EVALUATION OF DÜZCE URBAN FORESTS IN THE CONTEXT OF ECOLOGICAL SAFETY AND TREE-FOREST HEALTH

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Abstract

The concept of "ecological safety" evaluates the level of ecological risk, the amount of destruction of the ecosystem and the extent of the danger that ecological systems are facing. It reflects the degree of integrity and health of the ecosystem, and can also provide a guarantee for the sustainability of an ecological-economic system. When ecological safety is considered in terms of people; It defines the ecosystem that does not threaten human life, health and wellbeing, and aims to prevent ecosystems from being damaged. In this study, Düzce Urban forest, which is one of the functional green infrastructure elements of Düzce city, was evaluated within the framework of ecological safety, forest and tree health.

Risk factors that reduce ecological safety in Düzce urban forest were determined within the scope of the study. Düzce urban forest which has ecological functions such as regulating city climate by controlling temperature, humidity and wind, providing noise control and improving air quality, protecting the plant and wildlife diversity, in recent years, it has been faced with the problems of vandalism, being a crime scene, environmental pollution, air-water-soil pollution, and the increase of invasive species. In Düzce, which is the 5th province with the highest air pollution rate in Europe, urban open and green spaces are scarce in quantity and in a fragmented structure. Therefore, urban forest and urban trees are very important to continue urban existence in a healthy way, both in terms of environmental health and human health. In line with the threats and problems identified within the scope of the study, the ecological safety of the urban forest and urban trees were evaluated and suggestions were made for the solution of the problems.

Keywords: *Ecological safety, forest health, urban forest, urban tree, Düzce*

1. INTRODUCTION

Ecological safety is a concept that aims at the healthy functioning of ecosystems, ecosystem services and ecological cycles (Pirages and DeGeest 2004; Çelik, 2017). In the face of the problems caused by the rapid and uncontrolled urbanization and the fact that a large part of the world's population lives in cities, environmental safety and ecological safety in cities are becoming increasingly important (Hodson and Marvin, 2009). The existence and functions of urban green spaces form the basis for the ecological safety of a city (Çelik, 2017). Urban forests, which have an important place in urban green space systems, have different benefits for urban people in many ways in terms of economic, ecological and social aspects (Yılmaz et al., 2006).

Urban forests provide positive contributions to the protection of the living environment and biological diversity for flora and fauna species (Ertem Mutlu 2016; İnanç, 2019). Urban trees and urban forests have an important position in order to reduce CO2 emissions and store carbon in urban centers. (Gezer and Gül, 2009; Girti et al., 2010). In addition, it provides many economic contributions to the city in terms of both livelihood and production areas. Urban forests have invaluable physical benefits such as reflection and glare reduction, flood prevention and erosion control, as well as climatic effects such as cooling, wind control, balancing the urban climate, temperature and humidity control, reducing air pollution for the city (Tyrvainen et al., 2005; Girti et al., 2010).

Urban forests are an important component of green infrastructure (Karaşah, 2020). Green infrastructure is an eco-sociological network in which natural, semi-natural and cultural areas are holistically planned and managed to provide ecosystem services and protect biodiversity in rural and urban landscapes (Benedict, 2000; Hepcan and Hepcan, 2018). In recent years, green infrastructure has become a strategic approach that can offer alternative solutions to ecological, social and environmental problems by being widely used in terms of sustainable land use in the world (Wilker et al., 2016; Demiroğlu et al., 2019).

Düzce urban forestc was chosen as the study area because it is an important part of the green belt surrounding the city of Düzce and it is one of the unique areas in the city with the status of active green space. According to the results of the "World Air Pollution Report-2021"; Düzce is in the 5th place in terms of the highest air pollution rate in Europe. Open and green areas in the city are few in number and in a fragmented structure. For this reason, urban forest and urban trees are very important in terms of both environmental and human health in order to maintain the existence of the city in a healthy and sustainable way. Having an important role in Düzce urban open and green space system, increasing the daily life quality of the people of the city, serving the concepts of ecological safety, ecosystem services and green infrastructure are the prominent features of the study area. However, the potential of Düzce urban forest cannot be utilized sufficiently, and it contains risks such as vandalism, noise, odor, fire, invasive species, environmental pollution, etc. Within the scope of the study, suggestions were presented for the solution of the problems identified after the observations and evaluations made in the area of Düzce urban forest.

2. MATERIALS AND METHODS

2.1. Materials

Within the scope of the study, Düzce urban forest located in the Western Black Sea region of Turkey was evaluated. Düzce urban forest was registered as an urban forest by the General Directorate of Forestry in 2011 and its size is 117,027 ha. Düzce city forest is 7 km away from the city center and is located next to the Düzce city center (Çinis, 2016) (Figure 1).



Fig. 1. Study area (Düzce urban forest)

Source: Google Earth, 2022

2.2. Methods

The method of the study was carried out in two stages. In the first stage, the concepts of green infrastructure, ecological safety, forest and tree health in the literature were discussed and Düzce Urban Forest was evaluated from the perspectives of landscape architecture and forest engineering disciplines within the framework of ecological security, forest and tree guard.

In the second stage, the data obtained from the field studies were evaluated. In the years of 2021 and 2022, in June and July, Düzce urban forest was visited and observations were made. Within the scope of the study, risk factors, threats and problems that reduce ecological security in Düzce urban forest were determined and suggestions were made for their solution.

3. RESULTS AND DISCUSSION

In this part of the study, the location of Düzce Urban Forest in the open and green space system of Düzce city, the characteristics of flora and fauna, the opportunities it offers, and the risk factors for ecological safety have been evaluated.

The Düzce urban forest, chosen as the study area, is located in the permanent housing area 8 km outside the city, as the new settlement area of the disaster victims after the great earthquake disaster in Düzce province in 1999. Düzce City Forest is located right next to it (Figure 2).



Fig. 2. Düzce urban forest and surrounding settlements

Urban forest is the first and only urban forest established within the borders of Düzce province in 2011 and its total size is 158 ha. According to the data of the Turkish Statistical Institute for 2021, the total population of Düzce is 400,976 and it serves the people of Düzce (TUİK, 2022).

Düzce urban forest was used as a recreation area for picnic and hiking activities for the people of Düzce in the first years when it was opened, and it was in high demand by the people of the city (Figure 3).



Fig. 3. Düzce urban forest and its usage by urban society

Before the Düzce urban forest was put into service to the public, afforestation was carried out with Pinus radiata, which is one of the fastest growing species but an exotic species, within the scope of industrial plantation. In addition to these unnatural species, Pinus sylvestris, Fagus orientalis, Quercus cerris,

Carpinus betulus and Abies nordmanniana trees naturally spread in the Düzce urban forest (Figure 4). It is possible to see boar, fox, rabbit and squirrel fauna species in Düzce urban forest and surrounding forest areas (GDF, 2009).



Fig. 4. Flora of Düzce urban forest

Land management problems in the urban forest caused the closure for use and its abandoned (Figure 5). Main problems are caused a big forest fire in the area that it is affected by climate change in the last years, air pollution and security concerns related to illegal usage of the area (Daşdemir et al., 2021).

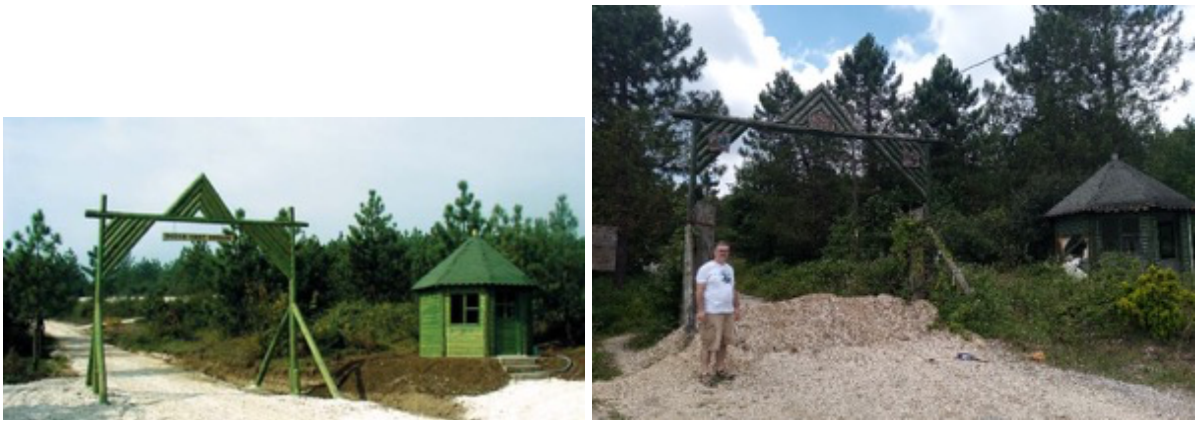

Fig. 5. The closed entrance of Düzce urban forest

In terms of infrastructure, it has been determined that Düzce urban forest has problems with access roads, toilets, playgrounds, picnic areas and the lack of regular renovation and repair works (Figure 6). It is stated that similar problems are seen in other urban forests established in Turkey. It can even be said that the term "Defined urban forest" is used for these areas due to insufficient infrastructure and applications (Köse, 2021).



Fig. 6. Infrastructure problems of Düzce urban forest

In the Düzce urban forest, first of all, *Pinus radiata* afforestation area should be given the status of "urban forest" with the thought that it can be the closest and most suitable urban forest to the city, creating an entrance gate by adding some landscaping elements to the existing forest area, which will enable the people of the city to benefit from the forest, necessary and sufficient in the area. It has been determined that putting it into use without taking precautions brings some ecological safety and tree health problems. Some of these can be listed as damaging the trees (vandalism) by humans, cutting the branches and trunks of pine trees unconsciously to be used in barbecue, not removing the dried, overturned and infested trees from the area (Poland et al., 2021).

Another problem detected in the Düzce urban forest is the outbreaks caused by the American white butterfly and Pine processionary beetle, which is one of the risks brought by invasive species, *Pinus radiata* species (Figure 8).



Fig. 7. Ecological safety and tree health problems of Düzce urban forest



Fig. 8. Invasive species (American white butterfly and Pine processionary beetle) problems of Düzce urban forest

One of the biggest disaster risks in Düzce urban forest is the risk of forest fire due to its proximity to the city and the high flammability of resinous species such as Pinus radiata. The most obvious example of

this is the burning of a forest area of 4 hectares as a result of the Düzce urban forest fire in 2020. The cause of the fire has not been determined (Figure 9).



Fig. 9. Forest fire in Düzce urban forest in 2020

4. CONCLUSIONS

In this study, Düzce urban forest was evaluated within the scope of ecological safety and urban tree health. It has been determined that the urban forest, which is an important part of the urban green infrastructure, providing recreational opportunities to the people of Düzce, providing economic and social benefits to the city, unfortunately cannot adequately evaluate the potential it contains.

Due to the existence of land management problems in the urban forest, it has been closed for use and abandoned. In the first years when the city forest was opened for use, it was an area preferred by the people of the city for picnic area, children's playground, parking lot, walking tracks, infrastructure and superstructure elements and recreational activities. However, it has recently turned into an area where urban crimes can be committed and threatens the safety of the people of the city, as the land has not been adequately protected, cannot be operated and managed in a sustainable way, and abandoned. The establishment of a large number of urban forests in a short time without considering the planning and management principles of urban forests in Turkey and without taking into account the objectives of urban forestry brings many problems and causes many of them to be closed. The main starting point of these problems is to give urban forest status by placing landscape reinforcement elements of the forest areas closest to the city without making a sustainable urban forest management plan, without asking the opinions of the relevant stakeholders and without their support. Due to similar reasons, Düzce urban forest is just one of the urban forests that were closed without being managed in a sustainable way.

Fire, flood and wind, bark beetle epidemic, American white butterfly epidemic, pine processionary beetle epidemic, herbivore damage to tree trunks and bark peeling, etc. in the Düzce urban forest, there are risks in the context of ecological safety and urban tree guard concepts. Human interventions, environmental pollution and vandalism are other factors that threaten the study area.

The exacerbation of forest fires, floods and wind erosion due to global climate change, the invasiveness of harmful species, and the inability to provide the desired benefit to the people of the city may cause devastating environmental, social and economic losses. In the forest fire that broke out in the Düzce city forest in 2020, the burning of approximately 4 ha area caused both ecological safety and economic losses. New tools and better integration of different knowledge repositories are urgently needed to support better ecological safety in urban environments. To ensure urban forest health, conservation plans should be put in place to reduce human destruction, including conservation targets and target species. Species found in urban forests and the resilience and fragility characteristics of urban trees should be determined and their defense properties against pests should be increased.

An exotic species, *Pinus radiata*, was brought by industrial afforestation in the Düzce urban forest, and a wrong species was selected for the study area. The use of exotic species accelerates the entry of different herbaceous and woody pests into the area. It creates risks for the natural species present in the

area and causes unforeseen negativities that initiate extinction steps. The natural structure has not been preserved in accordance with the understanding of urban forestry in Düzce urban forest. For this reason, it is necessary to re-establish the natural species of the area identified during the field studies, to remove the broken, insect-damaged and dry *Pinus radiata* species from the area and to carry out the studies in accordance with the principles of sustainable forest management.

Social awareness should be created about the concepts of ecosystem services, green infrastructure, ecological security and tree health provided by urban forests, and multidimensional participation platforms should be created for the solution of bio-security problems. Large-scale management of urban green infrastructure approach should be adopted together with city managers and planners for the determination, monitoring, maintenance and management of the current status of urban forests and urban trees.

Studies should be carried out to monitor the health of urban forests and urban trees by using innovative methods. Artificial intelligence, remote sensing, GIS and drone use can be used for Düzce urban forest and urban open and green areas with similar risks. It is emphasized in many studies in the literature that urban trees and urban forests provide ecological, social and economic benefits in ecosystem services and urban open and green space systems. Considered from the context of tree and forest health, it has a high priority as the most important environmental factors affecting the daily life of the society as mentioned in the COST Action "Urban Tree Guard - Safeguarding European urban trees and forests through improved biosecurity (UB3Guard) CA20132".

ACKNOWLEDGMENTS

This study is supported by the COST Action "Urban Tree Guard - Safeguarding European urban trees and forests through improved biosecurity (UB3Guard) CA20132".

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