

Poplar plantations in Turkey: an overlooked habitat for orchids

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Abstract: Turkey's orchid flora is one of the richest in the Mediterranean region, but is also under threat from intensification of agriculture, land-use change, habitat loss, overgrazing and salep harvesting (tuber collection). With this study, we would like to draw attention to the importance of economic poplar plantations as orchid habitats. In six of the eight plantations surveyed in five provinces of Turkey, altogether 12 orchid species (*Anacamptis elegans*, *A. fragrans*, *A. pyramidalis*, *Cephalanthera longifolia*, *C. damasonium*, *Epipactis helleborine*, *E. persica*, *Himantoglossum jankae*, *Ophrys apifera*, *O. oestriifera*, *Ophrys* sp., *Serapias feldwegiana*) were found. In the plantations with an average area of only 0.27 ± 0.21 hectares, the presence of 0–5 orchid species was recorded (mean \pm SD = 1.88 ± 1.80). The density of orchid populations varied from 0 to 355.6 specimens per hectare. Both tuberous and rhizomatous orchids were encountered in the studied plantations, but the former ones were dominant: 8 species (67%) and 232 specimens (94%) of the studied orchids were tuberous. The average trunk diameter in poplar plantations harboring orchids ranged from 16.7 to 21.8 cm. In the surveyed plantations, there were no traces of tuber harvesting or overgrazing, which may contribute to their suitability as habitat for orchids. Considering the recent extent of poplar plantations and their expected further increase in Turkey, studying their role in orchid conservation seems important and timely.

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Introduction

Turkey has one of the richest floras among the countries of the Mediterranean region. Due to its geographic location and varied climatological, geo-

logical and geomorphological conditions, about one third of the approximately 9,000 species of vascular plants found in the country are endemic (ÇOLAK 2001). Unfortunately, this important biodiversity hotspot on a global scale is now in crisis (ŞEKERCIOĞLU et al. 2011), mainly due to dramatic changes in natural habitats caused by human activities. Agricultural intensification has resulted in a significant reduction in the extent of natural habitats in Turkey. For example, total forest cover had declined by 44% by the end of the 20th century (MAYER and AKSOY 1986).

Turkey is probably the richest in orchid floras in the Mediterranean region. The species richness of orchids is well documented by KIRCA et al. (2020), who discusses 191 orchid taxa (species and subspecies), including 39 Turkish endemics (20.4%). The most important threats to orchids in Turkey are agricultural intensification, overgrazing, tuber (salep) collection, habitat loss and rapid urbanization (KASPAREK and GRIMM 1999, SEZİK 2002a, 2002b; KIRCA et al. 2020). Although the country's forest cover increased by 5.9% between 1973 and 2009 (GROSS 2012), this is mainly due to the establishment of conifer monocultures. Due to the increase in intensive farming, the total grassland area and the Mediterranean shrubland, which is home to a highly diverse biodiversity, have decreased drastically in recent decades in the country (CAMCI ÇETİN et al. 2007).

With the degradation and fragmentation of natural habitats worldwide, small patches of semi-natural habitats have become more valuable as refugia for native wildlife (SAUNDERS et al. 1991). Anthropogenic habitats now occupy a significant proportion of the Earth's surface, and their extent is increasing rapidly (ELLIS 2019). Recently, it has become increasingly evident that anthropogenic habitats such as abandoned mines and industrial sites (GREENWOOD and GEMMELL 1978, BARINA 2000, 2001; ESFELD et al. 2008, SHEFFERSON et al. 2008, LUNDHOLM and RICHARDSON 2010), urban environment (KANTSA et al. 2013, LISZTES-SZABÓ 2013, SONKOLY 2014, REWICZ et al. 2017) and roadside verges (FEKETE et al. 2017, 2019, 2020) could be colonized by European and Mediterranean orchids. Cemeteries may also play a significant role in the conservation of orchids in Turkey (LÖKI et al. 2015, 2019a, b; MOLNÁR et al. 2017a, b). Another type of anthropogenic habitats, poplar plantations harbor at least 31 orchid species in 15 European countries (WERNER 1982, ADAMOWSKI and CONTI 1991, MOLNÁR et al. 1998, 2000; ADAMOWSKI 2006, CSIKY 2006, JAKUBSKA et al. 2006, TÓTH 2009, ARCHAUX et al. 2010, VOIGT and SOMAY 2013, CSÁBI et al. 2015, TULLUS et al. 2015, ARADI et al. 2017, ILLYÉS et al. 2017, LUKÁCS et al. 2017, SÜVEGES et al. 2019, 2020; MOLNÁR et al. 2022).

The aim of this paper is to investigate whether industrial poplar plantations are a suitable habitat for orchids in Turkey.

Materials and methods

We studied eight randomly selected economic plantations of *Populus × canadensis* in five Turkish provinces in June 2014 (Table 1, Fig. 1). The geocoordinates and the elevation of the visited plantations were determined using a Garmin eTrex Legend handheld GPS device and recorded in WGS84 format. We aimed to quantify age and tree density of the poplar plantations. As an estimate for tree age, we recorded the trunk diameter of ten poplar trees in five plantations at a height of 130 cm above ground by using a standardized measuring tape. The distance from the nearest neighbor was also determined for ten tree individuals. The area of each plantation was measured using Google Earth Pro software. All orchid taxa and the number of generative individuals were counted in the whole area of each visited plantation. Species were identified based on KÜHN et al. (2019) and DELFORGE (2006). Authors of plant names are listed in Table 2. During fieldwork, particular attention was devoted to searching tracks of salep collection activity.

Table 1. Location, area and trunk characteristics of poplar plantations studied.

1. táblázat. A vizsgált nyárfaültetvények elhelyezkedése, területe és törzsjellemzői. (1) Település (tartomány); (2) Lelőhely; (3) Tszf. magasság; (4) Terület; (5) Törzsméret átlag ± szórás (cm); (6) Törzstávolság átlag ± szórás (m); (7) nincs adat.

ID	Settlement (Province) (1)	Location (2)	Altitude a.s.l. (3)	Area (4)	Trunk diameter at breast height Mean±SD (cm) (5)	Distance to nearest trunk Mean±SD (m) (6)
1	Güleç (Tunceli)	39.11637°N 39.62231°E	531 m	0.13 ha	no data (7)	no data (7)
2	Kuzalan (Samsun)	41.06667°N 35.98157°E	307m	0.18 ha	21.5 ± 3.7	3.2 ± 0.8
3	Kuzalan (Samsun)	41.06635°N 35.98108°E	618 m	0.71 ha	21.3 ± 2.8	2.8 ± 0.4
4	Taşmanlı (Sinop)	41.90456°N 35.04779°E	46 m	0.16 ha	21.8 ± 6.0	3.2 ± 0.9
5	Demirciler (Bolu)	40.70732°N 31.67928°E	761 m	0.27 ha	16.7 ± 2.9	3.2 ± 0.7
6	Hüsamettindere (Bolu)	40.39653°N 31.12635°E	1090 m	0.19 ha	22.5 ± 5.3	3.8 ± 0.3
7	Memeceler (Bolu)	40.37810°N 30.66119°E	554 m	0.53 ha	no data (7)	no data (7)
8	Yeniköy (Sakarya)	40.39562°N 30.58363°E	494 m	0.29 ha	no data (7)	no data (7)

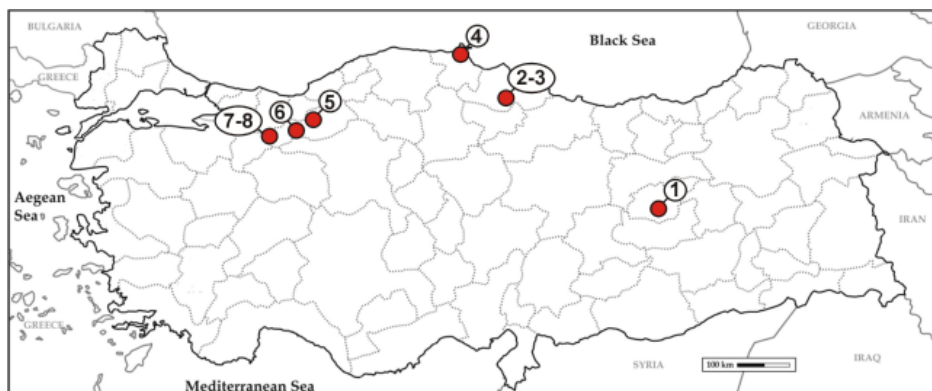


Fig. 1. Location of the surveyed poplar plantations in Turkey. For location data see Table 1.

1. ábra. A vizsgált nyárfa ültetvények elhelyezkedése Törökországban. A lelőhelyek adatait az 1. táblázat tartalmazza.

Table 2. Orchids of poplar plantations studied in Turkey. Abbreviated growth habit: T = tuberous, R = rhizomatous species.

2. táblázat. A vizsgált törökországi nyárültetvények orchideái. A növekedési típusok rövidítése: T = gumós, R = rizómás. (1) Település (Tartomány); (2) Orchideafajok (példányok száma) [Növekedési típus]; (3) Orchidea-sűrűség (példány/ha); (4) felszántva.

Settlement (Province) (1)	Orchid species (number of individuals) [Growth habit] (2)	Orchid density (specimens/hectare) (3)
1 Güleç (Tunceli)	<i>Epipactis persica</i> (Soó) Nannf. (4) [R], <i>Cephalanthera longifolia</i> (L.) Fritsch (1) [R]	38.5
2 Kuzalan (Samsun)	<i>Himantoglossum jankae</i> Somlyay, Kreutz et Óvári (2) [T]	11.1
3 Kuzalan (Samsun)	<i>Anacamptis pyramidalis</i> (L.) Rich. (120) [T], <i>Serapias feldwegiana</i> H. Baumann et Künkele (2) [T]	171.8
4 Taşmanlı (Sinop)	<i>Anacamptis pyramidalis</i> (5) [T], <i>Anacamptis fragrans</i> (Pollini) Bateman et al. (1) [T], <i>Serapias feldwegiana</i> (3) [T], <i>Ophrys oestriifera</i> M. Bieb. (3) [T], <i>Ophrys</i> sp. (7) [T]	118.8
5 Demirciler (Bolu)	<i>Ophrys apifera</i> Huds. (1) [T], <i>Anacamptis elegans</i> A. Molnár et Lovas-Kiss (30) [T], <i>Anacamptis pyramidalis</i> (58) [T], <i>Epipactis helleborine</i> (L.) Crantz (7) [R]	355.6
6 Hüsametindere (Bolu)	<i>Cephalanthera damasonium</i> (Mill.) Druce (3) [R]	15.8
7 Memeceler (Bolu)	– (ploughed) (4)	0
8 Yeniköy (Sakarya)	– (ploughed) (4)	0

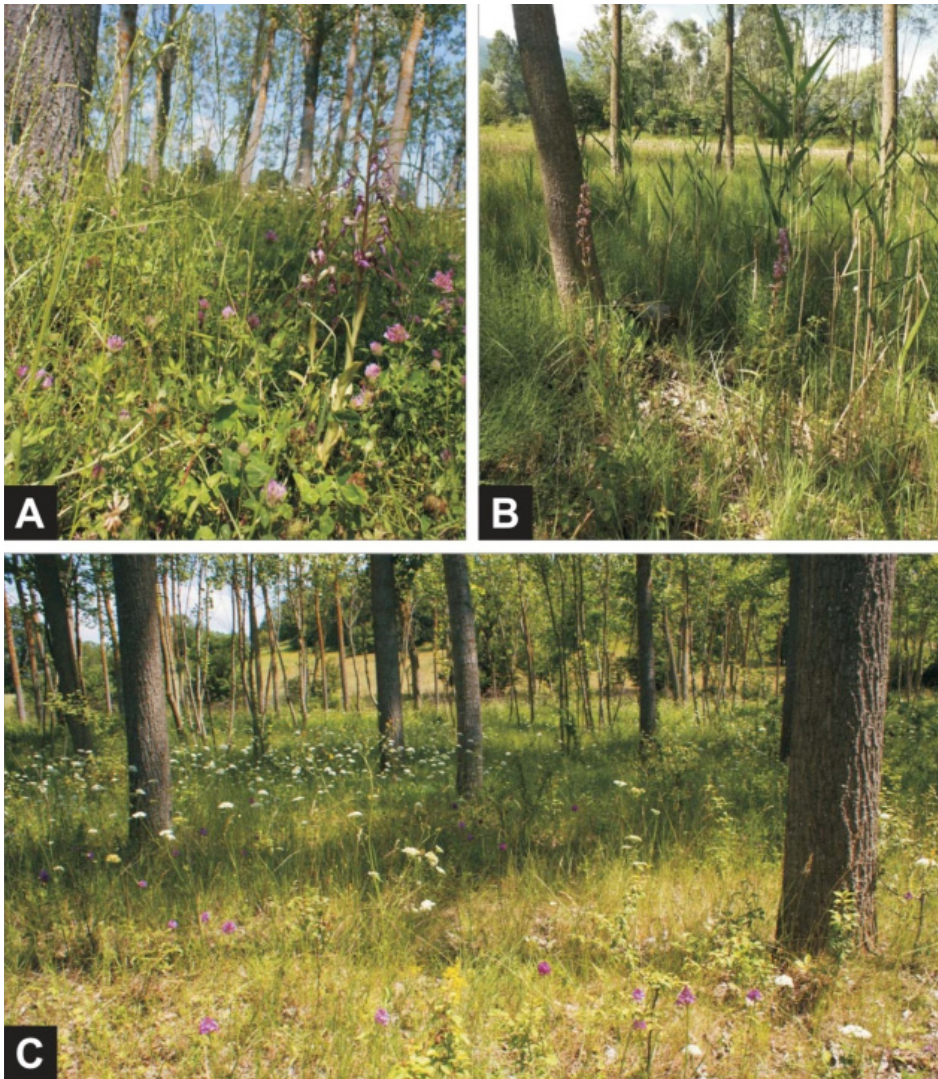


Fig. 2. Orchids occurring in poplar plantations in Turkey. A – *Himantoglossum jankae* (Kuzalan, Samsun); B – *Anacamptis elegans*, *A. pyramidalis*, *Epipactis helleborine*, *Ophrys apifera* (Demirciler, Bolu); C – *Anacamptis pyramidalis*, *Serapias feldwegiana* (Kuzalan, Samsun). Photo by A. Molnár V. (A and C) and T. Nagy (B).

2. ábra. Orchideák előfordulása törökországi nyárfäültetvényekben. A – *Himantoglossum jankae* (Kuzalan, Samsun); B – *Anacamptis elegans*, *A. pyramidalis*, *Epipactis helleborine*, *Ophrys apifera* (Demirciler, Bolu); C – *Anacamptis pyramidalis*, *Serapias feldwegiana* (Kuzalan, Samsun). Molnár V. A. (A és C) és Nagy T. (B) felvételei.

Results

Orchids were found in six of the eight plantations surveyed (75%), with a total of 12 orchid species and more than 240 generative specimens (Table 2, Fig. 2). (We were unable to identify fruiting specimens of one early flowering *Ophrys* species in the lack of flowers bearing key specific characteristics.) Two of the eight plantations were recently ploughed, where no orchid specimens were found. The most widespread and abundant species was *Anacamptis pyramidalis*, which was found in three plantations. *Serapias feldwegiana* was encountered in two plantations, while both species were observed in one plantation. Although occurrences of eight tuberous orchid species were documented in four plantations, no evidence of tuber collection for salep was detected.

In the plantations with an average area of only 0.27 ± 0.21 hectares, the presence of 0–5 orchid species was recorded (mean \pm SD = 1.88 ± 1.80). The density of orchid populations varied from 0 to 355.6 specimens per hectare (Table 2). The average trunk diameter in poplar plantations harboring orchids ranged from 16.7 to 21.8 cm, and the average distance between the neighboring trunks ranged from 2.8 to 3.8 m (cf. Tables 1 and 2).

According to growth habit, both tuberous and rhizomatous orchids were found in the studied plantations, but the former ones were dominant: 8 species (67%) and 232 specimens (94%) of the studied orchids were tuberous (Table 2).

Discussion

Based on our study, industrial poplar plantations in Turkey represent valuable habitats for terrestrial orchids. Although the orchid flora of Turkey is well known and recently intensively studied (KREUTZ 1998, KREUTZ and ÇOLAK 2009, KIRCA et al. 2020), to our knowledge, hitherto no orchids have been documented in Turkish poplar plantations. This may be an important finding from a conservational point of view for the three following reasons:

1) Plantations of *Populus × canadensis* (= *×euramericana*) and *P. deltoides* are widely cultivated in Turkey. The total area of Turkish poplar plantations in 1993 was estimated 160,000 hectares (ENGİNDENİZ 2003) and annual poplar wood production is about 4 million m³ (TUNÇTANER and ÖZEL 2008). Current Turkish wood production does not meet the national demand for wood-products and therefore it seems necessary to increase the area of tree plantations (SEMERCİ et al. 2020).

2) Tuber collection for culinary purposes (salep and ice cream) is considered as a key threat to Turkish orchids (SEZİK 2002a, 2002b, 2006, KASPAREK and GRIMM 1999). Fortunately, in the studied plantations we did not detect any tuber

collecting activity, which may suggest that plantations may be at least partially exempt from tuber harvest.

3) Overgrazing is a major general conservation problem globally (CALLAWAY et al. 2000, HOMEWOOD and RODGERS 1987, PAPANASTASIS et al. 2002, MOLNÁR et al. 2017c) and especially in Turkey (OZTAS et al. 2003, ŞEKERCIOĞLU et al. 2011). Based on our experience, poplar plantations are largely free from grazing, and this may play a role in the establishment and survival of orchids.

According to MOLNÁR et al. (2022), it is poorly understood how certain characteristics of poplar plantations influence presence and abundance of orchids such as area and age of the plantations. Based on our study, the area of poplar plantations hosting orchids was 0.27 ± 0.21 hectares (mean \pm SD), suggesting that very small plantations may be suitable for orchid establishment.

The productivity of poplars and profitability of plantations strongly depends on fertility treatments (GHEZEHEI et al. 2021), as well as rotation period (SCHIBERNA et al. 2021). These factors are also likely to be related to the suitability of the plantations for orchids, but this needs further research. From a conservation point of view, increasing the rotation age, low-intensity cultivation, and minimizing ploughing and usage of herbicides in the plantations is highly favorable.

Our preliminary results suggest that poplar plantations in Turkey may provide suitable habitat islands for certain orchid species – especially in landscapes under intensive agricultural cultivation. However, it is important to emphasize that cultivated plantations of poplars for timber production should not replace natural forests.

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Törökországi nyárfaultetvények: az orchideák figyelmen kívül hagyott élőhelye

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Összefoglalás: Törökország orchideafőrájára jellemző, hogy egyrészt az egyik leggazdagabb a Mediterrán térségben, másrészt a mezőgazdaság intenzívebbé válása, a tájhasználat megváltozása, az élőhelyek átalakulása, a túllegeltetés és a gumók kiásásával járó szálep-gyűjtés miatt rendkívül veszélyeztetett. Közleményünkben szeretnénk felhívni a figyelmet a gazdasági célú nyárfaultetvényekre mint orchidea-élőhelyekre. 5 tartomány 8 tanulmányozott ültetvénye közül 6-ban fordultak elő orchideák, összesen 7 nemzetség 12 fajtát (*Anacamptis elegans*, *A. fragrans*, *A. pyramidalis*, *Cephalanthera longifolia*, *C. damasonium*, *Epipactis helleborine*, *E. persica*, *Himantoglossum jankae*, *Ophrys apifera*, *O. oestrifera*, *Ophrys* sp., *Serapias feldwegiana*) találtunk meg. Az átlagosan mindössze $0,27 \pm 0,21$ hektár területű ültetvényekben 0–5 faj (átlag \pm szórás = $1,88 \pm 1,80$) jelenlétét regisztráltuk. Az orchideaállományok sűrűsége 0 és 355,6 példány/hektár között változott (átlag \pm szórás = $88,95 \pm 124,6$). Az ültetvényekben egyaránt előfordultak gumós és rizómás növekedési típusú orchideák, de többségben voltak az előbbieket: a megtalált orchideafajok közül 8 (67%), az egyedek közül 232 (94%) volt gumós. Az orchideás ültetvényekben az átlagos törzsátmérő 16,7 és

21,8 cm közötti volt. A tanulmányozott ültetvényekben nem tapasztaltuk orchideagumók gyűjtésének vagy túllegeltetésnek nyomait, ami hozzájárulhat ahhoz, hogy megfelelő élőhelyül szolgáljanak egyes orchideafajok számára. Figyelembe véve a nyárfaültetvények jelentős kiterjedését és területük várható további növekedését Törökországban, szerepüket az orchideák megőrzésében érdemesnek tűnik vizsgálni.

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