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THE CHANGE IN THE DISTRIBUTION AREA OF ABIES CILICICA SUBSP. CILICICA IN THE LAST 20 YEARS DUE TO CLIMATE CHANGE (CASE STUDY: ADANA REGIONAL DIRECTORATE OF FORESTRY, TURKEY)

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Summary

Climate change, the effect of which has been increasing since the end of the nineteenth century and its effects have reached very dangerous dimensions, also creates a great danger for forest ecosystems. Due to the Mediterranean Basin in which Turkey is located, it is among the countries that can be significantly affected by climate change in terms of both its geographical structure and ecology. A. c. subsp. *cilicica*, one of the Mediterranean fir taxa, is an important species that continues its distribution on the Taurus Mountains in the south of Turkey. Due to its distribution area and ecological demands, it is a very sensitive species against climate change. In this study, it is aimed to examine the changes in the distribution areas of the A. c. subsp. cilicica species within the boundaries of Adana Regional Directorate of Forestry, which are among the areas most affected by climate change. As a result of the study, it was determined that the average temperature in the study area increased by 1.14°C between 2000-2020 within the scope of Adana Regional Directorate of Forestry, while the distribution area of *A. c.* subsp. *cilicica* species narrowed to 16 609 ha. Between 2000 and 2020, a decrease of 32.2% was observed in pure stands and a decrease of 22.2% in mixed stands.

Introduction

One of the biggest concerns in ecological science today is the impact of climate change on ecosystems. This is a huge challenge for foresters and ecologists. These difficulties arise from our insufficient understanding of biological processes. As a result of this situation, while some species are expected to change their geographical distribution or adapt to new conditions, some species with limited habitats are also expected to become extinct (Hughes, 2000; McLachlan et al., 2005; Parmesan, 2006; Root and Schneider, 2006). ; Schivo et al., 2019). It is known that climate plays a decisive role in the large-scale

distribution of these species (Guisan and Thuiller, 2005). It is also one of the most important factors affecting the growth and reproduction of organisms (Lawler et al., 2009).

To reduce the impacts of climate change on ecosystems, the conservation of biodiversity is a key goal that requires both the quantification of biodiversity and the monitoring of its losses (Balmford, 1996). For this reason, supporting conservation and development activities for species that may be affected by climate change has become even more important in recent years. The gradual decrease in the distribution of the *A*. *c*. subsp. *cilicica* species, which is the subject of the study, in Turkey has made this species an "endangered species" (IUCN, 2021). In the reports of the General Directorate of Meteorology (MGM), Adana is among the provinces that will be most affected by climate change (URL-1). The aim of the study is to examine the period of 2000-2020 in order to observe the distribution of the endangered *A*. *c*. subsp. *cilicica* species within the scope of Adana Regional Directorate of Forestry.

Material and Method

Abies cilicica subsp. In order to determine the distribution of cilicica species, stand type maps for the years 2000 and 2020 were obtained from the planning unit of the General Directorate of Forestry (OGM). With the help of the ArcGIS package program, the areas where the species spread were determined in the plans. Climate data for the region is provided by the World Bank Group - Climate change information portal (URL-2). Google EarthPro version package program was used to display and evaluate the regional directorate and the areas it spreads. Adana Regional Directorate of Forestry, which is the subject of the study, was chosen as the study area because it is the most widespread area of the species (Figure 1).



Figure 1. Representation of Adana Regional Directorate of Forestry on the physical map of Turkey

Results

By examining the 2000 and 2020 management plans of *A*. *c*. subsp. *cilicica* species, pure and mixed stands were determined. The distribution areas of the species are shown in figure 2.



Figure 2. *Abies cilicica* subsp. *cilicica* Distribution areas of cilicica in 2000 (left), 2020 (right)

According to the climate data of the studied area; While the average temperature level in Adana was 15.55 °C in 2000, this value increased to 16.69 °C in 2020 and the temperature increased by 1.14 °C (Figure 3). Increasing temperature levels with climate change limited the distribution areas of *A. c.* subsp. *cilicica* species and its distribution was 49 098.5 ha mixed, 17 677.7 ha pure, a total of 66 776.2 ha in 2000, 38 188.3 ha mixed, 11 978.9 ha in 2020. pure area decreased to 50 167.2 ha in total. The decrease in the distribution area of the species was determined as 10 910.2 ha in pure stands and 5 698.8 ha in mixed stands. Between 2000 and 2020, a decrease of 32.2% was observed in pure stands and a decrease of 22.2% in mixed stands. It is noteworthy that pure stands of the species are more affected than mixed stands.



Figure 3. Adana province temperature data between 1901-2020. **Conclusion**

Climate change can slowly but permanently and dangerously alter ecosystems. Although precise estimates cannot be made about the extent and consequences of the changes that will occur, it is clear that ecosystems will be severely affected by this change. The shrinkage of the *Abies cilicica* species used in the study in the 20-year period is 16 600 hectares. The distribution areas of the

species that cannot adapt quickly to climate change are shrinking. It is seen that the distribution of the species in Adana Regional Directorate of Forestry decreases significantly in the southern parts and it carries its distribution in the natural distribution area from the east to the north. These results necessitate the development of species-specific strategies as soon as possible, especially in regions where the risk of adverse effects against climate change is high. It requires the implementation of silvicultural measures against climate change with greater care in the operation of forests.

It would not be correct to attribute damage to a species in ecosystems only to climate change. The increase in temperature and decrease in precipitation and the change in precipitation regime enable insects and pests that cannot spread in the region to find the opportunity to spread in the area (Shaver et al., 2000; Logan et al., 2003; Björkman et al., 2011). Species whose distribution areas are narrowed also have to struggle with biotic factors and their extinction may be at risk. The distribution of the Abies cilicica subsp. cilicica species, which is the subject of the study; fires, uncontrolled operation of forests, temperature increases due to climate change, many abiotic and insect damage, and many biotic factors such as harmful micro-organisms. The fight against these biotic and abiotic factors is of great importance. South of Turkey; The protection of this species, which serves as a filling tree in the fog belt ecosystem, is of great importance for the Mediterranean region. Necessary precautions should be taken and the extent to which the existence of the species will change with the projections for the coming years should be determined. Again, the potential distribution areas of the species should be determined and measures should be taken against necessary situations, and even planting it in suitable areas for its distribution is necessary for the continuation of the species in the forest ecology of Turkey.

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