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Structure of a riparian forests in Western Greece

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Abstract

Purpose of this research was to study the structure of the riparian forests of Trichonida Lake in the Western Greece (a protected area of Natura 2000 network with Code GR2310009). The research recorded four different types of structure consisting of mixed stands of *Platanus orientalis and Salix alba* and pure stands of *Platanus orientalis* or *Salix alba*. The mixed stands of *Platanus orientalis-Salix alba* were at the stage of the medium to thick trunks. They were dominated by 80 % plane trees and belonged to habitat 92C0. In the mixed stands of *Salix alba-Platanus orientalis, Salix alba* (60 % of the trees) appeared on the upper and middle storey and was absent from the under storey, where only *Platanus orientalis* occurred. In this type of structure there were also a few stems of *Salix alba* and *Platanus orientalis* in the aging phase with DBH> 120 cm. *Platanus* dominated at the upper and middle storey and was absent from the understorey, which was dominated by *Salix*. Mixed willow-plane stands resulted from penetration of willows into original plane stands, which were at their eventual dominance due to the rapid growth of willows. These stands were classified as habitat 92A0. The pure stands of *Platanus* were stable, multi-storieyed and at the stage of medium-sized stems. The pure stands of *Salix alba* were very stable (slenderness index 39) two-storieyed stands (without understorey). *Platanus* was the pioneer tree species, while *Salix* colonized the old *Platanus* stands and participated in all tree storeys. The intense human presence in the area has had a negative impact on the structure and dynamic of the riparian forest, leading to the risk of possible change of habitat types. It is proposed to draw up immediately a management plan, which should set limitations of human pressures, rehabilitation, restoration and protection of the structure and habitats of the forest Trichonida's Lake with the appropriate silvicultural measures.

Key words: Lake Trichonida, plane forest, protected area, softwood riparian forest.

Introduction

According to Baker (2002) the term 'riparian areas' that describes areas adjacent to surface freshwater bodies, first appeared in the scientific literature in the early 1970's (Zaimes 2007). Since then, it has been officially accepted by the scientific community with hundreds of articles and dozens of books being published, related to riparian areas. Riparian forests act as ecological corridors with significant benefits for biodiversity (Sitzia et al. 2018). From ancient times they served as migration routes of flora and fauna contributing to the exchange of biogenetic material (Gerken 1988, Kuhn 1991). They are complex ecosystems affected by variable flood regimes, altitude climate changes and mountain influences. These factors put the plant community under a wide range of competitive pressures, resulting in a high level of biodiversity (Naiman et al. 1993, Tabacchi et al. 1998, Steiger et al. 2005). The great biodiversity of riparian forests relies on the functioning of riparian areas. Erosion, transport and deposition of materials, the uprooting of riparian vegetation from one area and its establishment in another during flooding are the basic functions of a river system (Mandžukovski et al. 2021).

Riparian forests are considered to be among the most dynamic ecosystems with a very high biodiversity (Efthimiou et al. 2016) They contain mainly hydrophilic plant species, resistant to mechanical pressure, since they have to deal with a soil full of water and strong river flows (Zogaris et al. 2007). According to Mandžukovski et al. (2021), the riparian forests are very rich and dynamic ecosystems. They are periodically flooded by surface or underground water for a time interval of a few days to a few weeks (Efthimiou 2000).

In a riparian ecosystem, water and vegetation are in constant and mutual interaction. The function of the flood contributes to the dynamics of riparian forests, the colonization of islets and banks, the reappearance of species in new locations or in areas that had been displaced by other species. Flooding often limits or displaces species that cannot withstand inundation. First, the willow colonizes the newly formed riparian soils and stabilizes them. In the second year poplar enters, and as the fastest growing species (Hohenberger 1989), surpasses the other trees and dominates the upper floor.

These ecosystems are characterized also by rich fauna and many different habitat types despite the fact of their occurrence mainly on sandy soils. The rich biological activity makes riparian forests very similar to rainforests (Efthimiou 2001).

Depending on their composition, structure, dynamics and ecological conditions, two large groups of riparian forest communities are distinguished: riparian forests growing in places with direct influence of water and hardwood forests with less, indirect influence of water (Efthimiou 2000, 2001).

Riparian forests are a key element of Europe’s natural heritage with high value due to their high biodiversity (Tsitsonis 2009). According to Cierjacks et al. (2010), these ecosystems play an important role in the storage of organic carbon. However, knowledge about the spatial patterns of organic matter distribution of riparian ecosystems is still insufficient.

Dafis (1993) characterized the riparian forests as ecosystems with great internal stability and balance as long as they remain unaffected by any human activity and intervention. But they are threatened with immediate collapse of destruction after all sorts of external disruptions. According to Efthimiou (2017), the lack of management of riparian forests led these ecosystems to their degradation, shrinkage and often their extinction. The intense grazing of the riparian forests as well as their intensive logging with the aim of converting these areas into monocultures, (mainly poplar), limited their surface to one third (1/3) during the 18th century (Dafis 1993). Therefore, there is an urgent need for their conservation. Unfortunately, the knowledge of most European countries about the importance of these forests is still insufficient. The natural riverside forests in Greece are found around the rivers Nestos, Spercheios, Pinios, Axios, Acheloos, Evinos and in the lakes Volvi, Doirani and Trichonida.

An ecologically important riparian forest of Western Greece is found around Lake Trichonida. The riparian forest receives very intense human activity but we have very little knowledge (almost non-existent research) about its structure. The originality of this research is that it is the first attempt to characterize the structure of the riparian forest in a lake in Western Greece which belongs to the European ecological network Natura 2000. According to Dister and Drescher (1987), Heller (1963, 1969), the knowledge of forest structure and dynamic is a necessary precondition of the forest's knowledge in general and of forestry capacity as well as decision making regarding their management in particular (Efthimiou 2012). According Chianucci et al. (2016) its effective management is hampered by the complexity of the interactions of mixed tree species and the influence of environmental factors on plant diversity.

A riparian forest is all the closer to nature when it is made up of a spatial mosaic of various types of structure, depending on the phase of development and consists of various overlapping floors with abundance of climbing species. The description of the remaining natural riparian forests in Europe combines the above characteristics (Knapp 1971, Carbiener 1974).

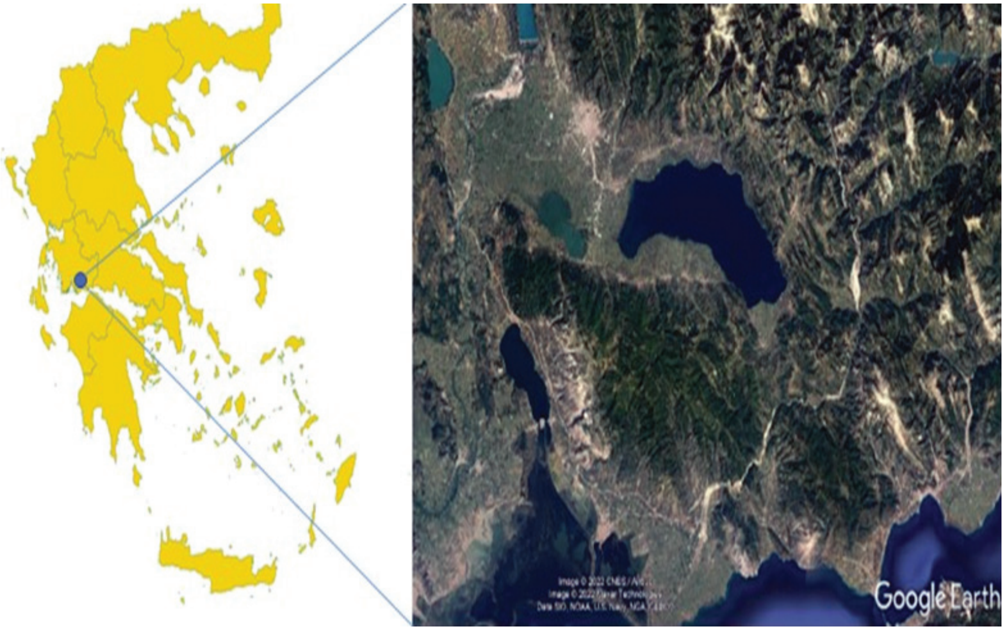
According to Assmann (1961), the slenderness index characterized the stability of stand. Low degrees of slenderness show constant conditions, while high degrees are characteristic for stands of non-constant structure (Röhle 1982). More specifically, when a tree has mechanical stability H:D > 100 it is characterized as very unstable, H:D = 80–100 unstable, H:D < 80 stable, H:D < 0.45 very stable (Apatsidis 2013).

The main objectives of this research were to answer the questions: a) what are the structures of softwood riparian forests found around Lake Trichonida? What are the biotic and abiotic factors that threatens them? Answering of these questions could help the close-to-nature management of these forests in the protected area.

Materials and Methods

Lake Trichonida (Fig. 1) is located in the southeastern part of the Prefecture of Aitoloakarnania between the coordinates 38°28' and 38°40' north latitude and 21°20' and 21°40' east longitude, in Western Greece. It is 20 km away from the city of Agrinio and is one of the most important lakes in Western Greece as it has great aesthetic, ecological and fishing value. It hosts a large number of rare and endangered plant and animal species. It has been included in the European Ecological Network 'NATURA 2000' with code GR2310009 (EEA 2021) as a Special Area of Conservation (SAC).

Lake Trichonida is the largest and deepest lake in Greece (Seguin et al. 2020). It is a warm monomictic lake of karstic origin with an area of 98 km^2, a maximum depth of 58 m and a water volume of about $2.8 \cdot 10^9$ m^3 (Doulka 2010). According to Zacharias et al. (2003) the hydrological basin of Lake Trichonida has an area of almost 400 km^2 and is characterized as lowlands to semi-mountainous. It is bounded north by the peaks of Mount Panetoliko (1924 m), southwest by Mount Arakinthos (<900 m) and east by Mount Harama (<700 m). According to recent studies by Kehayias and Doulka (2014), Lake Trichonida is classified as an oligotrophic lake with a trend of increasing eutrophication, i.e., there is a movement towards the prevalence of mesotrophic



a **b**

Fig. 1. The case study (a) (Papathanassiou 2016–2022) and Lake Trichonida (b) (Network of Cities with Lakes 2021).

conditions.

For the study of the structure of riparian vegetation around Lake Trichonida, a total of 5 representative sample plots consisting of *Platanus orientalis* L. and *Salix alba* L. were established. These two species are found in four different stand types (ST) differing in the composition of the dominant arboreal vegetation (Athanasiadis 1985, 1986; Efthimiou 2000).

On each sample plot, all trees with a diameter of 4 cm or above were measured as well as height measured with the help of Haga altitude.

Tree individuals were classified according to the IUFRO classification system (Dafis 1966, Dister and Drescher 1987, Smiris 1987, Efthimiou 2012, Efthimiou et al. 2015) according to their social status. Their social status is characterized by Classes of height in tree storeys (Upper storey: Middle storey, Under storey):

a) 100 Upper storey: individuals with a height greater than 2/3 of the upper height of the stand.

b) 200 Middle storey: stems whose height varies from 1/3–2/3 of the upper height.

c) 300 Under storey: stems less than 1/3 height of the upper height.

The structure data were processed statistically and the diagrams were drawn with the help of Excel. The parameters of descriptive statistics for diameter and height were calculated for each type of structure in total, by type and by storey. The total basal area per hectare ($m^2 \cdot ha^{-1}$) was also calculated in total and by species for each surface. The mechanical stability was calculated as (H:D) = total tree height divided by DBH both overall for each surface and by type and storey.

Results

The research revealed that the riparian forests consist of riparian tree species in pure or mixed stands. The vegetation recorded in each type of structure studied refers to the dominant vegetation. Finally, the understorey was dominated by the species *Nerium oleander* L., *Rubus* sp, *Vitex agnus-castus* L., *Agrostis vinealis* Schreber. Individuals of *Juncus acutus* L. were also observed around the perimeter of the survey area. A large part of the understorey was occupied by *Rubus* sp. and *Hedera helix* L.

The four types of structure found and measured in the survey area were:

(i) pure stand of *Platanus orientalis* (ST1);

(ii) mixed stands of *Platanus orientalis* and *Salix alba* (ST2);

(iii) mixed stands of *Salix alba* and *Platanus orientalis* (ST3);

(iv) pure stand of *Salix alba* (ST4).

The detailed results for each type of structure are analyzed below.

1. Pure stand of *Platanus orientalis* (ST1)

It was a pure stand of *Platanus orientalis*, which appeared in all classes with a diameter of 15 to 70 cm (Fig. 2). The total density of the stand was 338 stems·ha^{-1}, with average diameter 40.11 cm, average height 25.71 m, total basal area 48.97 m^2·ha^{-1} and slenderness index 64. All these parameters characterize a fixed stand (Table 1).

About 69 % of the total basal area was produced from the upper storey. Also, 55 % of stems were in the upper-storey, 34 % in the middle-storey and 11 % in the under-storey.

The tallest tree was 44 m. Most stems appeared in the 34 and 38 cm DBH classes which, in terms of maturity phase, are classified in the stage of moderate trunks (Fig. 2), while a significant number of stems were classified in the phase of mature trunks (classes of diameter 54 and 58 cm). The distribution of height showed a multi-storey stand with distinct storeys with four maximum in steps 19, 23, 29 and 35 m (Fig. 3).

2. Mixed stand of *Platanus orientalis-Salix alba* (ST2)

It is a mixed stand of *Platanus orientalis* and *Salix alba* with a total density of 332 stems·ha^{-1}, an average diameter of 39.3 cm, an average height of 29.40 m, a total basal area of 47.02 m^2·ha^{-1} and the slenderness index is 75. That shows that these are fixed stands (Table 2). Total 94 % of the total basal area was produced by the upper storey.

The tallest tree was *Platanus orientalis* with a height of 37 m. The largest num-

Table 1. Stand parameter statistics of *Platanus orientalis* pure stand (ST1).

Stand parameter	Upper storey	Middle storey	Under storey	Total
DBH, cm	45.23	34.47	31.50	40.11
DBH [min–max], cm	23–70	15–52	21–40	15–70
Height (H), m	32.74	19.21	10.00	25.71
H [min–max], m	24–44	15–23	7–12	7–44
Slenderness Index (H:D)	72	56	32	64
Total basal area (G), m^2·ha^{-1}	33.89	12.03	3.05	48.97
Density, ha^{-1} (share, %)	187 (55)	115 (34)	36 (11)	338

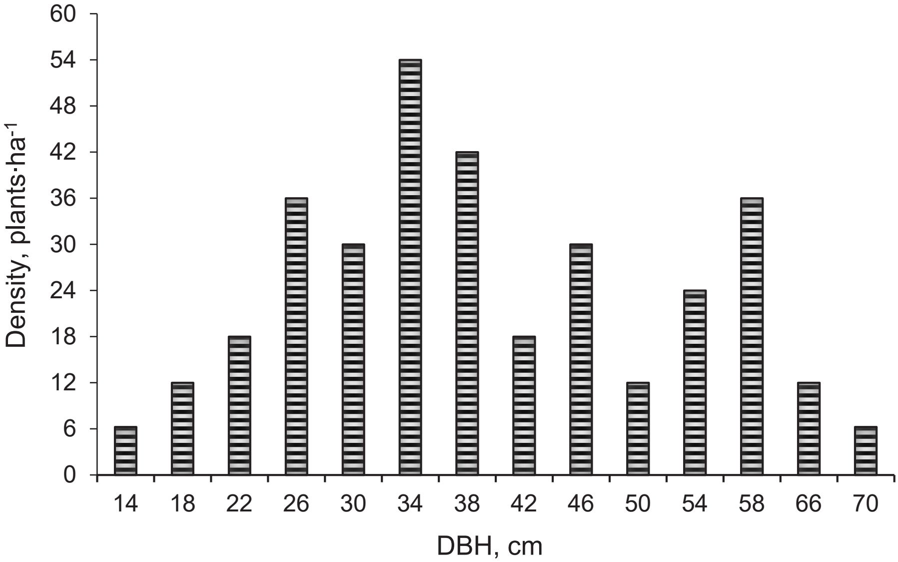


Fig. 2. Diameter distribution of *Platanus orientalis* pure stand (ST1).

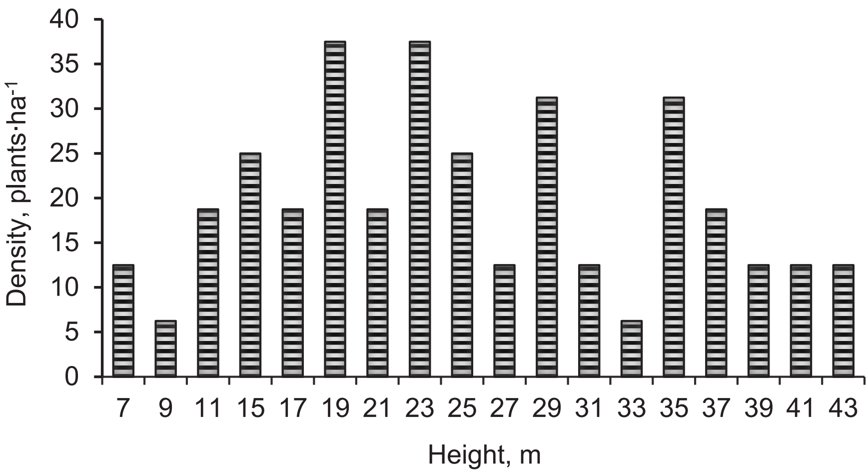


Fig. 3. Height distribution of *Platanus orientalis* pure stand (ST1).

ber was found in diameter classes o of 50 and 58 cm, which classified to the maturity stage of the moderate to thick logs (Fig. 4). The height distribution shows a storey stand with maximums at heights of 31 and 35 m (Fig. 5).

Total 75 % of *Platanus orientalis* individuals are in the upper storey, 25 % in the middle storey while *Salix alba* appeared equally only in the upper storey and under storey (50 % are in the upper storey and 50 % in the under-storey) and was completely absent from the middle storey (Table 3).

Table 2. Stand parameter statistics of *Platanus orientalis-Salix alba* mixed stand storeys (ST2).

Stand parameter	Upper storey	Middle storey	Under storey	Total
DBH, cm	48.00	20.00	17.00	39.30
DBH [min–max], cm	30–58	16–24	16–18	16–58
Height (H), m	34.29	24.00	6.35	29.40
H [min–max], m	31–37	19–29	6–8	6–37
Slenderness Index (H:D)	71	120	37	75
Total basal area (G), $m^2 \cdot ha^{-1}$	44.08	2.18	0.76	47.02
Density, ha^{-1} (share, %)	233 (71)	66 (20)	33 (9)	332

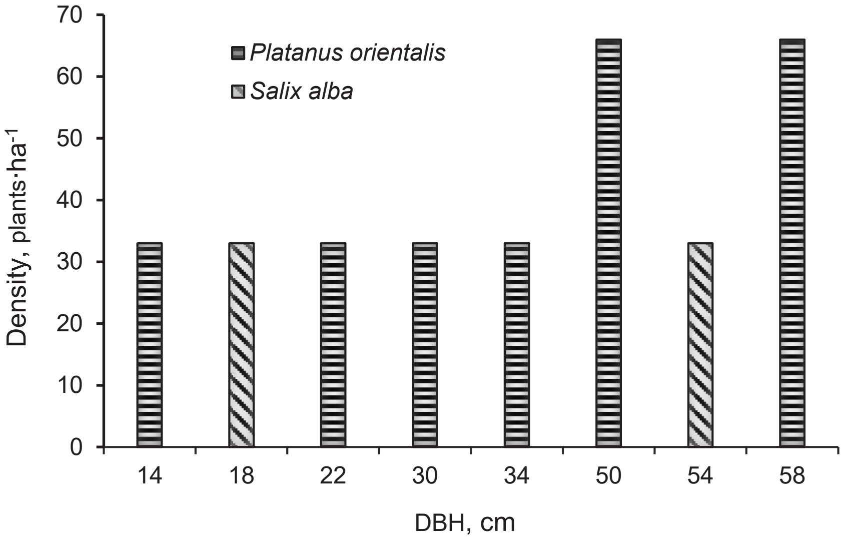


Fig. 4. Diameter distribution of *Platanus orientalis-Salix alba* mixed stand (ST2).

Table 3. Stand parameter statistics of *Platanus orientalis-Salix alba* mixed stand species (ST2).

Stand parameter	*Platanus orientalis*				*Salix alba*			
	Upper storey	Middle storey	Under storey	Total	Upper storey	Middle storey	Under storey	Total
DBH, cm	47.17	20.00	-	40.38	53.00	-	17.00	35.00
DBH [min–max], cm	30–58	16–24	-	16–58	53	-	16–18	16–53
Height (H), m	34.00	24.00	-	32.00	31.00	-	6.35	24.00
H [min–max], m	31–37	19–29	-	19–37	30–36	-	6–8	6–36
Slenderness Index (H:D)	72	120	-	79	58	-	37	68
Total basal area (G), $m^2 \cdot ha^{-1}$	36.3	2.18	-	38.91	7.35	-	0.76	8.11
Density, ha^{-1} (share, %)	200 (75)	66 (25)	-	266	33 (50)	-	33 (50)	66

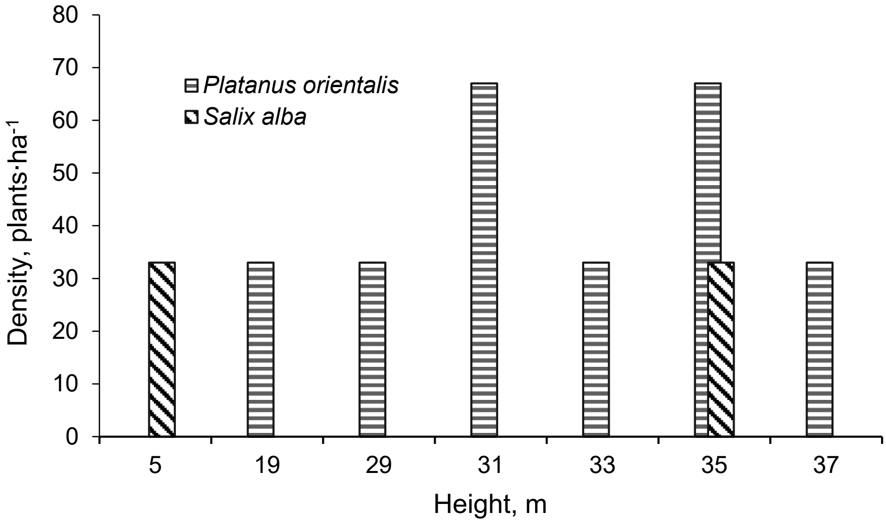


Fig. 5. Height distribution of *Platanus orientalis*-*Salix alba* mixed stand (ST2).

3. Mixed stand of *Salix alba* and *Platanus orientalis* (ST3)

The mixed stand with *Salix alba* and *Platanus orientalis* had a total density of 75 stems·ha^{-1}, average diameter of 33 cm, average height of 15 m, total basal area 15.20 m^2·ha^{-1} and the slenderness index 69. These results indicate that the stand is stable or fixed (Table 4). Total 96 % of the basal area was produced by the upper storey.

Salix alba dominates with 45 stems per hectare and is followed by *Platanus orientalis* with 30 stems per hectare. For *Salix alba* 78 % of the stems were in the upper storey, and 22 % in the middle storey, while for *Platanus orientalis* 50 % were in the upper storey, 33 % in the middle storey and 17 % on the under storey (Table 5).

The tallest tree was 30 m (*Platanus orientalis*). The largest number of trees were found in the diameter classes of 14 and 22 cm which means they are at the stage either of maturity or thin logs (Fig. 6). Height distribution showed a two storied stand with maximum number of stems at 13 and 17 m (Fig. 7).

Table 4. Stand parameter statistics of *Salix alba*-*Platanus orientalis* mixed stand stories (ST3).

Stand parameter	Upper storey	Middle storey	Under storey	Total
DBH, cm	39.00	19.50	6.00	33.00
DBH [min–max], cm	8–140	13–28	6	6–140
Height (H), m	17.20	12.50	2	15.00
H [min–max], m	13–30	6–18	2	2–30
Slenderness Index (H:D)	76	60	33	56
Total basal area (G), m^2·ha^{-1}	14.54	0.65	0,01	15.20
Density, ha^{-1} (share, %)	50 (67)	20 (27)	5 (6)	75

Table 5. Stand parameter statistics of *Salix alba-Platanus orientalis* mixed stand species (ST3).

Stand parameter	*Salix alba*				*Platanus orientalis*			
	Upper storey	Middle storey	Under storey	Total	Upper storey	Middle storey	Under storey	Total
DBH, cm	33.00	19.00	-	26.00	59.30	21.00	6.00	28.80
DBH [min–max], cm	14–120	14–23	-	14–120	8–140	13–28	6	8–140
Height (H), m	16.40	12.00	-	14.20	19.00	13.00	2	11.30
H [min–max], m	6–18	6–23	-	6–23	11–30	6–20	2	2–30
Slenderness Index (H:D)	92	43	-	76	71	59	33	54
Total basal area (G), $m^2 \cdot ha^{-1}$	5.90	0.28	-	6.18	8.08	0.37	0.01	8.46
Density, ha^{-1} (share, %)	35 (78)	10 (22)	-	45	15 (50)	10 (33)	5 (17)	30

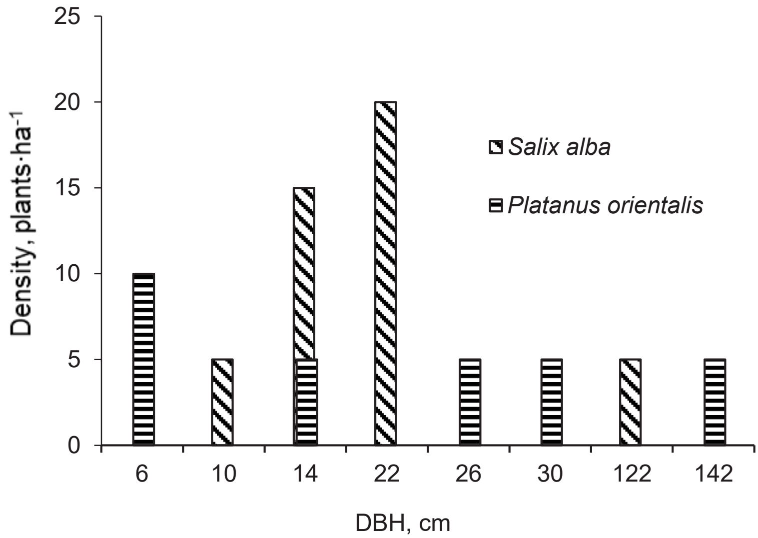


Fig. 6. Diameter distribution of young stands *Salix alba-Platanus orientalis* mixed stand ST3.

Figures 4 and 6 indicate that certain diameter classes are missing. These could have been illegally logged, which is confirmed by the many stumps observed in the study area during fieldwork.

4. Pure stand of *Salix alba* (ST4)

The pure stand of *Salix alba* had a total density 67 stems·ha^{-1}, average diameter of 31 cm, average height of 12 m, total basal area of 5.56 $m^2 \cdot ha^{-1}$ and slenderness index 39, which show, that these are very high stability stands (Table 6). About 92 % of the total basal area was produced by the upper storey. About 66 % of stems were in the upper storey, and the remaining 34 % – in the middle storey.

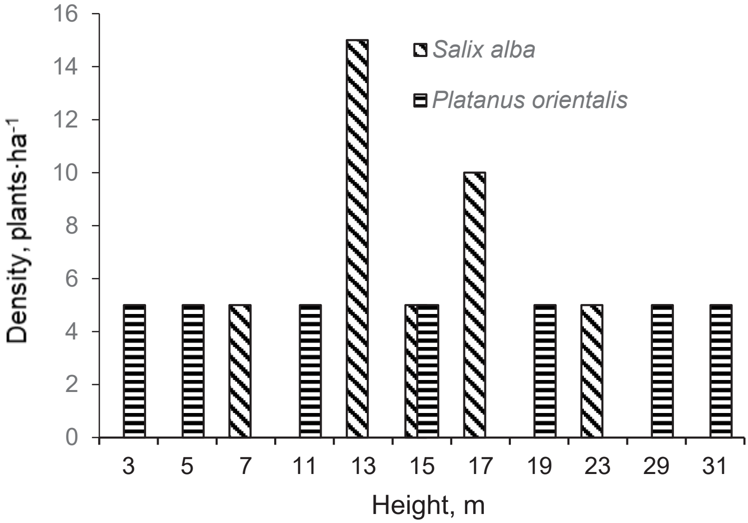


Fig. 7. Height distribution of young stands *Salix alba-Platanus orientalis* mixed stand ST3.

Table 6. Stand parameter statistics of *Salix alba* pure stand (ST4).

Stand parameter	Upper storey	Middle storey	Under storey	Total
DBH, cm	38.00	31.50	-	31.00
DBH [min–max], cm	30–43	13–18	-	13–43
Height (H), m	15.00	10.00	-	12.00
H [min–max], m	12–17	4–7	-	4–17
Slenderness Index (H:D)	39	32	-	39
Total basal area (G), $m^2 \cdot ha^{-1}$	5.13	0.43	-	5.56
Density, ha^{-1} (share, %)	44 (66)	23 (34)	-	67

The tallest tree was 17 m. The largest number of trees was found in the diameter class of 42 cm, and therefore, the stand can be classified in the stage of medium trunks (Fig. 8). The distribution of height shows a multi-storey structure (Fig. 9).

Discussion

Lake Trichonida belongs to the European ecological network NATURA 2000 with code GR2310009. In the study area, riparian forests with two dominant forest species, *Platanus orientalis* and *Salix alba*, were recorded around the lake.

The mixed stands willows dominated numerically (by 50 % of plane) on the two upper floors while they were absent from the basement. Mixed willow-sycamore stands resulted from the entry of willows into original sycamore stands and their eventual dominance due to the rapid growth. These clusters should be listed in habitat 92A0.

The pure stands of *Platanus orientalis* (ST1) are fixed stands. They were found on all storeys and in all size classes with a greater appearance of trees in the stage of medium and old age trunks. There is mod-

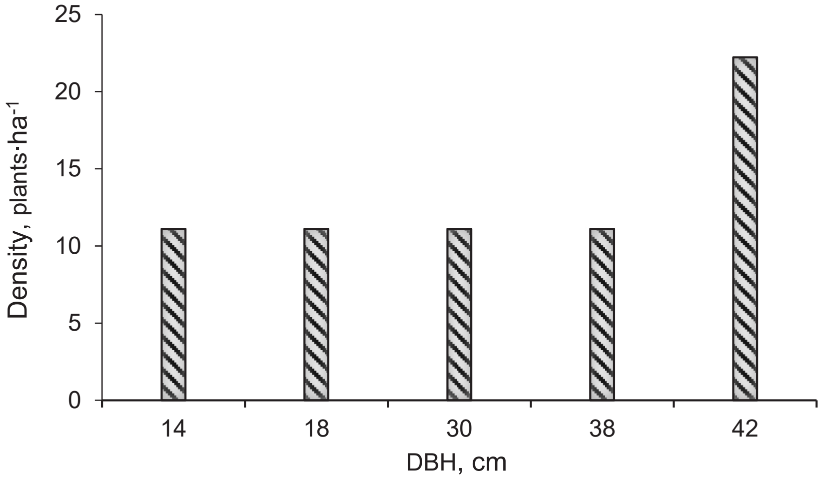


Fig. 8. Diagram of diameter distribution of *Salix alba* pure stand (ST4).

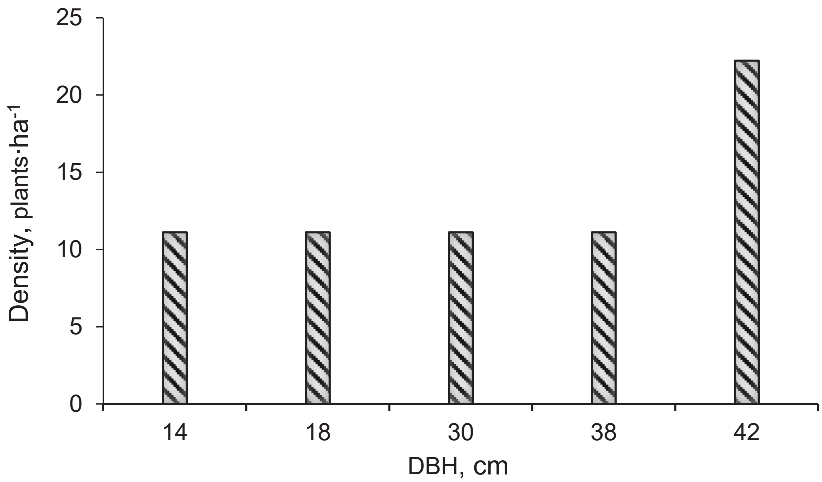


Fig. 9. Height distribution of *Salix alba* pure stand (ST4).

erate natural regeneration despite intense human activity. A similar type of structure with pure stands of *Platanus orientalis*, has been studied in central Greece, around Pinios River (Pipinis 2003). There the rebirth of *Platanus orientalis* does not exist at all from spermoblasts but only a few premoblasts that came from illegal timbering.

The mixed stands *Platanus orientalis*-*Salix alba* (ST2) was the main and most frequent variant of the riparian forest of Lake Trichonida. The absence of *Salix* from the middle storey indicates their possible logging or grazing in previous years. The absence of *Platanus* from the under storey and entrance of *Salix* shows a dynamic tendency of the riparian forest to be dominated by the *Salix*, if they are not protected as to ensure their natural evolution.

The mixed stands *Platanus orientalis-Salix alba* (ST2) are characterized as stands with marginal stability, according to the classification of the stability of a stand (Apatsidis 2013). According to Navratil and MacIsaac (1993), the high value of the slenderness index is an indication that there is competition between trees. Consequently, the high value of the slenderness index, 120 on the middle storey, shows that the trees of the middle storey, which are only *Platanus*, show a strong competitiveness with each other (tables 2 and 3).

According to Efthimiou et al. (2015) a similar type of structure of mixed riparian stands with *Platanus orientalis*, *Populus alba*, *Salix alba* is found, in the riparian forest of the river Richios where *Platanus orientalis* and *Salix alba* appear in the middle storey and in the under storey, while the upper storey consists of all three species. In Peneus River *Platanus orientalis* (Pipinis 2003), forms mixed stands with *Salix alba* in which the two species appear on all floors of the stand. Mixed forests of *Platanus orientalis* and *Salix alba*, with a similar type of structure are found in southern Bulgaria and specifically in Struma, Mesta, Ardas, Vacha, Chaia rivers and their tributaries Dimitrov et al. (2018). Research in a mixed riparian stand *Platanus mexicana* Moric. and *Alnus acuminata* Kunth, on the banks of the Xaltatempa River, in the State of Puebla, Mexico, reports that in the 'gallery' forest *Platanus mexicana*, was recorded along the entire length of the river and had the highest values in diameter, height and density than *Alnus acuminata* (Luna 2018).

In the mixed stands of *Salix alba-Platanus orientalis* (ST3), the study of their structure showed that *Salix* colonizes the old stands of *Platanus orientalis* and gradually appears on the upper two storeys, probably due to the intensity of pressures from human activities.Mixed stands of *Salix alba-Platanus orientalis* are the dominated riparian forest type around Lake Trichonida. These are young mixed stands in which *Salix alba* had greater competitiveness (higher slenderness index values) than *Platanus orientalis* especially on the upper storey (Table 5). *Salix alba* was absent in the under storey. This dynamic is captured by the analysis of structure elements in mixed willow-plane stands. In the research of Efthimiou et. al. (2016) on Richios River (Macedonia), pure riparian stands of *Platanus orientalis*, *Populus alba* and *Salix alba* were recorded in which the *Salix alba* penetrated into old stands of *Platanus orientalis* and appears on all three storeys.

In the mixed stands of *Platanus orientalis-Salix alba*, the study of their structure shows that the *Salix* colonizes in old stands of *Platanus orientalis* and gradually appears on all storeys or in some depending on the intensity and time of pressures from human activities. This dynamics in mixed stands of *Platanus* has been confirmed by similar structure research in mixed stands *Platanus-Populus-Salix* in deciduous riparian forest in SW United States and northern Mexico, in which the *Platanus* is a pioneer tree species (Stromberg 2002).

In both of the structure's types of mixed stand with plane and willow, the willow participates in the upper storey. If it is considered that the sycamore disease has been detected in the area (verbal communication with Management Body) and given the 'aggressive invasion' of the willow in the riparian forest, the 92A0 habitat is likely to dominate in the future. This must be considered seriously for the management of the riparian forest.

Pure stands of *Salix alba* (ST4) are stands with high stability. These are two-storied stands with very high stability (slenderness index 39) while trees are absent from the under storey at the stage of maturity of the medium logs (Table 6).

The study of Sitzia et al. (2018), on the genetic diversity and structure of *Salix alba* populations along fragmented riparian corridors in northeastern Italy (on the Po Plain) on the middle of the river Brenta, showed high genetic similarity among different structures. The magnitude of genetic diversity in each structure and genetic differentiation among them suggested that these bases are dynamic, capable and adaptive to possible changes in their humid environment. A study by Piton et al. (2020), on the semi-natural banks of rivers in the French Alps (Isère, France), showed that the restoration of the degraded bank of the river using willow planting techniques, improved both protection against erosion and riparian ecological functions. These techniques are often based on the establishment of Salicaceae species and sometimes Tamaricaceae species that can be strongly affected by the appearance of a beaver. In our country there are no such surveys.

The research on the structure of the riparian forest of Lake Trichonida, which is the first study of the structure of the riparian forest, showed that in recent years its existence is directly threatened not only by the intense human activity but also by the fungus *Ceratocystis platani* (J.M. Walter) Engelbr. & T.C. Harr. A parallel can be seen with the northern part of 'Bosco Fontana' area of Italy, where the mixed deciduous forest is considered one of the most endangered ecosystems in Europe.

Conclusions

In conclusion the riparian forest of Lake Trichonida is dominated by *Platanus* and *Salix* either in pure or mixed stands. Willow invasion into sycamore stands created mixed stands, in which willow appears with a potential to dominate the upper floors in the future. This shows a dynamic of predominance of 92A0 habitats against of 92C0. A big problem for the riparian forest of Trichonida is the absence of trees in the lower floor (absence of regeneration), absence of intermediate diameter classes mainly due to intense human activities. These pressures are changing the structure, undermining the natural dynamics and the future of the structure and composition of the riparian forest. As a result of the intense human presence, the current riparian forest that exists in Lake Trichonida, in western Greece, is noticeably shrunk and degraded. This is especially evident in mixed *Salix-Platanus* stands (ST3) where many diameter classes are absent between young and very old trees. The existence of the riparian forest maintains the rich biodiversity of the area, which gives it great ecological value and makes it imperative to immediately protect, recover and restore it with new plantings of riparian forest species (*Platanus*, *Salix*, *Populus*) in selected public areas around the lake. The problems identified in the structure and dynamics of the riparian forest must be the basis for the immediate preparation of a management plan, which provides for its demarcation, the limitation of human pressures (eig. illegal logging in site), for the recovery, restoration and preservation of the structure, dynamics and of the biotopes of the riparian forest of Lake Trichonida in western Greece with appropriate silvicultural measures.

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