution of groups deviated somewhat from the expected westward expansion patterns potentially due to eddy formation in the east. (Figure 7c).

Phytoplankton communities within the studied groups exhibited both significant similarities and dissimilarities. While some species overlapped across all groups, each group was characterized by specific members that consistently contributed most to its overall similarity. For instance, within Group 1, *Emiliania huxleyi* was the dominant species, but *Hillea fusiformis* made the most significant contribution to the group’s internal similarity.

An intriguing pattern emerged consistently across all groups: a dominant species co-existed with another species that played a key role in shaping the overall similarity within the group.
Conversely, distinct species played a crucial role in differentiating the phytoplankton communities between groups. These differentiating species, such as *Nitzschia tenuirostris*, *Gyrodinium estuariale*, *Choanoflagellate*, *Chaetoceros* sp., and *Bacteriastrum delicatulum*, were not necessarily absent from other groups. However, their presence or abundance differed significantly.

![Figure 7](image)

**Figure 7** (A) Dendrogram showing classification based on Bay-Curtis Similarity measure for surface samples, (B) Two-dimensional non-metric MDS ordination of all stations, (C) Phytoplankton patches, October-2017 Survey.

Winter revealed a distinct spatial organization of phytoplankton communities compared to fall. Eight main groups were identified based on Bray-Curtis similarity analysis (55% similarity level). Group 1, the most prevalent, was scattered across the study area (Figure 8a). Group 8 stood out as the most compositionally different group based on the ordination analysis (Figure 8b). Group 2 clustered offshore in the west, while Group 6 primarily comprised stations influenced by Göksu River discharge, including Taşucu Bay. Interestingly, the ETS stations formed four distinct groups along the sampling transect, suggesting a high degree of spatial variability within a relatively small area (Figure 8c). Finally, Group 3 encompassed the deep offshore waters in the eastern region. These findings highlight the interplay between large-scale patterns and local factors shaping winter phytoplankton community structure.

An analysis of species contributions revealed intriguing patterns within and between the studied groups. *Emiliania huxleyi* emerged as a dominant contributor to the internal similarity (intra-group similarity) for the first three groups. However, the species driving the second-highest contribution differed: *Chaetoceros socialis* in Group 1, and *Hillea fusiformis* in Groups 2 and 3. This highlights a shared presence of *Emiliania huxleyi*, but a variation in the species most responsible for group-specific similarity. Group 2 and 3 displayed further differentiation with additional contributors like *Nitzschia tenuirostris*, *Amphidinium* sp., *Calciosolenia brasiliensis* (Group 2) and *Nitzschia tenuirostris*, *Leptocylindrus mediterraneus*, *Bacteriastrum delicatulum* (Group 3). In contrast, Group 6 showed a distinct pattern with *Chaetoceros socialis* and *Skeletonema costatum* as the primary contributors to its internal similarity. Species of *Chaetoceros socialis*, *Skeletonema*
costatum, Heterocapsa sp. and Chaetoceros decipiens played a notable role in the discrimination of groups.

Spring revealed two distinct phytoplankton assemblages based on the Bray-Curtis Similarity measure (Figure 9a). Group 1, dominated by Emiliania huxleyi, primarily occupied deep offshore waters beyond the continental shelf. Group 2, dominated by Proboscia alata forma gracillima,
thrive in coastal and shelf areas, even extending offshore near the Göksu River discharge zone (Figure 9b & 9c). These two groups were separated in the MDS ordination (Figure 9b). Within each group, specific species contributed most to their overall similarity. In Group 1, *Heterocapsa* sp. played this role alongside *Emiliania huxleyi*. Additionally, *Pseudo-nitzschia delicatissima, Proboscia alata forma gracillima*, and *Hillea fusiformis* contributed significantly. Group 2, on the other hand, relied on *Pseudo-nitzschia delicatissima* alongside its dominant species. Other contributors included *Chaetoceros rostratus*. Species like *Chaetoceros rostratus, Chaetoceros curvisetus, Dactyliosolen fragilissimus, Pseudo-nitzschia delicatissima*, emerged as crucial indicators differentiating the two groups. Their contrasting presence or abundance likely reflects distinct environmental conditions in offshore versus coastal and shelf regions.

In summer, the surface phytoplankton communities differed across the study area, dividing into three distinct groups based on the Bray-Curtis Similarity measure (Figure 10). The largest group (Group 1) covered the western and eastern coastal shelf waters. A smaller group (Group 3) occupied the eastern offshore region. Notably, the smallest group (Group 2) solely included the shallowest eastern station.

![Figure 10](image1)

**Figure 10** (A) Dendrogram showing classification based on Bay-Curtis Similarity measure for surface samples, (B) Two-dimensional non-metric MDS ordination of all stations, (C) Phytoplankton patches, June-2018 Survey.

This separation likely resulted from a delay in sampling ETS1 due to a cruise interruption. The distinct flora at ETS1 is likely due to rapid changes in the shallow coastal environment, potentially influenced by nearby Lamas Creek (Figure 10c). MDS ordination diagrams confirmed the separation between all three groups (Figure 10b). Key species contributing to the similarity within each group were identified. For Group 1, *Leptocylindrus danicus* and *Rhizosolenia styliformis* were most dominant, while Group 2 was characterized by dominance of *Emiliania huxleyi* followed by *Pseudo-nitzschia delicatissima*. Both groups shared some similar contributors like *Hillea fusiformis*. 
Discussion

Consistent with the eastern Mediterranean, the Cilician Basin is known for its oligotrophic nature due to limited surface layer nutrients, particularly phosphorus (Azov, 1991; Krom et al., 1991). Riverine inputs from Göksu and Lamas rivers significantly influence seasonal variations in salinity, density, and nutrient concentrations (winter/spring highs, summer/fall lows). This highlights the interplay between regional oceanographic features (Asia Minor Current) and local freshwater inputs in shaping surface water properties. Nutrient limitation is crucial for phytoplankton growth, and the Redfield ratio (N/P/Si, 16:1:16) serves as a reference point (Harris, 1988). Deviation from this ratio can limit primary productivity. The observed high summer N/P ratio suggests potential for either increased biological uptake of phosphorus or atmospheric inputs of nitrogen, warranting further investigation (similar to Krom et al., 2010).

The study revealed distinct seasonal patterns in phytoplankton abundance and composition. Overall, phytoplankton abundance peaked in summer, likely driven by the influx of nutrient-rich freshwater from the Göksu and Lamas rivers, corroborating previous observations (Spatharis et al., 2007). Diatoms dominated throughout the year, particularly in shallow areas (consistent with Eker and Kıdeyş, 2000). Spring exhibited the highest diversity, potentially due to increased freshwater inputs and nutrients, as suggested by Vadrucci et al. (2008). Consistent with the notion that a high Dia/Dino index reflects diatom dominance (Wasmund et al., 2017), the Dia/Dino index indicated diatom prevalence except for fall, where dinoflagellates co-dominated. Notably, the study observed an upward trend in the frequency of HAB species from fall to summer, with dinoflagellates being the primary concern also mentioned by Vila and Maso, 2015. Spatial patterns in phytoplankton assemblages also varied seasonally. Fall and winter displayed patchiness, while spring and summer exhibited a clearer separation between coastal/offshore and east/west subpopulations. Consistent with observations in other coastal regions enriched by terrestrial sources (Cloern, 1996), the Göksu River exerted a strong influence, particularly during winter when increased flow expanded the freshwater zone, shaping phytoplankton distribution around its mouth and Taşucu Bay.

Declarations

The data collected and used for this study was obtained from the project titled “Impact Assessment of Hydroelectric Power Plants (HEPP) to Marine Ecosystems”, funded by TUBITAK (116Y125).

References


POSTER

PRESENTATIONS
Microplastic Contamination in Black Tea

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Abstract

Tea (Camellia sinensis (L.) O. Kuntze) is a significant plant belonging to the Theaceae family, with its homeland recognized as China. This plant grows as an evergreen tree or shrub. Tea, one of the most preferred beverages worldwide, is produced by various processing methods applied to leaves harvested from different varieties. The tea plant is a fundamental resource for the global tea industry. However, studies indicate a risk of microplastic contamination in this industry. Microplastics are typically tiny plastic particles, often smaller than 5 millimeters, formed from the breakdown of plastic materials. The degradation of plastic materials commonly used in agricultural practices can lead to microplastic contamination in soil and plants. Additionally, plastic packaging and equipment are frequently utilized in the processing of black tea in factories. These packaging materials and equipment may lead to the contamination of tea leaves with microplastics upon contact. Furthermore, tea bags or filters used during the brewing process may also contain microplastics. There is also a risk of microplastic contamination during the brewing process in consumers’ homes. This compilation aims to investigate the potential sources and effects of microplastic contamination in black tea production. Understanding microplastic contamination in this industry is a crucial step for developing and implementing solutions.

Keywords: Food security, microplastic pollution, tea, Rize.
Release of Sturgeon into the Wild: Ecological Context and Strategies

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Abstract

The release of farm-raised sturgeon, into their natural habitats is a critical conservation strategy aimed at reversing the decline of this species. This approach is essential for the restoration of ecosystems and the survival of sturgeon, which has faced significant population decreases due to anthropogenic pressures. This study highlights the importance of meticulously planning and executing release programs and the need to align these efforts with the ecological and biological requirements of species and their habitats. Key aspects of successful release strategies include understanding the ecological context, ensuring the compatibility of farm-raised fish with wild populations, and identifying targeted areas for release that maximize survival and integration chances. It also involves evaluating potential risks associated with reintroduction, such as disease transmission and genetic dilution, and implementing measures to mitigate these risks. Stakeholder engagement and community participation are highlighted as vital components of the release process, ensuring that conservation efforts are supported and sustained by those directly impacted. Regulatory compliance is also crucial to ensure that reintroduction programs meet legal and environmental standards. Further discussion covers the implementation and monitoring of release programs, stressing the importance of adaptive management to respond to challenges and changing conditions effectively. Success criteria and evaluation methods are proposed to assess the impact of release programs on sturgeon populations and ecosystem health. In summary, the text provides a comprehensive guide to the planning, implementation, and monitoring of sturgeon release programs, offering practical insights for conservationists and stakeholders involved in the restoration of this iconic species and their ecosystems.

Keywords: Sturgeon, conservation and restoration, release into the wild, ecological context.
Construction and Application of the First Concrete Artificial Reefs (ARs) Around the Sinop Peninsula in the Black Sea, Türkiye*

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Abstract

In this study, the construction and features of concrete artificial reefs (ARs) with the aim of strengthening adaptation to climate change and promoting small-scale fishing, supporting biodiversity and establishing marine protected areas (MPAs in the Sinop peninsula are described. Material and form of ARs: the ARs materials should be feature to avoid pollution and bioaccumulation of contaminants in the environment and in the aquatic organisms. The choice of the ARs material should also consider the resistance to the chemical and physical forces in constant action in the marine waters, the time-life, and the suitability for colonization by benthic communities. The "Reef Application Project Disposition" developed by the General Directorate of Fisheries and Aquaculture states that if the ARs are to be placed on the seabed in free fall form, the ARs used must have at least C25 specification. In this study, the cube-shaped concrete blocks (ARs with a volume of 1m³, consisting of reinforced concrete beams of 20x20 cm in size, were constructed. The ARs consist of three irons measuring 12m in length, 12mm in diameter, and weighing 10,656 kg each, as well as one iron measuring 12m in length, 10mm in diameter, and weighing 7,404 kg (12m/kg). The total weight of the irons used in a AR is 39,372 kg. The mix for the concrete (C blocks used is prepared with C35 specification. A total of 40 concrete ARs with these characteristics built and to be used in the MS-MPAs project (Strengthening the Climate Change Adaptation through the Mapping of Seagrass Meadows for Marine Protection Areas in the Black Sea ARs activities. *This study is co-financed by Republic of Türkiye and EU with the scope of the Climate Change Adaptation Grant Program (CCAGP - IPA II (MS-MPAs – Project No: TR2017 ESOP MI A3 04/CCAGP /041.

Keywords: Climate change, ARs, MPAs, seagrasses, Black Sea
Observations on the Distribution of 2 Invasive Species in Samsun Province in the Central Black Sea

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Abstract

In this study, observations on 2 invasive plant species detected in Samsun province located in the Black Sea region of northern Turkey are presented. One of these plants is Polygonum thunbergii Siebold & Zucc. species in Polygonaceae family and the other is Acalypha australis L. species in Euphorbiaceae family. Samsun province was found as a new distribution area according to the existing distribution information of both species in Turkey.

Polygonum thunbergii Siebold & Zucc. was previously known from the coastal sea of East Black Sea region. 4 years ago, it was observed by us in the sandy meadows and field edges of the river banks along the Terme stream in the Salıpazarı district. It was observed that it tends to expand the area where it settles. Although it is not a threat for now, it should be monitored carefully.

Acalypha australis L. was recorded from Trabzon province as a new genus for Turkey about 15 years ago. 3 years ago, a few individuals were observed in a private property in Salıpazarı district. However, since then the number of individuals has reached several thousand individuals. Despite our research on how the plant got here, we could not find anything. In the current situation, the 2nd area of this species was observed in the Black Sea region as an example of its discontinuous distribution in Turkey.

According to these findings, as a result of climate change, the coastal part of the warm and humid Black Sea region provides a suitable environment for many invasive species. In this study, the findings of 2 invasive species observed for the first time in Samsun province are given. It is very important to monitor new species without allowing them to threaten the existing biodiversity and prevent them from causing habitat and species losses.

Keywords: Invasive species, Polygonum thunbergii, Acalypha australis
Eco-Efficient Extraction Methods for Bioactive Compounds from Medicinal Plants

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Abstract

The extraction of bioactive compounds from medicinal plants is a pivotal aspect of both pharmacology and alternative medicine. This exploration consolidates recent advancements in this field, with a specific focus on supercritical fluid extraction (SFE), ultrasound-assisted extraction (UAE), and traditional solvent techniques. SFE, utilizing supercritical CO2, is particularly noteworthy for its environmental benefits and ability to produce high-purity extracts, despite its higher costs. This has led to its increasing popularity in green chemistry applications. In contrast, the UAE offers speed and cost-efficiency, albeit with a potential compromise on extract purity. A thorough analysis suggests that the choice of extraction method should be tailored to the specific bioactive profile of plant materials and the intended application of extracts, in order to strike a balance between efficiency, sustainability, and economic viability. The integration of green chemistry principles into these processes not only enhances the yield and quality of bioactive compounds but also plays a crucial role in promoting sustainable practices that are vital to the pharmaceutical and nutraceutical industries. This underscores the need for future research to focus on eco-friendly techniques that effectively balance cost, efficiency, and environmental impact.

Keywords: Bioactive compounds, green chemistry, supercritical fluid extraction, ultrasound-assisted extraction.
Effective Waste Management Practices in Botanical Gardens

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Abstract

In contemporary society, environmental awareness and sustainability imperatives are increasingly recognized as pivotal to the quality of life and the legacy left for future generations. This study underscores the significance of sustainable management practices within urban green spaces, which are crucial for the conservation and judicious utilization of environmental resources. It specifically examines a series of waste recycling workshops conducted at the Nature-Based Solutions School in Sezai Karakoç Literature Park under the auspices of Gaziantep Metropolitan Municipality. These workshops encompass a variety of processes, including greywater recycling, composting, conversion of waste oils into candles, and the fabrication of seed bombs from recycled paper. The selection of recycling materials is strategically aimed at minimizing environmental footprints and enhancing the sustainable use of natural resources. The end products of these workshops have been applied in a designated pilot area within the Botanical Garden. Notably, applying compost techniques has facilitated the effective utilization of organic waste, thereby meeting the garden’s demand for natural fertilizers. Additionally, the production and use of candles derived from waste oils and seed bombs crafted from waste paper have proven effective in valorizing environmental resources and promoting the principles of waste reuse. This investigation contributes to the foundational efforts in embedding sustainability practices within botanical gardens and elevating ecological consciousness. In conclusion, this study provides compelling evidence that targeted and well-executed sustainability initiatives in botanical gardens can lead to significant environmental improvements and catalyze wider ecological consciousness and action.

Keywords: Botanical Garden, Sustainability, Urban Green Spaces, Waste Management.
Exploring Variability in Morphological and Biochemical Characteristics of Betula pendula Pollen

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Abstract

Air pollutants, including nitrogen dioxide, ozone, and particulate matter, interact with pollen grains, inducing changes in their morphology and biochemistry. Elevated levels of air pollutants have been shown to alter pollen size, surface characteristics, and allergenic protein content, potentially increasing the allergenicity of pollen and exacerbating allergic reactions in susceptible individuals, thus prolonging the pollen season. In this study, we investigated the pollen size and chemical characteristics of Betula pendula pollen grains collected from different trees. Eight trees (P1-P8) were selected near main roads, potentially influenced by traffic pollution. Permanent pollen preparations were made following the Wodehouse method for each locality, and microphotographs of pollen were captured. At least 30 measurements were conducted for each sample, determining both polar and equatorial axes. Analysis of variance (ANOVA) test was applied for statistical evaluation. Fourier Transform-Infrared (FT-IR) spectra were recorded using a Bruker FT-IR Spectrometer (4000–400 cm⁻¹), with KBr disks prepared to analyze functional groups in all pollen samples. Pollen collected from trees along Atatürk Boulevard in Kızılay (P3) exhibited a significantly smaller pollen size compared to the other samples in terms of morphological characteristics, while pollen collected from Emek Park (P6) showed a different structural profile compared to the others as a result of FTIR analysis. Notably, the broad signals at 1629 cm⁻¹ in sample P6 corresponded to β-sheet vibrations indicative of secondary structural changes in proteins. Conversely, the medium peak between 1548-1557 cm⁻¹ observed in all samples except P6 was attributed to N-H bending and C-H stretching vibrations in proteins (Amide II vibration). These findings suggest that alterations in the secondary structure of proteins in the P6 sample could impact its function, with implications for biological processes such as cellular signaling, enzymatic activity, and structural stability. Variations in sun exposure, pollen collection date, and genetic structure of selected trees may have contributed to differences in pollen size and chemical structure. These findings suggest disparities in the allergenic potential of Betula pendula pollen in the air. Future studies aim to explore total protein content and allergen levels further.

Keywords: Betula, pollen, allergy, air pollution, secondary structure of protein
Integrated Water Resources Management

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Abstract

This review analyzes the concept of Integrated Water Resources Management (IWRM) and discusses the prospects for water resources management. Our rivers and groundwater are the lifeblood of the planet. There is a growing belief that we need to manage our most vital natural resource, water, in an integrated way, or more precisely through Integrated Water Resources Management, to ensure sustainable development. As water is fundamental to many aspects of life and the surrounding natural environment, there is a need not only to review its recent status and development, but also to identify future challenges to implementing integrated water management at the same time. In 2002, at the Johannesburg World Summit on Sustainable Development (WSSD), the Technical Advisory Committee of the Global Water Partnership defined Integrated Water Resources Management (IWRM) as "a process that promotes the coordinated development and management of water, land and related resources in order to maximize economic and social well-being in an equitable manner without threatening the sustainability of vital ecosystems" and emphasized that water should be managed basin-wide, in accordance with the principles of good governance and public participation. In recent years, the management of water resources has become increasingly complex. At the heart of this phenomenon are the problems faced in terms of scope and size. If the scope of management is taken into account, the answer to the question of where and how much water is available, nowadays the quantity of water and the quality of water are taken into consideration, and all the factors that make up these two factors need to be evaluated together. In other words, water resources are broadly referred to as "environment". It is included in the phenomenon of environment. Environment is also a natural whole such as water, air, soil, etc. Therefore, since intervention in one of these phenomena affects the others, water should be considered as resource management within the environment as a whole. In this context, in terms of water resource management, today's emerging approach is to ensure that resource management is basin-based and "integrated" with other natural resources. The basic principles of integrated basin management are that the goal is to improve and develop all aspects of the basin, not just water quantity. Improving and developing water resources is the creation of more coherent management policies.

Keywords: Integrated basin management, environment, planning, water resources
Comparison of M1 Tooth Morphologies of Microtus anatolicus and Microtus irani (Mammalia: Rodentia Specieses Distributed in Anatolia)

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Abstract

The systematics of Microtus in Anatolia has been subjected of many taxonomic research; it is one of the mammal groups that taxonomists are interested in because of its large number of species. As therefore, it has been the subject of numerous investigations utilizing both traditional morphological and molecular methodologies. According to the most recent mtDNA studies on the issue, Microtus anatolicus is found in a narrow area in the south of the Anatolian basin and occasionally hybridizes with Microtus irani. Although molecular technologies provide high resolution in detecting phylogenetic relationships between taxa, morphological investigations remain taxonomically important. One of the long-standing approaches for comparing taxa is the use of tooth morphology. Studies in the literature have revealed that measurements obtained on the mandible's M1 teeth can distinguish distinct species. The purpose of this study is to determine whether the Microtus anatolicus and M. irani lineages, two closely related evolutionary groups, differ morphologically. For the upper M1, 31 M. irani and 11 M. anatolicus samples were compared, while 38 and 11 samples were used for the lower M1 respectively. While 10 of the 19 lower M1 measurements had statistically significant difference, four of the 14 upper M1 characters have statistically significant difference. This study is essential because it calls attention to the fact that dental features can be used to discriminate between the Microtus irani and M. anatolicus clades. Although there are fewer samples for M. anatolicus, the data is suggestive since it highlights the morphological differences between the two lineages. A larger sample will more clearly demonstrate whether there is a morphological distinction between the two lineages. This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK) under the Grant Number 113R029.

Keywords: Teeth morphology, Microtus anatolicus, Microtus irani.
Removal of a Toxic Dye with a Low-Cost Adsorbent to Prevent Water Pollution: Equilibrium and Kinetic Study

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Abstract

Methylene Blue (MB) is a dye widely used by the textile, paper, rubber, plastic, leather, cosmetics, pharmaceutical and food industries. Wastewater from industries that use paint contains paint residues. These dyes, which are highly visible and toxic even at low concentrations, must be removed from wastewater before discharge into water bodies. Among the purification techniques recommended for this purpose, the adsorption method is a simple, economical, and proven method. The economy of adsorption systems is closely related to the adsorbent used. For this reason, the search for cost-effective adsorption materials continues.

In this study, the usability of the *Typha latifolia* plant, which is abundant in natural or artificial wetlands and emerges as a waste product during harvest periods, as an adsorbent in the treatment of dyed wastewater, was investigated. Within the scope of this study, adsorption experiments were carried out to remove methylene blue dye (MB) from aqueous solutions by modifying biomass with potassium hydroxide (KOH). In adsorption studies, the effects of initial dye concentration, pH, adsorbent amount and contact time on dye removal were evaluated. Experimental data were evaluated using isotherm and kinetic modelling. Isotherm data were explained by Langmuir and Freundlich isotherm equations. Kinetic data were analyzed using pseudo first-order and pseudo-second-order adsorption kinetic models. Both data sets were analyzed with nonlinear equations.

The results proved that basic operating parameters such as pH, contact time, adsorbent dosage and pollutant concentration are effective in MB adsorption with the prepared biomass. The optimum removal amount was achieved at pH 7, adsorbent dosage of 0.4 g/L and contact time of 120 minutes. The adsorption process followed well pseudo-second-order kinetics. The data of the equilibrium studies were quite compatible with the adsorption data of the Freundlich model. The results indicated that KOH-modified biomass (*Typha latifolia*), as an environmentally friendly adsorbent, could be used as an efficient adsorbent in the removal of dyes in aqueous media.

Keywords: Adsorption, *Typha latifolia*, KOH modification, methylene blue.
Detection of The Benthic Fauna of Eğirdir Lake Fishing Ground

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Abstract

Productivity in ecosystems depends on physical, chemical and other ecological factors, as well as being related to biocenosis. The place of benthic fauna in the biocenosis is important as it forms a link of the food chain. For this reason, benthic organisms are one of the living groups used as criteria in determining lakes in terms of productivity.

In this project study, it was aimed to detect the organisms found in the benthic fauna of Lake Eğirdir fishing ground, to determine the species and to compare them with the data obtained from previous studies and their changes over time. The sample material was obtained by the stone and sandy mud frame method in the littoral zone, the sand-mud in the sublittoral zone, and the silt-mud in the profundal zone by the Ekman bucket.

In this study, were included oligochaets, Hirudinae, Isopods, Amphipods, Turbellaria, Dipterans, Ephemeroptera, Pelecypods, Gastropods. At fishing ground on an average 2452 benthic individuals were found per square meter. Fishing ground of Eğirdir Lake benthic fauna showed oligotrophic character according to its qualitative and quantitative characteristics. Benthic fauna varied seasonally according to sampling areas and regions.

Keywords: Benthic, aquatic invertebrate, benthic invertebrates, Eğirdir Lake.
Effects of Microplastic Pollution on a *Neurergus strauchii* Population from Adıyaman Province

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**Abstract**

Microplastics are a type of environmental pollutant that can infiltrate habitats, limit the growth and development of organisms, increase mortality, disrupt endocrine metabolism, and even change gene expression. Research in this field is important, as pollution levels in the habitats where living things reside directly affect their quality of life. This study investigates the effect of microplastic pollution on a population of *Neurergus strauchii*, an aquatic salamander species, in Adıyaman province, Türkiye. Six individuals were sampled and brought to the laboratory for morphological measurements. The digestive system was extracted using a stainless steel dissection kit. Samples from the digestive system were placed in conical flasks and treated with 150 mL of 30% hydrogen peroxide. The samples were then incubated at 65°C for three days. After complete dissolution, the microplastic (MP) particles were filtered through a Whatman GF/C filter using a vacuum pump. The composition of the remaining MP particles on the filter was analyzed using FT-IR spectroscopy. After calculating the average quantity of MP per individual, it was found that a total of six MP particles were identified among six individuals, resulting in an average of one particle per individual. The chemical components of these polymers were EVA (83%) and PET (17%). The shapes of the MP particles were also examined, revealing that 83% were fibers and 17% were fragments. The dimensions of the MP particles were calculated, revealing a size range of 17 µm for the smallest particle and 389 µm (average = 240) for the longest particle. The research results indicate that microplastic pollution in aquatic environments may pose a potential risk to the animals that inhabit them.

**Keywords:** amphibians, aquatic, environmental pollution, FT-IR, polymer
Distribution of Geophytes on the Islands in Tuz Lake and the Factors Affecting this Distribution

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Abstract

This study was carried out within the scope of the project titled "Investigation of the Plant Diversity Patterns of the Islands in Tuz Lake and the Reasons for this Pattern" which is being carried out around Tuz Lake.

The geophytes of the selected 56 islands within the scope of the project were determined during the vegetation period of 2023 and 2024 the size and elevation of the islands determine the zonation pattern of the islands. Most of the islands show this zonation pattern but in some of them due to the small changes in elevation and also the smaller size whole island is covered with salt marsh. The soil salinities of both steppe and salt marsh vegetations were determined and the sampling depend on the area of the island.

As a result of the study, a total of 16 geophyte taxa belonging to 12 different genera from 7 different families were identified. The species identified on the islands were compared with the mainland regions of the study area and it was determined that there was a significant difference in terms of the number of species represented. There are only 6 geophyte taxa on the mainland, all of which are common with geophytes found on the islands.

As a result of the soil salinity measurements, it was determined that the salinity values of the steppe zones on the islands varied between 85.9-363.6 μS/cm, and the coastal-mash zones varied between 450.6-6705.7 μS/cm. On the islands covered with saline marshes where there is no zonation, salinity values vary between 484.0-1979.0 μS/cm. Both soil salinity and herbivory were evaluated to explain the distribution pattern of geophytes on the studied islands.

Keywords: Geophytes, Tuz Lake, islands, salinity, distribution
Deep Ecology in the Context of Environmental Ethics

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Abstract

Ecology is a concept that deals with human relationships with the natural environment, in which humans exist and are a part of. Despite the extensive scope of ecology, its crisis has not been resolved solely through efforts to conserve natural resources and technical measures.

Today, it is not possible to present a single ideology of the ecological movement that is universally accepted. However, examining different perspectives on solving environmental problems and adopting a holistic and unifying ideology could effectively address the issues facing our planet.

Biocentric ethics emerged as a response to anthropocentric approaches. According to this view, humans cannot claim superiority over other living beings. Other living beings also possess inherent value due to their existence, and all living beings have moral standing by virtue of being alive.

Environmental ethics goes a step further than biocentric ethics by also considering inanimate entities as subjects of ethics. According to the environmental approach, every entity in the universe (including plants, animals, and other ecosystem members) is a component of the life cycle. Each entity has different functions and equal rights. According to this perspective, humans are not masters of nature but merely a part of the ecosystem.

Deep ecology, while rooted in biocentric or ecocentric approaches, focuses on nature instead of humans, advocating for an approach that grants rights to the entirety of nature, including entities beyond humans. In this context, the philosophy of deep ecology emphasizes the integrity of nature and the value of all life forms from an environmental ethical perspective. It encourages humans to view nature not only as a resource but also as a part of life, serving as an important source of inspiration for the preservation of the natural environment. This perspective is presented to us as an approach that could provide fundamental solutions to ecological problems.

Keywords: Deep ecology, ethics, environmental ethics
Relationship between Meteorological Parameters and Airborne Pollen Spectrum in Erfelek (Sinop) 2022-2023

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Abstract

This study was conducted for determining the plant taxa of the pollen grains in the atmosphere of the Erfelek district and investigating the effects of meteorological factors on pollen concentration, by analyzing daily, weekly, and monthly changes in the atmosphere. The types and amounts of pollen grains in the atmosphere were determined using the Burkard trap. The trap was placed in a building approximately 5 m above the ground near Erfelek. The data of the research was recorded between 01 May 2022 and 31 May 2023. Pollen counts were expressed as the number of pollen grains in the air/m³. On the basis of the average of one year (2022-2023, the dominant arboreal taxa in the atmosphere were Acer sp. (2.66%), Carpinus sp. (19.05%), Cestanea sp. (1.37%), Corylus sp. (3.12%), Cupressaceae/Taxaceae (2.88%), Fagus sp. (2.65%), Juglans sp. (3.65%), Pinaceae (56.32%), Quercus sp. (3.12%), and Grass (Poaceae (15.19%), whereas the dominant non-arboreal taxa were Asteraceae (10.34%), Apiaceae (2.74%), Chenopodium sp. (2.99%) and Plantago sp. (9.72%). Meteorological parameters such as temperature, relative humidity, wind speed and precipitation greatly affected atmospheric pollen concentration during the sampling period. The pollen concentrations were positively correlated with increasing temperature and wind speed and negatively correlated with rainfall and relative humidity.

Keywords: Airborne pollen, volumetric analysis, Erfelek (Sinop, meteorological parameters
Fostering Ecosystem Awareness: Pedagogical Approaches to Teaching Ecology in Botanical Gardens

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Abstract

Botanical gardens are vital interdisciplinary hubs, uniquely situated at the intersection of botany, ecology, and pedagogy. These institutions are essential in advancing public comprehension of ecological processes and conservation challenges. This review examines how botanical gardens worldwide are addressing these challenges through innovative educational strategies, drawing upon a comprehensive analysis of ecological pedagogy. This study is a broad spectrum of pedagogical methodologies implemented across various botanical gardens, drawing upon quantitative data such as visitor learning outcome surveys and qualitative feedback from educational program participants. Moreover, the analysis highlights cutting-edge practices that enhance ecological literacy, including immersive digital reality environments and interactive exhibits, which have shown a statistically significant improvement in ecological awareness among participants, as demonstrated by pre- and post-visit assessments. The strategic use of botanical gardens as platforms for enhancing global biodiversity awareness is explored. However, extends to how these gardens influence sustainable behaviors among visitors, supported by recent studies indicating a noticeable shift towards sustainable practices among regular attendees. Botanical gardens are pivotal in filling ecological literacy gaps through well-structured educational programs that are both scientifically grounded and experientially rich. These programs, exemplified by specific case studies and supported by empirical data, affirm the role of botanical gardens in leading ecological education and sustainability initiatives. As a result, botanical garden training increases ecological awareness, and it is crucial in fostering environmental stewardship and shaping the ecological consciousness of future generations.

Keywords: Biodiversity, conservation, ecology, education, botanical gardens.
Effects of Hydrological Connectivity on Aquatic Organisms: Preliminary Observations from Konya Closed Basin

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Abstract

Growing demand for freshwater is a major concern for freshwater biomes. Anthropogenic stressors such as agriculture, pollution, water abstraction coupled with droughts associated with climate change pose major threats to aquatic organisms. The ability to avoid these factors is severely hampered by the alteration of hydrological pathways. The The Konya Closed Basin in Central Anatolia is a basin where all these negative factors interact.

Although the Konya Closed Basin is the fourth largest basin in Turkey in terms of surface area, the contribution of the basin to Turkey’s surface water potential in terms of surface water flows has been decreasing over the years and was determined to be 1.3% in 2020. Historical processes and environmental changes in the basin have allowed the basin to develop its own unique flora and fauna. A significant majority of the elements contributing to biodiversity are endemic species and these are both vulnerable and highly restricted by these factors.

We are currently running a TÜBİTAK project to determine how these changing, or already changed, hydrological connections will affect aquatic populations. In this project, surface flows, water pollution will be determined and their effects on fish, trichoptera and diatoms will be assessed. We will then apply climate change scenarios to forecast the future of the basin and possible threats and provide guidance on how to prevent undesirable consequences.

Main objective of this study is to present the ongoing TÜBİTAK project, and threats identified in the basin in terms of hydrological connectivity. This study was supported by Scientific and Research Council of Turkey (TÜBİTAK under the Grant Number 123Y021. The authors thank to TÜBİTAK for their supports.

Keywords: Pollution, climate change, sustainability, aquatic flora and fauna
The presence of *Lycopus exaltatus* L. in the Marmara Region, Türkiye

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**Abstract**

*Lycopus exaltatus* L. is widely distributed in the moist riparian areas of Europe and Asia. According to the Flora of Turkey, it is included in the natural distribution areal of Turkey, so it is given as a probable species. However, it was not known from Turkey until today. However, it was collected in Bingöl province in 2022 and its presence in Turkey was confirmed.

In this study, observations of *Lycopus exaltatus* L. in the Marmara region are presented. In the Marmara region, it was observed at a point in the Ormanlı village of Çatalca district of Istanbul province. Here *Lycopus europeaus* L. was also found together in the same habitat. The habitat of the species here is moist grassland and flooded forest edge around the river. In addition, this species was also identified 2 points in Kocaeli province. Again, were also observed Ulubat Lake in Bursa. And, Celepköy village in Çatalca, İstanbul. When all these data are brought together, the presence of *Lycopus exaltatus* in 5 different localities in the Marmara region has been confirmed. Thus, its presence in the east and west of Turkey is confirmed. In this case, it would not be wrong to say that the distribution area of the species can cover the whole country. We can say that it can be observed from different regions with further research. Thus, with the new observations, the distribution information of Lycopus species has been expanded with new distribution information and its chorology in Turkey has been revealed. Habitus and habitat photographs of the species are given. A distribution map has also been prepared according to the available distribution information.

**Keywords:** *Lycopus exaltatus* L., new localities, new observations
**Introduction**

Türkiye is a country rich in plant biodiversity (Davis 1965-1985; Anonymous, 2005). About 34% of the existing species are endemic (Ekim et al. 2000; Güner et al. 2000). Currently, many new taxa are added to the flora of Türkiye every year (Davis et al. 1988; Güner et al. 2012). Thus, this richness is increasing day by day. However, the number of species about which there is not enough information is also quite high (Ekim et al. 2000).

The Lamiaceae family is one of the largest families of flowering plants with approximately 268 genera, 8,133 species and 9,888 taxa (Mill, 1982; WFO, 2024). In our country, the Lamiaceae family has 787 taxa (608 species, 179 subspecies and varieties) belonging to 48 genera with the latest publications (Behçet and Cengiz 2023). There are about 15 species belonging to the genus Lycopus in the world and most of them are located in Europe, Asia and N. America (Behçet and Cengiz 2023). In the 7th volume of the Flora of Türkiye, while the distribution information of the species *Lycopus europaeus* L. is available, morphological differences are given about the species *L. exaltatus* in the description, but no information about its distribution is given (Mill, 1982). Later, in the study titled List of Plants of Türkiye by Dirmenci (Dirmenci 2012), this situation has been discussed. According to Henderson (1962), *L. exaltatus* is distributed from Germany, Austria, Hungary and Italy in Eastern Europe to the Himalayan region of India and Siberia via Russia and Türkiye. However, its presence in Türkiye was recently confirmed by Behçet and Cengiz (2023) who collected specimens from Bingöl for the first time. In this study, we provided information about the status of *L. exaltatus* in the Marmara region as a new distribution area.

**Materials and Methods**

This research is an investigation based on field observation. Individuals observed in the field were collected and dried as herbarium material. Herbarium samples are kept in Duzce University DUOF herbarium. Photographs of the plants were taken (Figure 1,2) and a distribution map was prepared in the Google Earth program (Figure 3).

**Results**

In this study, *L. exaltatus* was collected and/or observed at different times and places by the observers mentioned in the article. When the observed localities are taken together, it is understood that this species is widely distributed in the Marmara region. Flora Orientalis already states that its distribution in this region is probable.

**Species:**

*Lycopus exaltatus* L.f., Suppl. Pl. 87 (1781).

Homotypic Synonyms

• *Lycopus europaeus* var. *exaltatus* (L.f.) Lej., Rev. Fl. Spa: 7 (1825).

Heterotypic Synonyms

• *Lycopus exaltatus* var. *ovatus* Benth., A.P.De Candolle, Prodr. 12: 180 (1848).
• *Lycopus italicus* L. ex B.D.Jacks., Index Linn. Herb.: 100 (1912), nom. inval.
• *Lycopus pinnatifidus* Pall., Reise Russ. Reich. 3: 655 (1776), nom. nud.

**Inflorescence:** Jun-July, **Fruit:** July-August

**Habitat:** Wetland soils, in and near helophyte communities around standing waters and marsh.
Distibution:

İstanbul, Çatalca, Ormanlı village, marshy meadows, 0-10 m.
Observer: Bilal ŞAHİN; İstanbul, Çatalca, Celepköy village, near Durusu Lake, 0-10 m.
Observer: Hasan YAŞAYACAK; (DUOF 10995, DUOF 10996) Kocaeli, Kandıra, along the coastline around Lake Arıklar, 100 m.
Observer: Hüseyin DOĞAN Kocaeli, İzmit, İzmit Gulf, Kumla stream buy, 0-10 m.
Observer: Hüseyin DOĞAN Bursa, between Bursa-Uluabat lake, near Uluabat lake, 0-10 m.
Observer: Bülent BIÇİCİ

Figure 1. Habitat and general view of *L. exaltatus*
Figure 2. *L. exaltatus* and *L. europaeus* species that share the same habitat and live side by side

Türkiye Distribution:
Marmara Region (in this study), Eastern Anatolia Region (Behçet and Cengiz 2023), probably Black Sea Region, Southeastern Anatolia Region, Central Anatolia Region

World Distribution:
Albania, Altay, Austria, Belarus, Bulgaria, Buryatiya, Central European Rus, Czechoslovakia, East European Russia, Germany, Greece, Hungary, Irkutsk, Italy, Kazakhstan, Kirgizstan, Krym, North Caucasus, Northwest European R, Poland, Romania, South European Russi, Transcaucasus, Ukraine, West Himalaya, West Siberia, Xinjiang, Yugoslavia

Discussion
*L. exaltatus* is widely distributed in wetlands in Europe and Asia. According to Flora orientalis (Boissier, 1879), its distribution in Türkiye is as follows: “in paludosis Thraciae (Friv.) (Thrace); Bithynie (Sibth., Boiss.) (Bursa); Paphlagoniae (Wied) (Kastamonu); Tauriae et regionis Caucasicae (M.B.Rehm).” However, according to Flora of Türkiye (1982), these records were not used and not included in the flora since no collected specimens were seen. In
2012 (Dirmenci); according to the list of plants of Türkiye Flora Orientalis and some personal observations; Marmara, Black Sea and Eastern Anatolia Regions were given as a possible distribution area. Previously; a specimen collected by Serdar Aslan in Siirt province could not be identified due to insufficient material, but it was stated that it could be *L. exalatus*. It was reported that the presence of this species in Türkiye needed confirmation (Dirmenci 2012). However, Behçet and Cengiz (2023) wrote an article confirming the presence of the species in Türkiye with a specimen collected from Bingöl province. Thus, while the existence of this species has not been confirmed until today, as of 2023, it was collected from the eastern Anatolia region and recorded as a species present in the flora of Türkiye. In this study, we have presented the species *L. exaltatus* by combining observations made at many points in the Marmara region. According to this study, it has been confirmed by observations that the species has a wide distribution in Turkey.

*L. exaltatus* is an aquatic plant living in Asia and Europe (including Türkiye) in moist wetlands, lakes and rivers, in hydrophytic and mesophytic habitats, especially in association with helophyte plant communities. With this habitat preference, the plant prefers the same areas as *L. eurpaeus*. In fact, in the population in Ormanlı village, the two species were observed together in the same habitat, even side by side (Figure 2). This species is not mentioned in the Wetland Plants of Türkiye published by Seçmen and Leblebici (1997). However, it is possible that the two species are living together and may have been confused due to morphological variations. This is already mentioned in the notes of *L. europaeus* in Flora of Türkiye (Mill, 1982).

Thus, this study confirms the presence of *L. exaltatus* in Türkiye once again. Again, after the Eastern Anatolia region, it was detected in a few points in the Marmara region. Considering the distance between the two regions, we can say that all regions of Türkiye are included in the possible distribution area for *L. exaltatus* species in the future, and it is possible that records from a much wider region and area may emerge with further studies.

Figure 3. Distribution of *L. exaltatus* in the Marmara region (Coordinates 41°40' - 41°54' N; 27°40' - 32°40' E)
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