WOOD, BARK AND PITH STRUCTURE IN TREES AND SHRUBS OF CYPRUS: ANATOMICAL DESCRIPTIONS AND ECOLOGICAL INTERPRETATIONS

Direttore della Scuola: prof. Mario Aristide Lenzi
Coordinatore d’indirizzo: prof. Tommaso Anfodillo
Supervisore: prof.sa Tiziana Urso
Co-supervisore: prof. dr. Fritz H. Schweingruber

Dottorando: dott. Alan Crivellaro
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Preface

The idea of this thesis starts in 2005 in the island of Cyprus. At that time I was visiting the ancient timber structures belonging to the Cyprus’ cultural heritage with a group of European scientists. During a visit to the city of Limassol, I bought a reference flora book of the region. I chose the book *Trees and Shrubs in Cyprus* (Tsintides *et al.* 2002). Once made it home, I looked for some literature about the wood anatomy of the flora of the island; I realized that only few species indicated in the book were described in their wood anatomies. I also learned that I visited a very interesting country, also from the botanical and ecological points of view.

Few months later I met prof. dr. Fritz H. Schweingruber at the Dendroanatomical week in Davos Laret (CH). We discussed the feasibility of a large study focused on the anatomy of Cyprus’ trees and shrubs. We early realized that the indigenous flora to the island of Cyprus can be considered representative for the eastern Mediterranean region.

Finally, in 2007, we started to work on the Cyprus’ trees and shrubs wood anatomy. A first result was my master thesis in Forestry Science concerning wood anatomy and ecology of 26 Cypriot species from the southern costal range. After this first approach Mr. Takis Tsintides and Mr. Charalambos S. Christodoulo of the Forestry Department - Cyprus’ Ministry of Agriculture and Environmental Recourses (and Authors of the book I bought in Limassol few years earlier) demonstrated their warm interest in my larger project covering the entire woody flora of the island. They offered the needed assistance in an extensive collecting campaign on Cyprus, by providing plant identification, and logistic assistance during fieldwork in 2009 and 2010. Since that time samples collection and slides preparation were carried out.

At this moment the original idea, with modifications and improvement, exists in this thesis.
Acknowledgements

To reach the aims of my PhD project I needed the help of many scientists and specialists from different countries. I feel to start this thesis with my acknowledgments to the people that supported me with enthusiastic contribution.

First and foremost I wish to thank my thesis’ mentor, Fritz H. Schweingruber, for his warm encouragement and thoughtful guidance. He has been supportive since the days I began working on the anatomy of Cyprus’ plants as an undergraduate. Ever since, Fritz has encouraged me in many ways.

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I want to express my great gratitude to Barbara Lachenbruch of the Department of Wood Science and Engineering, Oregon State University, Corvallis (USA), for accepting me the internship opportunities in her group and leading me working on biomechanics and wood anatomy. I’m also deeply indebted to Katherine McCulloh of the Department of Forest Ecosystems and Society at OSU. Barb and Kate demonstrated me what share knowledge and productive collaboration are in science, their ideals and concepts will have a remarkable influence on my entire (prospective) research career. During my six months long stay at OSU I also had the opportunity to meet and discuss with Steve Volker, Frederick Meinzer, Lisa Ganio, and Peter Kitin, I really appreciated their advices and talks.

I spent four months at Swiss Federal Institute for Forest, Snow and Landscape Research in Switzerland, during that time I met Holger Gartner, Paolo Cherubini and Patrick Fonti, they supported me in many ways. I wish to thank also Petra Zibulski of the Institut für prähistorische und naturwissenschaftliche Archäologie (IPNA) in Basel (CH), we shared thought on the definitions of anatomical features for bark and pith anatomies.

During my PhD I have collaborated with many other colleagues for whom I have great regard, and I wish to extend my warmest thanks to all those who have helped me in many ways.

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Abstract

The dissertation deals with wood, bark and pith anatomy of trees and shrubs of Cyprus. It consist of three parts: (1) the anatomical description of stem wood, twig bark and pith of the endemic and indigenous trees and shrubs species belonging to the flora of the island, (2) the ecological wood and bark anatomies interpretation and (3) a study focused on conductive vs. mechanical tradeoff in climbers vs. subshrubs.

Original samples for each species were collected during 3 field trips on Cyprus. About 270 species were collected, and 600 double stained (astra blue and safranin) slides were prepared. New lists of anatomical features were developed for the specific needs of this research, especially for bark and pith anatomy. The described species represent almost the entire woody flora of the island. A great number of them have never been anatomically described before. The anatomical descriptions are a perfect base for wood anatomists interested to wood structure of single species or the range of anatomical patterns within the Eastern Mediterranean region, and also for archeologist and palaeobotanists who determine wood remains, and for wood technologist who compare structures with physical wood properties.

In the ecological wood anatomy analysis we observed wood diffuse porous structure associated to woody chamaephytes. We detected semi-ring and ring porous xylems related to nanophanerophytes and phanerophytes. Rays features seem to be associate to space filling in wood, and the rays dimensional features seems to be constrained by vessels. In fact, rays became larger moving from woody chamaephytes to phanerophytes, and the numbers of rays per millimeter decrease moving from woody chamaephytes to phanerophytes, maybe allowing vessels to be greater in taller life forms. Raylessness is clearly associated to woody chamaephytes. Rays composition vary from homogeneous in woody chamaephytes, to heterogeneous in nanophanerophytes and phanerophytes. The axial parenchyma was rare in woody chamaephytes, apotracheal in nanophanerophytes and mainly paratracheal in phanerophytes. Endemic species showed absence of axial parenchyma, raylessness, homogeneous rays, and did not show association to tension wood. We recorded a predominance of diffuse porous species in dry/hot site, and the presence of ring porous species in wet/cold sites. Diffuse porous structures were associated to rocky and sandy sites, and semi-ring porous woods to forest and shrublands habitats. Thick walled fibers species were associated to moist and ruderal habitats, thin walled fibers to forest and shrubland species. A clear trend was observed in fiber wall thickness vs. wood density: greater in the fiber wall thickness, greater is the wood density.

The bark anatomical features describe sieve tube morphology and distribution, sclerenchyma presence and arrangement, rays, phellem, phelloderm, crystals, secretory structures, and appearance under polarized light. Sieve tubes were typically arranged tangentially in nanophanerophytes but not in woody chamaephytes. Bark ray dilatation was noted in moist site species but lacking in
endemic, shrubland, and forest species. Sclerenchyma tended to be lacking in woody chamaephytes, and in endemic and dry site species. The tangential arrangement of fibers tended to be lacking in woody chamaephytes and Mediterranean species. The presence of prismatic crystals was associated with nanophanerophytes and phanerophytes, but not with endemic, shrubland, or forest species. Phloem homogeneity was associated with endemic species. Phellem homogeneity was associated with climbers, phanerophytes, and species of moist habitats. The association of sclerenchyma with life form suggests a biomechanical role, especially for young twigs. The level of endemism and the species' habitat were strongly linked to a number of bark features opening new fields of ecophyletic and ecophysiological investigation.

In the third part of the dissertation the all sampled woody climbers (10 species) and most of the woody subshrubs (25 species) of Cyprus were characterized by their vessel and fiber anatomies relative to mechanical and hydraulic function. Consistent with their lower need for self-support, on average the climbers had lower wood density than did the subshrubs, and had a lower proportion of their cross-section devoted to fibers. Consistent with climbers’ need for higher hydraulic conductance and total plant height, climbers had vessel sizes and frequencies closer to the theoretical packing limit than did subshrubs.
Riassunto

La tesi si occupa di anatomia del legno, della corteccia e del midollo di alberi e arbusti appartenenti alla flora dell'isola di Cipro. Si compone di tre parti: (1) la descrizione anatomica del legno del tronco, e di corteccia e midollo dei rametti, (2) l'interpretazione ecologica dell'anatomia del legno e della corteccia e (3) uno studio focalizzato sul compromesso delle funzioni di conduzione e di sostegno meccanico in liane a piccoli arbusti.

Nel corso di 3 campionamenti a Cipro sono stati raccolti campioni per circa 270 specie. Da questi sono stati realizzati 600 preparati anatomici a doppia colorazione (stra blu e safranina). Nuove liste codificate per la descrizione delle caratteristiche anatomiche della corteccia e del midollo sono state sviluppate appositamente per gli scopi di questa ricerca. Le specie descritte rappresentano quasi l’intera flora legnosa dell’isola. Un gran numero di specie sono qui descritte prima dal punto di vista anatomico. Le descrizioni anatomiche sono una base perfetta per anatomisti legno interessati alla struttura in legno di singole specie o allo studio della gamma di modelli anatomici nella regione del Mediterraneo orientale, e anche per archeologi e paleobotanici che hanno la necessità di identificare reperti legnosi, e anche per tecnologi del legno che confrontano le strutture anatomiche con le proprietà fisiche e meccaniche del legno.

Le indagini di ecologia del legno hanno rilevato relazioni statisticamente significative tra legno a porosità diffusa e camefite legnose, mentre le porosità semi diffusa e anulare sono legate alle nanofanerofite e alla fanerofite arborea rispettivamente. Le caratteristiche dei raggi sembrano associate al riempimento dello spazio nel legno e le dimensioni dei raggi in sezione trasversale sembrano limitate dai vasi. Infatti i raggi sono più larghi nelle fanerofite arboree che nelle camefite legnose e il numero di raggi per millimetro diminuisce passando da fanerofite arboree, a nanofanerofite fino alle camefite legnose, consentendo così alla forme biologiche con altezza maggiore di avere vasi più grandi. L'assenza di raggi è una caratteristica tipica delle camefite legnose. La composizione dei raggi varia da omogenea nelle camefite legnose a eterogenea in nanofanerofite e fanerofite arboree. Il parenchima assiale è raro o difficilmente osservabile nelle camefite legnose, tipicamente apotracheale nelle nanofanerofite e principalmente paratracheale nelle fanerofite arboree. Le specie endemiche a Cipro sono caratterizzate dall'assenza di parenchima assiale, dall'assenza di raggi o dalla presenza di raggi omogenei e non mostrano alcuna relazione significativa con la presenza di legno di tensione. È stata riscontrata una netta predominanza di specie a porosità diffusa nei siti caldi e secchi, e di specie a porosità anulare in siti umidi e freddi. Legni a porosità diffusa appartengono a specie che vivono in siti rocciosi e sabbiosi, la porosità anulare è associata ad habitat forestali e di macchia mediterranea. Le fibre a parete spessa risultano legate a a siti umidi, fibre a pareti sottili ad habitat forestali e di macchia mediterranea. Un chiaro trend lega proporzionalmente lo spessore delle fibre con la densità del legno.
Le caratteristiche anatomiche analizzate per la corteccia descrivono morfologia e distribuzione dei tubi cribrosi, la presenza e la disposizione di tessuti sclerenchimatici, i raggi, il sughero, il felloderma, i cristalli, le strutture di secrezione e la visibilità in luce polarizzata. I tubi cribrosi sono tipicamente disposti in bande tangenziali nelle nanofanerofite, ma non nelle camefite legnose. L'allargamento dei raggi nel felloderma è legato a specie che vegetano in siti midi, non è presente nelle specie endemiche, in quelle tipiche di macchia mediterranea a negli habitat forestali. I cristalli sono associati alle nanofanerofite e alle camefite arborea, non alle specie endemiche, di macchia e di ambiente forestale. L'omogeneità del felloderma è stata riscontrata nelle camefite lianose, in quelle arborea e alle specie di ambienti umidi. L'associazione di tessuti sclerenchimatici con le forme biologiche suggerisce un ruolo biomeccanico di questo tessuto, soprattutto nei giovani rami. Il livello di endemico e l'habitat delle specie sono fortemente legati a diverse caratteristiche anatomiche della corteccia offrendo nuove possibilità di studio nel campo dell'ecologia e dell'ecofisiologia. Nella terza parte che costituisce la tesi tutte le 10 specie di fanerofite lianose campionate e la maggior parte delle camefite legnose (25 specie) sono state caratterizzate per quanto riguarda le caratteristiche anatomiche di vasi e fibre che hanno ripercussioni importanti nelle funzioni di conduzione e di sostegno meccanico del legno. In accordo con la loro inferiore necessita di auto-sostegno, le fanerofite lianose hanno una densità basale inferiore rispetto alle camefite legnose. Inoltre, le liane presentano una inferiore proporzioni di sezione trasversale destinata a fibre. In accordo con la maggiori necessità conduttive e in relazione alla loro altezza, le liane hanno un diametro e una frequenza dei vasi che le colloca più vicine al funzione "packing limit" rispetto alle camefite legnose.
1. Introduction

Five regions on the Earth, located between 30° and 40° latitude both in northern and southern hemisphere, have a Mediterranean climate. These Mediterranean regions occupy less than 5% of the Earth's surface, they are isolated one to the other, and are found in the west or south-west coasts of the continents. Mediterranean regions are known by their outstanding biodiversity (Cowling et al. 1996), and they also have exceptionally high numbers of rare and locally endemic plants (Arroyo et al. 1994, Cody 1986, Cowling et al. 1992, Thompson et al. 2005).

In the surrounding Mediterranean Sea area the main reason of the richness in plant species is not so much the variety of species in any given area as the remarkable number of endemics, many of which are restricted to a single or few localities in sandy areas, islands, geological areas with unusual soil or rock type, or to isolated mountains range (Blondel & Aronson 1999). More than half of the species in the Mediterranean region are endemic, and 80% of all European endemic species are Mediterranean (Gomez-Campo 1985).

Mediterranean island floras typically show high percentage of endemism, usually 10 to 13%, or even greater (Médail & Verlaque 1997). Examples include Corsica with 11% (240 endemic from a total of 2150 vegetal species), as compared to only 7.2% for the nearby continental area of south-eastern France. Crete has about 11.7% endemics among plants (200/1710), Sicily 9.7% (255/2402) (di Martino & Raimondo 1979), and the three larger Balearic islands each about 12%. In the island of Cyprus 95 endemic taxa are recorded at species level, and 132 at lower taxonomic levels, the latter represent 7% of the total number of species that grown in Cyprus (Alziar 1995, Quezel 1988). Cyprus is the most eastern island in the Mediterranean Sea and it is the third largest island in area. In relation to its size, Cyprus has one of the richest floras in the Mediterranean. This is due to a number of factors, including its geological structure, climatic conditions, geographic location (situated in the boundary of three continents), its insular character, the surrounding sea, and its topographical configuration (Tsintides et al. 2002). Extensive plains, mountain masses, wetlands, coasts, sand dunes, gorges and cliffs provide a huge variety of habitats for many indigenous and endemic species.
References to the flora of Cyprus can be found in many ancient texts. The first true scientific investigation can be accurately dated to 8th April 1787, since that day three British botanists, John Sibthorp, John Hawkins, and Ferdinand Bauer systematically collected and identified 313 specimens (Meikle 1977). Ever since that time many researchers explore the island’s flora, producing books and noteworthy botanical collections which served as valuable reference sources for other researchers (e.g. Holmboe 1914, Chapman 1949, Meikle 1977, 1985, Pantelas et al. 1993, Tsintides 1998, Tsintides et al. 2002).

Despite the interest of Botanist on Cyprus’s plants identification, very few literature have been published on the anatomy of this interesting flora. Some wood atlases for the eastern Mediterranean region, and for some adjacent areas, have been published (e.g. Abbate Edlmann et al. 1994, Chudnoff 1956, Huber & Rouschal 1954, Fahn et al. 1986). Some woody species of the region were described in some other books (Schweingruber 1978, 1990, Schweingruber et al. 2011). But all the available descriptions for the Eastern Mediterranean species are of limited values for identification, since they are fragmentary, and since most of them have been published before the introduction of the codified international anatomical characters list (Wheeler et al. 1989).

The lack of comprehensive basic knowledge on the wood structure of lignified species indigenous to the Eastern Mediterranean countries, and the continuing demand for wood identification, gave rise to the idea of the work presented in this thesis.

Overall aims of the study

The overall aims I followed during my work can be summarized as follow:

1) describe the anatomy of wood, bark and pith of the endemic, indigenous, and of the most common adventive woody species that grow in Cyprus.

Wood of only a few shrubs and dwarf shrubs, as well as wood of not widely technologically used trees, has been investigated thoroughly and in detail before. Pith and bark anatomy were rarely presented systematically for a great number of species (Schweingruber et al. 2011). Here I will describe in details pith and juvenile bark anatomies by following a new classification for anatomical features of those tissues. I
think that combining bark, wood and pith anatomical information it will be much more possible to determine a plant fragment found of an archaeological site, or pieces of wood that have been washed ashore. Identifying wood from archeobotanical findings (carbonized wood, glacial deposits, etc.), historical objects, and remains belonging to the human cultural heritage (prehistoric stuffs, structural beams, etc.) is often difficult because wood anatomical features are only partially present. Therefore, having bark and pith anatomical descriptions address new possibilities in plant identification, and new ecological applications will be opened. The results of this objective consist in the second chapter.

2) Describe the presence of relationships between anatomical features and ecological, taxonomical and biological factors.

A large dataset covering almost the entire woody flora of a well defined geographical region (the island of Cyprus) represent a great opportunity to describe patterns in distribution of anatomical features in relation to ecological, biological, taxonomical attributes. The results of this objective will be described in the third chapter by an analysis based on selected anatomical features in endemic and indigenous species growing on Cyprus. At the same time, by investigating the same anatomical features, an evaluation of the suitability for dendrochronological and dendroecological studies (ring distinctness, age of plants) is possible.

3) Use anatomical data of some selected species to test some biomechanical hypothesis and the constrain in mechanical and conductive functions in stem.

A wide range of taxonomically important anatomical structures occurring in Cyprus, including various habits from trees, shrubs, dwarf shrubs to some perennial herbs and woody liana, were sampled and described. By characterizing vessel and fiber anatomies relative to mechanical and hydraulic function of all the woody climbers (10 species) and most of the woody subshrubs (25 species) of Cyprus I will test some biomechanical hypothesis. The results of this objective will be described in the fourth chapter.
2. Wood, bark and pith anatomy of Cyprus’ trees and shrubs

Introduction

The island of Cyprus lies at the easternmost end of the Mediterranean basin, neighboring Africa, Asia and Europe, 64 km south of Turkey and 105 km west to Syria, between 34°33’ - 35°41’ north and 32°17’ - 34°35’ east (Fig. 1). With an area of 9251 km² Cyprus is the third island in the Mediterranean Sea (after Sicily 25711 km², and Sardinia 24090 km², and before Crete 8261 km²). Its greatest length is approximately 225 km, and its greatest width is approximately 65 km.

Fig. 1. This image, acquired by NASA’s Moderate-resolution Imaging Spectrometer (MODIS) on January 26, 2008, shows the dust that blew toward Cyprus from the coast of Turkey. The Island of Cyprus is clearly located at the easternmost end of the Mediterranean Sea (www.earthobservatory.nasa.gov)
According to Hadjikyriacou (2005) four different geographical regions can be identified in the island (Fig. 2), each one with different geological formations (Fig. 3) and other interesting features:

- The Troodos range is a dome-shaped highland of mainly infertile igneous rocks situated in the central-western part of the island, rising to 1952 m at Mount Olympus. Lower belts of dome-shaped pillow lava, a most infertile area, which level off gradually towards the cost, surround the hard igneous rocks.

- The Pentadactylos range, situated in the north, is mainly composed of limestone and rises to 1024 m. This mountain range is composed of a succession of mostly allochthonous sedimentary formations.

- The Mesaoria or central plane is situated between the Troodos and Pentadactylos mountain ranges and has low relief, not exceeding 180 m, near Nicosia, the capital city of Cyprus. This plan is composed of flysch-type rocks carried by rivers from the Troodos and Pentadactylos ranges.

- The coastlands from valleys that almost entirely surround the country: Kyrenia valley with its narrow coast in the north, Pafos and Chrysochou valleys in the west, and Famagusta valley in the east. The soils are alluvial and fertile.
The geotectonic zone of Troodos consists of the ophiolite rocks of Troodos, aged 92 millions years, which comprise part of the oceanic crust and extend below Mesaoria plain. The collision of the African and Eurasian lithospheric plates and the subsequent subduction of the former beneath the latter resulted in the uplifting and final placement of the Troodos range. Troodos ophiolite has an elliptical shape and its longer axis has a NW - NE direction. It is a dome-shaped with Olympus the highest peak (1952 m). Its most distinguishing characteristic in that the lower stromatographic rocks (namely the ultrabasic plutonic rocks), topographically appear at the highest parts of the range, replaced gradually towards the circumference by the stromatographically overlaid rocks. The ophiolite of Troodos in one of the best preserved and most thoroughly studied worldwide and it constitute a model for geologist who study the oceanic crust (Konstantinou et al. 1997).
Fig. 3. Geological map of Cyprus (Geological Survey Department, www.moa.gov.cy).
Climatic conditions on Cyprus

The overall climate on Cyprus is Mediterranean, but on a local basis it is strongly influenced by geographical position related to relief and position relative to the Mediterranean Sea. According to the Rivas-Martínez classification, the bioclimate is mediterranean-mesophytic to xerophytic-oceanic with zones ranging from thermo-mediterranean-semi-arid to supra-mediterranean-humid (Barber & Valles 1995).

According to the data available from the Cyprus’ Meteorological Service’s website (2011) detailed climatological information are available for the island. The predominantly clear skies and high sunshine amounts give large seasonal and daily differences between temperatures of the sea and the interior of the island, which also cause considerable local effects especially near the coasts.

In summer the island is mainly under the influence of a shallow trough of low pressure extending from the great continental depression centered over southwest Asia. It is a season of high temperatures with almost cloudless skies.

In winter Cyprus is near the track of frequent small depressions that cross the Mediterranean Sea from west to east between the continental anticyclone of Eurasia and the low-pressure belt of North Africa. These depressions give periods of disturbed weather usually lasting from one to three days and produce most of the annual precipitation, the average fall from December to February being about 60% of the annual total. The average annual total precipitation increases up the southwestern windward slopes from 450 mm to nearly 1100 mm at the top of the central Troodos massif. On the leeward slopes amounts decrease steadily northwards and eastwards to between 300 and 350 mm in the central plain and the flat southeastern parts of the island. The narrow ridge of the Kyrenia range produces a relatively small increase of rainfall to nearly 550 mm along its ridge at about 1000 m. Snow occurs rarely in the lowlands and on the Kyrenia range but falls frequently every winter on the ground above 1000 m usually occurring by the first week in December and ending by the middle of April.

The seasonal difference between mid-summer and mid-winter temperatures is quite large at 18°C inland and about 14°C on the coasts. In July and August the mean daily temperature ranges between 29°C on the central plain and 22°C on the Troodos mountains, while the average maximum temperature for these
months ranges between 36°C and 27°C respectively. In January the mean daily temperature is 10°C on the central plain and 3°C on the higher parts of Troodos mountains with an average minimum temperature of 5°C and 0°C respectively. Frosts are rarely severe but are frequent in winter and spring inland.

The flora of Cyprus


Indigenous or native plants are those which form natural populations on Cyprus. In total the indigenous flora of Cyprus (Pteridophytes and Spermatophytes) include 1610 species or 1738 taxa at variety level (Alziar 1995, Meikle 1977, 1985, Cyprus Flora 2007).

Endemic plants are those restricted exclusively to the island. The endemic flora of Cyprus includes 108 species or 143 taxa at variety level (6.7% and 8.7% of the indigenous flora respectively). The National Forest Park of Troodos in a center per endemics, hosting 13 local endemics and 74 Cyprian endemics, while the all Troodos range host 94 endemic taxa. Other important areas for endemics are the Pentadactylos range and Akamas Peninsula with 56 and 44 Cyprian endemic taxa, respectively (Tsintides et al. 2007). Some notable flora elements are the endemic trees Cedrus brevifolia (Hook F.) Henry and Quercus alnifolia Poech, and also the endemic shrub Bosea cypria Boiss., a relict element of Tethys.

Exotic plants are the adventive and cultivated species; most of them originated from very distant geographical regions, while some are native to nearby areas of the Mediterranean region. The alien flora includes 238 taxa (Meikle 1977, 1985, Cyprus Flora 2007, Tsintides et al. 2007).

Cyprus is an island with diverse landscapes, due both its varied climate, geology, and the presence of man since -8200 (Guilaine & Br fois 2003; Peltenburg 2003, Peltenburg et al. 2000). Of the total forest area, natural
vegetation includes high forests (44.6%), maquis (32.6%), al lower vegetation types such as shrubs and phrygana (22.8%) (Hadjikyriacou 2005). Shrubs, alternating with build up areas and fields, cover the hills. The plains of the lowlands are covered by cultivations (about 45% of the island) and habitations, but there are also small areas of natural habitats locality. The natural and semi-natural vegetation types as well as the cultivations, especially traditional ones such as tree orchards, constitute important habitat of rare plants (Hadjikyriacou 2005).

The thermophiles Calabrian pine (*Pinus brutia* Tenore) form most of the extent forests, from sea level to about 1400 m altitude, and cover the Troodos and Pentadactylos Mountain range and part of the Akamas peninsula. Cypress (*Cupressus sempervirens* L.) forests occur mainly in Pentadactylos. The semi-deciduous *Quercus infectoria* Oliv. subsp. *veneris* (A.Kern.) Meikle forms only remnant stands at the western part at the western part of the island. The *Pinus nigra* J.F.Arnold subsp. *pallasiana* (Lamb.) Holmboe forests, the endemic *Cedrus brevifolia* forest stands of mountain Juniper are restricted to the higher altitudes of Troodos. The golden oak (*Quercus alnifolia*) occurs under the conifers or in pure stands, at altitude of 700 m and above all across the Troodos range (Tsintides *et al.* 2007).

Meikle (1977) subdivides the island of Cyprus in 8 botanical divisions to illustrate the internal distribution of each species. Fig. 4 shows a map with Cyprus’ botanical divisions and tab. 1 describes each one of them.

![Fig. 4. Botanical divisions of Cyprus mapped (Meikle 1977).](image)
<table>
<thead>
<tr>
<th>Botanical division</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division n. 1</td>
<td>A very heterogeneous area topographically, geologically, and floristically, with much natural (but often heavily grazed) vegetation. Mostly hilly, with deep narrow gorges cut through chalk, limestone or sandstone, and with areas of serpentine. The coasts are generally low, and sandy or rocky, except for a limited range of steep cliffs in the northern coastal range.</td>
</tr>
<tr>
<td>Division n. 2</td>
<td>Mostly the Troodos range, an area of high, but usually rounded or pyramidal, igneous peaks, with much of the ground above 1200 m, reaching 1952 m at the summit. The whole area abounds of endemics.</td>
</tr>
<tr>
<td>Division n. 3</td>
<td>A region of rounded chalk hills, gradually rising inland towards the Troodos range. Much of the ground consists of vineyards, and the costal belt is extensively cultivated, the hilly zone consists of calcareous marls and limestone. Few salt lakes are located in this region.</td>
</tr>
<tr>
<td>Division n. 4</td>
<td>Mostly cultivated and heavily grazed with numerous barren, eroded chalk or limestone hills. Larnaca salt lake provides habitat for many halophytes.</td>
</tr>
<tr>
<td>Division n. 5</td>
<td>Almost wholly occupied by the fields of the Mesaoria plain, with weed communities on waste and fallow lands.</td>
</tr>
<tr>
<td>Division n. 6</td>
<td>Heavily cultivated region, which includes the most dry region of the island.</td>
</tr>
<tr>
<td>Division n. 7</td>
<td>Includes almost all the Kyrenia range, and the fertile northern coastal range. The rugged limestone cliffs and pinnacles host a rich flora.</td>
</tr>
<tr>
<td>Division n. 8</td>
<td>The peninsula, an area of fertile soils, low hills and extensive sandy or rocky shores, was not visited during this research.</td>
</tr>
</tbody>
</table>

Tab. 1. Descriptions of botanical division of Cyprus (Meikle 1977).
Materials and methods

Samples collection
The goals of this research could not be reached without an extensive sampling of original plant material. Sample collection was carried out in three distinct sampling trips: on February 2009, on September 2009, and on March 2010. Different times of the year, which correspond to different plant phenological phases, were chosen to facilitate plant identification in relation to presence of flowers or seeds.

The specimens were collected in the sites indicated in the following map (Fig. 5). These collections were mainly from the Troodos region, Akamas peninsula, and from the southern coastal range.

![Sampling sites on Cyprus (map drew by Charalambos S. Christodoulou)](image)

We followed the book Trees and Shrubs in Cyprus (Tsintides et al. 2002) as a sampling reference list. The book covers 366 taxa, including endemic, indigenous, adventive and exotics plants. The Authors of the book are personnel of the Cyprus’ Department of Forests and are the same people that facilitated me to carry out the field sampling activities and plan identification. During the sampling activities special emphasis has been placed on endemic and indigenous species to the island of Cyprus. Additionally, some fruit trees and cultivated plants have been included. A number of introduced species, generally used as interior or pot plants, have been omitted, as well as some exotics that are rare on Cyprus or found only in botanical or private gardens.
Rare or protected species where collected in botanical gardens, especially from the Arboretum in Athalassa National Park, which is situated south-east from Nicosia.

Every sampling day, just before the fieldwork, we listed the plants growing in the specific region we were going to visit. We used the range descriptions in the standard reference of the woody flora (Meikle 1979, 1985; Tsintides et al. 2002) to choose a sampling area that was representative of the geographic distribution and habitat range for each species.

At the representative site we collected samples from one individual. The individual chosen appeared normal, healthy, and was one of the tallest individuals of that species at a site.

For each plant two samples were cut off: one from the stem (in multi-stem shrubs from a vertical stem), and another one from a twig. A stem portion was cut near the plant’s base (with the height dependent on the plant’s stature). The sample from the stem was extracted in different ways on the base of stem diameter: stems less than 2 cm in diameter were cut with a scissor; stems with diameter from 3 to 12 centimeters were cut off with a saw; and for stems larger than 12 centimeters a core was extracted with a Pressler corer. A 5-8 centimeters long pieces of twigs were cut from a shoot with a scissor. The twig sample was chosen from the principal stem for plants shorter than 2 meters. For plants taller than 2 meters the twig sample came from a branch. The distance between the tip of the shoot and the sampling point was variable: I followed the rule to have a 2-4 years old sample from each twig (age of the twig was determined by counting the bud scars).

The disks were stored in a sealed plastic bag to which we added several drops of 40% ethanol and kept them at 3-4°C until they were sectioned. On each plastic bag a pre-printed label table was stuck to register site and sample information.

**Site and sample characteristics description**

During field sampling information about the sampled plant and about the environment where the plant thrived were recorded. The basic information were:

- date, general location, and forest region,
- elevation, slope, and aspect,
• any evidence of site disturbance,
• water equability at the micro site level.

If needed a plot diagram with a brief description of key site features was sketched.

Information regarding the sampled plant and the samples themselves were recorded on a pre-printed label glued on each sealing bag. The recorded information concerned:

• scientific name and family,
• growth form, plant height,
• phenology,
• distance from the tip of the branch to the sampling location for twig sample measured in centimeters,
• distance from the soil level to the sampling region for stem sample measured in centimeters,
• name of the nearest village or locality,
• elevation of the sampling site in meters,
• location by Northing/Easting UTM system coordinates,
• date of sampling.

Later, in the office, the work continued with the following tasks:

• to locate the sampling site on a map and record it,
• if latitude and longitude were not entered in the field, to determine the coordinates from the map,
• to compare elevation recorded in the field with that indicated on a topographic map, and adjust if appropriate,
• check again that all the required information has been collected and recorded,
• transcription of the information collected on the field into an excel format dataset.

**Slide preparation and observation**

Permanent slide collection offer a number of advantages concerning wood studies. The structure of wood, which is the main point of a slide collection, is there for viewing with a microscope using transmitted light, or by polarized light, to show crystals and other structure non readily visible under transmitted
or reflected light (Schweingruber et al. 2011). Sections can be stained to show various structures more clearly. However, different staining of wood tissues is only really effective when the wood is freshly cut from a living plant (Ives 2001). In order to study wood anatomy, it is necessary to observe the cell structure in three different planes: transverse, tangential and radial. At least one thin section was cut from each of these planes and mounted together on one slide. From each 5-8 cm long disk, coming both from the stem and from the twig, a 1 cm long disk was cut off from the central part. In this way only wood which did not come in contact with alcohol was cut and stained. The blocks were split longitudinally by using a chisel. Stem disks greater than 1.5 cm in diameter were split to obtain a cubic block 1 cm each side, when possible keeping the rays running parallel to one side of the transverse section. In very small blocks a little forward planning was necessary to determine the sections cutting order, but where possible the transverse section was cut first. In twig disks special care was needed to preserve the bark and the pith on the same section. The wood samples didn’t require any preparation before microtoming. The sections were cut using a disposable blades and a sliding Reichert microtome in each of two wood anatomy laboratories: the Dept. Land, Environment, Agriculture and Forestry - University of Padova (TeSAF - UNIPD) in Italy, and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) in Switzerland. Tangential sections were cut from the outer growth ring, mostly from intermediate and latewood. The sections were stained with astra blue and safranin, dehydrated with alcohol and xylene, and mounted in Canada balsam (Chaffey 2002; Schweingruber 2007). The cell walls richer in cellulose were blue stained and those richer in lignin were red-stained; with this double-staining, parenchyma cells were usually blue and the remaining cells were usually red. This made it easier to study the wood patterns in cross-sections. Sections were finally mounted in Canada balsam or Eukitt®. Transmission light microscope was used to observe slides. Polarized filters were applied for observing crystals presence, and for examining the stages of cell wall development. Sections were imaged using a digital camera mounted on the microscope.
**Definition of wood anatomical features**

The wood anatomy of coniferous woods was described following the IAWA list of microscopic features for softwood identification (Richter *et al.* 2004).

The wood anatomical characters for hardwoods were described on the basis of the IAWA List of Microscopic Features for Hardwood Identification (Wheeler *et al.* 1989). As this list is proposed for tree and shrub woods, it was slightly modified to fit with the anatomical features observed in the collected samples. In particular a number of complementary features or character states were inserted following the “Definition of anatomical features” proposed by Schweingruber *et al.* (2011). At the same time some IAWA features were not considered at all because of their uncertain determination in the observed samples.

Next pages give a short description of all the wood anatomical features detected in the observed samples. Full color pictures will accompany those features which do not belong to IAWA Hardwood List (Wheeler *et al.* 1989). These features can be discriminated by the general appearance as “X.#” where “X” is the modified relative IAWA character number and “#” is a consecutive number.

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**Growth rings distinctness**

1 - *Growth rings distinct*  

Growth rings with an abrupt structural change at the boundaries between them. Growth rings number can be easily and exactly determined.

1.1 - *Clearly demarcated rings only along some radii*  

The change at the boundaries between rings is visible only along some radii or only in between some parenchyma rays. This character may present a solution to the problem of ambiguous differences between “indistinct” and “distinct” growth ring boundaries and the presence of intermediates between them.
2 - Growth rings
*indistinct or absent*

Growth ring boundaries marked by more or less gradual structural changes at their poorly defined boundaries, or not visible. Growth ring number cannot be easily determined and their number is uncertain.

2.1 - Only one ring

Only one growth ring is present in the observed sample. This feature was used for annual plants, for perennial specimens that did not show any annual growth ring delimitation, and for 1-year-old twig samples.

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**Wood porosity**

3 - Wood ring-porous

Wood in which the earlywood vessels are distinctly larger (greater than 6 times in diameter) than those in the latewood of the previous and of the same growth ring, and form a well-defined zone or ring,
Transitional structures between features 3 and 4, and 4 and 5 may occur even within different growth rings of the same individual. In such cases both features were marked and described as present.

Vessel arrangement

4 - Wood semi-ring-porous
Wood in which the vessels in the earlywood are distinctly larger (3 to 5 times) than those in the latewood of the previous growth ring, but in which there is a gradual diameter decrease to narrower vessels in the latewood of the same growth ring. Earlywood vessels are generally closely spaced. This intermediate condition between ring-porous and diffuse-porous may occur even within an individual, in different growth rings or in different regions of the same growth ring.

5 - Wood diffuse-porous
Wood in which the vessels have more or less the same diameter throughout the entire growth ring. This category also includes woods in which the latest formed vessels in the latewood are considerably smaller than those of the earlywood of the next ring, but in which the vessel diameter is uniform throughout most of the growth ring.

Transitional structures between features 3 and 4, and 4 and 5 may occur even within different growth rings of the same individual. In such cases both features were marked and described as present.

Vessel arrangement

6 - Vessels in intra-annual tangential bands
Vessels arranged perpendicular to rays and forming discontinuous short or continuous tangential bands. These bands can be straight or wavy, and can or cannot change shape and dimension crossing a ray.

7 - Vessels in diagonal and/or radial pattern
Vessels arrangement intermediates between tangential and radial (dendritic). Transition between diagonal and dendritic distribution may occur within an individual. In ring-porous woods, only the intermediate wood and latewood was examined.

8 - Vessels in dendritic pattern
Vessels arranged in a branching pattern, forming distinct tracts, separate by areas without vessels.

Solitary vessels

9.0 - Vessels predominantly solitary
Most of the vessels (as opposed to “90% or more,” IAWA character list) appear not to contact another vessel. Vessels are in pairs only by chance, most apparent pairs actually are overlapping ends of vessels elements as seen in transverse sections.
Vessel groupings

9.1 - Vessels in radial multiples of 2 to 4 common
Commonly radial files of 2 to 4 vessels in contact.

10 - Vessels in radial multiples of 4 or more common
Commonly radial rows of 4 or more adjacent vessels.

11 - Vessel (predominantly) in clusters
Groups of 3 or more vessels having both radial and tangential contacts. Groups about as wide radially as tangentially.

In the common situations in which vessels are partly solitary, partly in radial multiples, or partly in small clusters all the characters were marked and described. This is in contrast to considering the absence of IAWA features 9, 10, and 11 as “the most common vessel grouping”.

Perforation plates

13 - Simple perforation plates
Perforation plates with a single circular or elliptical opening.

14 - Scalariform perforation plates
Perforation plates with elongated and parallel openings separate by one to many mainly unbranched bars.

19 - Foraminate perforation plates
Perforation plates with circular or elliptical openings like a sieve; the remaining wall portions can be thicker than in the reticulate type (e.g. Ephedra spp.).
Bars number in scalariform perforation plates
15 - Scalariform perforation plates with \( \leq 10 \) bars.
16 - Scalariform perforation plates with 10 - 20 bars.
17 - Scalariform perforation plates with 20 - 40 bars.
18 - Scalariform perforation plates with \( \geq 40 \) bars.

Intervessel pit arrangement
20 - Intervessel pits scalariform Horizontally elongated or linear intervessel pits arranged in a ladder-like series.
21 - Intervessel pits opposite Intervessel pits arranged in short to long horizontal rows across the length of the vessel.
22 - Intervessel pits alternate Intervessel pits arranged in diagonal rows.

Intervessel pit size
Horizontal diameter of a pit chamber at the broadest part was measured for all pits type (note: IAWA list suggest not measuring size of intervessel pits in scalariform pits).
24 - Intervessel pits minute \( \leq 4 \) \( \mu m \).
25 - Intervessel pits small 4 - 7 \( \mu m \).
26 - Intervessel pits medium 7 - 10 \( \mu m \).
27 - Intervessel pits large \( \geq 10 \) \( \mu m \).

Vessel-ray pits
30 - Vessel-ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell.
31 - Vessel-ray pits rounded or angular with large apertures.
32 - Vessel-ray pits with large horizontal apertures.

Vessel helical thickenings
36 - Helical thickenings in vessel elements present Ridges on the inner face of the vessel element in a roughly helical pattern. Very thin and thick helical thickenings were marked and described.
39 - Helical thickenings only in narrower vessel elements Narrower does not means always latewood vessels.
Vessels cell wall thick

39.1 - *Vessels cell wall thickness* ≥ 2 μm. This feature is well seen if the vessels cell wall is thicker than surrounding cell tissues.

Mean tangential diameter of vessel lumen

In transverse sections the tangential diameter of the earlywood vessel lumina, excluding the wall, was measured at the widest part of the opening. In ring-porous woods and woods with two distinct diameter classes, only the larger size vessel classes are determined.

40.1 - *Mean tangential diameter of earlywood vessel lumina* ≤ 20 μm.
40.2 - *Mean tangential diameter of earlywood vessel lumina* 20 - 50 μm.
41 - *Mean tangential diameter of earlywood vessel lumina* 50 - 100 μm.
42 - *Mean tangential diameter of earlywood vessel lumina* 100 - 200 μm.
43 - *Mean tangential diameter of earlywood vessel lumina* ≥ 200 μm.

Vessels dimorphism

45 - *Vessels of two distinct diameter classes* Wood with a distinct bimodal distribution of tangential diameters of vessel lumina. Feature applied only to diffuse porous wood.

Vessels per square millimeter

Every vessel was counted, regardless of type of vessel grouping. No data were collected for ring porous woods because of the ambiguity in the determination of the feature.

46 - *Earlywood vessels per square millimeter* ≤ 5.
47 - Earlywood vessels per square millimeter 5 - 20.
48 - Earlywood vessels per square millimeter 20 - 40.
49 - Earlywood vessels per square millimeter 40 - 100.
50.1 - Earlywood vessels per square millimeter 100 - 200.
50.2 - Earlywood vessels per square millimeter ≥ 200.

Mean earlywood element length
52.1 - Earlywood vessel element length less than 50 µm
52.2 - Earlywood vessel element length 50-100 µm
52.3 - Earlywood vessel element length 100-200 µm
53.1 - Earlywood vessel element length 200-500 µm
53.2 - Earlywood vessel element length greater than 500 µm

Tyloses and deposits
56 - Tyloses common Outgrowths from an adjacent ray or axial parenchyma cell through a pit in a vessel wall, partially or completely blocking the vessel lumen, and of common occurrence.
58 - Gums and other deposits in heartwood vessels and/or fibers A wide range of substances in vessels and/or fibers lumen was noted.

Imperforate tracheary elements
60 - Vascular/vasicentric tracheids present Imperforate cells resembling in size, shape, pitting, and wall ornamentation narrow vessel elements and intergrading with the latter. Also including imperforate cells with numerous distinctly bordered pits in their radial and tangential walls, present around the vessels, and different from ground tissue fibers.

Ground tissue fiber pits
61 - Fibers with simple to minutely bordered pits Fibers (libriform fibers) with simple pits or bordered pits with the chambers less than 3 µm in diameter.
62 - Fibers with distinctly bordered pits Fibers (or fiber-tracheids or ground tissue tracheids) with bordered pits with chambers over 3 µm in diameter.
Fiber helical thickening
64 - *Helical thickenings in ground tissue fibers* Helical thickenings in ground tissue fibers, or ridges on the inner face of the fiber wall in a roughly helical pattern.

Septate fibers
65 - *Septate fibers present* Fibers with thin, unpitted, transverse wall(s). They are mostly un lignified and blue-stained.

Fiber bands
67 - *Parenchyma-like fiber bands alternating with ordinary fibers* Tangential bands of relatively thin-walled fibers alternating with bands of thicker-walled fibers.

Fiber wall thickness
68 - *Fibers very thin-walled* Fiber lumina 3 or more times wider than the double wall thickness.
69 - *Fibers thin- to thick-walled* Fiber lumina less than 3 times the double wall thickness, and distinctly open.
70 - *Fibers very thick-walled* Fiber lumina almost completely closed.

The intermediate character 69,70 was used to describe “thick to very thick” wall in fibers

Tension wood
70.2 - *Tension wood present* The gelatinous layer, blue-stained, is visible in fibers. Gelatinous layers usually separated from the other cell wall layers during sectioning.

*Acer pseudoplatanus* L. (40x)  *Ceratonia siliqua* L. (100x)
Flat marginal fibers

70.3 - Radial flat marginal fibers
Thick fibers that form a more or less continuous layer of variable width at the margins of a growth ring.

![Scabiosa cyprica Post (40x)](image1) ![Lonicera etrusca Santi (40x)](image2)

Axial parenchyma

75 - Axial parenchyma absent, extremely rare, or not recognizable.

Apotracheal axial parenchyma

76 - Axial parenchyma diffuse
Single parenchyma strands or pairs of strands distributed irregularly among the fibrous elements of the wood.

77 - Axial parenchyma diffuse-in-aggregates
Parenchyma strands grouped into short discontinuous tangential or oblique lines.

Paratracheal axial parenchyma

78 - Axial parenchyma scanty paratracheal
Occasional parenchyma cells associated with the vessels, usually related to paratracheal diffuse parenchyma, which are immediately adjacent to vessels.

79 - Axial parenchyma vasicentric
Parenchyma cells forming a complete sheath of parenchyma around a solitary vessel or vessel multiple.

83 - Axial parenchyma confluent
Coalescing vasicentric or aliform parenchyma surrounding or to one side of two or more vessels, and often forming irregular bands.

84 - Axial parenchyma
Paratracheal parenchyma forming semi-circular
unilateral paratracheal hoods or caps only on one side of the vessels and which can extend tangentially or obliquely in an aliform or confluent or banded pattern

**Banded parenchyma**

Numerous kinds of parenchyma bands were described: independent of the vessels (apotracheal), definitely associated with the vessels (paratracheal) or both.

85 - Axial parenchyma bands greater than three cells wide (e.g. Ficus).

86 - Axial parenchyma in narrow bands or lines up to three cells wide (e.g. Quercus).

89 - Axial parenchyma in marginal or in seemingly marginal bands

89.1 - Parenchyma marginal thin walled, dark in polarized light.

Parenchymatous bands that form a more or less continuous layer of variable width at the margins of a growth ring.

Parenchyma cells without secondary wall do not reflect polarized light and appear as dark zones.

89.2 - Ring shake

Thin walled parenchyma cell rings that typically break along the ring boundary during sample preparation procedures (e.g. Saxifraga).
Ray width

According to IAWA Hardwood list (1989) rays width was determined on the tangential section by counting the number of cells on the widest part of the rays, perpendicular to the ray axis. When rays are of two distinct sizes (feature 103), the width of the larger size class was used.

96 - Rays exclusively uniseriate

96.1 - Rays

predominantly uniseriate

90% or more rays are uniseriate, the remaining rays are usually 1 to 3 seriate

97 - Ray width mostly 1 - 3 cells

98 - Larger rays commonly 4 - 10 seriate
99 - Larger rays commonly greater than 10 seriate

Stem lobed

99.2 - Stem lobed

The external shape of the stem in transverse section is not roundish, but is divided in multiple parts by radial fissures of various depth.

Fumana thymifolia (L.) Verlot (4x)

Ray height

100 - Rays with multiseriate portion(s) as wide as uniseriate portions

100.1 - Rays confluent

Lateral border of ray (tangential section) merges with axial tissue.

Lycium schweinfurthii Dammer (200x)  Salvia lanigera Poir. (200x)
Rays unliignified

100.2 - Rays become invisible in polarized light

Aggregate rays

101 - Aggregate rays Lateral border of ray (tangential section) merges with axial tissue.

Ray height

102 - Ray height > 1 mm The large rays commonly exceeding 1 mm in height.

Rays of two distinct sizes

103 - Rays of two distinct sizes When viewed in tangential section, rays form two distinct populations by their width and usually also by their height.

Ray cellular composition

104 - All ray cells procumbent.
105 - All ray cells upright and/or square.
106 - Body ray cells procumbent with one row of upright and/or square marginal cells.
107 - Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells.
108 - Body ray cells procumbent with over 4 rows of upright and/or square marginal cells.
109 - Rays with procumbent, square and upright cells mixed throughout the ray.
Rays per millimeter
The number of rays per linear unit was determined from a transverse section along a line perpendicular to rays. This procedure permitted measurement of the number of rays per millimeter exclusively in latewood.

114 - Rays per millimeter ≤ 4/mm.
115 - Rays per millimeter 4-12/mm.
116.1 - Rays per millimeter 12-20/mm.
116.2 - Rays per millimeter ≥ 20/mm.

Wood rayless
117 - Wood rayless Wood without apparent radial elements evaluated in tangential section.

Storied structure
Storied structure refers to cells arranged in horizontal series as viewed in tangential section.

119 - Low rays storied, high rays not storied and axial parenchyma and/or vessel elements storied.
120 - Axial parenchyma and/or vessel elements storied.
121 - Axial parenchyma and/or vessel elements storied and fibers storied.

Oil cells
124 - Oil and/or mucilage cells associated with ray parenchyma.

Radial canals
130 - Radial canals Tubular intercellular duct surrounded by an epithelium present in rays.

Successive cambia (included phloem)
133.1 - Concentrically Vascular bundles are separate from one other.
arranged single vascular bundles
133.2 - Concentric continuous

The successive cambia produce continuous tangential band of lignified xylem and discontinuous radial strips of unliignified parenchyma and phloem.

Prismatic crystals

136 - Prismatic crystals present

Solitary rhombohedral or octahedral crystals composed of calcium oxalate, which are birefringent under polarized light.

136.1 - Prismatic crystals in ray parenchyma cells

141.1 - Prismatic crystals in axial parenchyma cells
Crystal druses

144 - Druses present
Compound crystal, more or less spherical in shape, in which the many component crystals protrude from the surface giving the whole structure a star-shaped appearance.

145 - Druses in ray parenchyma cells

146 - Druses in axial parenchyma cells

Other crystals

149 - Raphides
Bundle of long needle-like crystals.

150 - Acicular crystals
Small needle-like crystals, not occurring in bundles.

151 - Styloids and/or elongate crystals
Crystals at least four times as long as broad with pointed or square ends.

153 - Crystal sand
A granular mass composed of very small silicate crystals.

Definition of bark macroscopical features

A huge variety of different textures can be found in barks of woody plants. I tried to apply to my samples the Vaucher (2003) classification of bark textures, which describe external appearance of barks into 18 different types. The classification was in many cases too ambiguous in its practical applications, and it was not possible to classify the barks by macroscopic features.

Definition of bark anatomical features

The term bark designate all the tissues outside the vascular cambium (Trockenbrodt 1990). In the secondary state, bark includes the secondary phloem, the primary tissues that may be still present outside the secondary phloem, the periderm, and the dead tissues outside the periderm (Evert 2006). Bark anatomical features were anatomically described in a number of papers and plant anatomy books (Baas 2001, Carlquist 1992b, Chang 1954, Evert 2006, Howard 1977, Junikka 1994, Ley-Yadun 1991, Machado et al. 2005, Manwiller 1972, Metcalfe & Chalk 1950, Miles & Smith 2009, Schweingruber 2006, Trockenbrodt 1990, Zahur 1959). I followed the available literature to find out the following codified list of features used in bark anatomy descriptions.
Sieve tubes

B1 - Groups of 3 or more sieve tubes

Groups of sieve tubes can be recognized among other phloem cells of the axial system.

B1.1 - Sieve tube arrangement in tangential rows

Tangentially distributed sieve tube groups can be recognized among other phloem cells of the axial system.

B1.2 - Sieve tube arrangement in radial rows

Sieve tubes in more or less long continuous radial files.

B2 - Collapsed sieve tubes present

Sieve tubes are more or less collapsed or obliterated.

Ray dilatation

B3 - Distinct ray dilatation

All rays become dilated by cell expansion. Dilatation can occur by tangential increase of the number of ray cells, by expansion of ray cells, or both.

B3.1 - Only some rays become dilated

Usually larger rays become dilated.
Bark cellular composition

B4 - Sclerenchyma cells present both in phloem and cortex

Both fibers and sclereids are present in phloem and in cortex.

B8 - Phloem uniform

Composed only of sieve tubes and parenchyma cells, sclerenchyma cells are not present.

Fibers

B5 - Fibers present

Fibers are more or less thick walled, lignified and elongated. In primary phloem (visible in twig
samples), fibers occur in the outermost part of the tissue. In the secondary phloem fibers are present in various distributional patterns among other phloem cells of the axial system (see below). The fibers innermost layer, which has a structure quite similar to gelatinous layer in tension wood fibers, is unlignified (blue stained).

B5.0 - Fibers with unlignified innermost layer

Vinca major L. (100x)

B5.1 - Fibers in radial rows

Single or few cells wide rows of fibers are few cells wide in radial direction.

Alyssum chondrogynum B.L. Burtt (40x)

B5.2 - Fibers in tangential bands

Tangentially continuous fiber rows or bands, more or less alternating with bands containing sieve tubes and parenchymatous components of the axial system.
**B5.3 - Fibers scattered or irregularly dispersed**

Single fiber cells dispersed in phloem.

**B5.4 - Fibers grouped**

3 to more cells per group; groups irregularly or tangentially distributed in phloem.
**Sclereids**

*B6 - Sclereids present*  
Sclereids are very thick walled, lignified and relatively short cells (sclereid length variation is often present even within an individual). Sclereids’ secondary wall typically appears multilayered. Sclereid arrangement was described as fiber arrangement.

*B6.1 - Sclereids in radial rows*
*B6.2 - Sclereids in tangential bands*
*B6.3 - Sclereids scattered or irregularly dispersed*
*B6.4 - Sclereids grouped*

**Crystals**

*B7 - Prismatic crystals present.*
*B7.1 - Acicular crystals present.*
*B7.2 - Druses present.*
*B7.3 - Crystal sand present.*
*B9 - Raphides present.*

**Secretory elements and canals**

*B10 - With single, irregularly dispersed laticifers or ducts*
*B10.2 - Ducts.*

*Pistacia lentiscus* L. (100x)
B10.3 - Laticifers or intercellular canals.

Cell content

B11 - Cell contents in parenchyma cells.

Phellem

B14 - Phellem not clearly distinct

The cellular composition doesn’t permit clear separation between phloem and phellem.
B14.1 - Phellem homogeneous
Phellem distinct, consists of regularly arranged square or rectangular cells.

B14.2 - Phellem heterogeneous
Phellem distinct, consists of irregular shaped cells.

B14.3 - Phellem and/or epidermis distinct in polarized light.

B14.4 - Lignified cells in phellem
**B16 - Layered phellem**
Phellem composed of alternating bands of sclerenchyma and parenchyma tissues.

**Phelloderm**

**B18 - Layered phelloderm**
Phelloderm composed of alternating bands of sclerenchyma and parenchyma tissues.

**Definition of pith anatomical features**
Only very few paper and books describe the pith structure (Carlquist 1992b, Metcalfe e Chalk 1950, Oslon 2005, Piccioli 1919, Schweingruber 2007). The following list of features was defined by looking at the feature in the slides, not on the base of the available literature.

**Pith not visible in polarized light**

**P0.1 - Pith not visible in polarized light**
If the sample is observed in polarized light the pith area becomes completely black.

**Pith shape**

**P1 - Pith shape round**
The shape of the pith in transverse section is round or roundish to oval.

**P1.1 - Pith shape polygonal**
Pith shape with at least four straight sides and angles: rhomboid, hexagonal, irregular and star shaped. Triangular and pentagonal shapes are not described in this features (see P1.2 and P1.3).
P1.2 - Pith shape
triangular

Pith shape with three straight sides and angles.

Citrus paradisi Macfad. (4x)  Zygophyllum album L. (4x)

P1.3 - Pith shape
pentagonal

Pith shape with at five straight sides and angles.

Rubus discolor Weihe et Nees (2x)

P1.4 - Pith shape
square, rectangular

Pith shape with at four straight sides and angles.

Lantana camara L. (20x)  Micromeria cypria Kotschy (100x)
**Medullary sheath**

*P2 - Medullary sheath*  
A layer of thick-walled cells surrounding the pith.

**Pith cellular composition**

*P3 - Heterocellular pith*  
Different cell types in various distributional patterns occur among parenchymatic cells.

*P3.1 - Sclereids present*  
Sclereids in the pith.
P3.2 - Fibers present

Fibers in the pith.

Eucalyptus camaldulensis Dehnh. (40x)

P3.3 - Thick walled parenchyma cells present

Parenchyma cells with thick cell walls present.

Brassica hilarionis Post (100x)

P3.4 - Unlignified cells present

Pith completely or in part composed of unlignified cell walls. In safranin and astra-blue stained sections this cells appear blue.

Coronilla emerus L. (40x)
Cells of different shape and size occur throughout the pith.

Pith consisting of cells in two zones: different size and/or shape in pith center than in pith periphery.

Numerous kinds of substances visible in cell lumen (gum, tannins, dark staining substances).
Pith crystals

P6 - Prismatic crystals present.
P6.1 - Acicular crystals present.
P6.2 - Crystal druses present.
P6.3 - Raphides present.
P6.4 - Crystal sand present.

Pith canals

P7 - Laticifers or intercellular canals

Tube-like canals without border cells.

Zizyphus zizyphus (L.) Meikle (200x)

P8 - Intercellular canals with border cells

Schinus terebinthifolius Raddi (40x)
Pith cell pits

*P9 - Pits in longitudinal cell walls (radial section)*
Simple pits present in longitudinal pith cell walls.

*P9.1 - Pits in transverse cell walls*
Simple pits present in transverse pith cell walls.

*P9.2 - Pits grouped*
Simple pits aggregated into clusters of 2 or more in longitudinal and/or in transverse cell walls.

*Fagonia cretica* L. (200x)

*P9.3 - Pits of two distinct size and/or shape*
Pits of two distinct diameters or shapes in longitudinal and/or in transverse cell walls.

Primary vascular bundle

*P10 - Vascular bundles in the pith*
Vascular bundles completely embedded in the pith.
P10.1 - Primary vascular bundle separated from one another

Single vascular bundles are clearly separated from one another by rays or fibers.

P10.2 - Primary vascular bundle not distinct

Radial files of 2 or more tangentially adjacent primary vessels easily recognizable.

P13 - Axial cells arranged in regular rows

Pith cells in regularly arranged vertical rows, observed in radial section.
Results: wood, bark and pith anatomical descriptions

General anatomy was described recording the presence of anatomical features listed in the codified anatomical characters lists. Conifers and Angiosperms wood anatomies were described by the specific IAWA lists of anatomical features (Richter et al. 2004, Wheeler et al. 1989), including the added features presented in the previous chapter. Bark and pith anatomies were described by the new codified lists specifically developed in this work. The description of each species starts with a short overall plant description which comprehends its life form, plant height, and soil type where it usually grows. The description of the anatomical features for stem wood, juvenile bark and pith are presented for each species. Wood features are described separately from each one of the three anatomical sections (transverse, radial and tangential). Each description is completed by the codified list of anatomical features for wood, bark (codes start with the capital letter “B”) and pith (codes start with the capital letter “P”). After the plant name is indicated the plate number in annex 1 for photomicrograph.

Cupressaceae

*Cupressus sempervirens* L.
(Annex 1, plate no. 1)

Evergreen tree up to 30 m in height, with broad or, most commonly, conical crown. Native to eastern Mediterranean and northern Iran. Low demanding species (0-1400 m alt.).

**Xylem**

Transverse section: Growth ring boundaries distinct. Latewood tracheids thin walled (double wall thickness less than radial lumen diameter). Axial parenchyma present, diffuse and tangentially layered.

Tangential section: Average ray height medium (5 to 15 cells). Rays in part 2-3 seriate.

Bark

Pith

Codified description
28 32 34 40 44 50 54 56 72 73 74 76 80 85 87 92 98 103 108 — B1.2 B4 B5 B5.2 B7.3 B14.3 — P1.1 P3.3 P4 P9 P9.1 P9.3 P10.2

_Juniperus excelsa_ M.Bieb.
(Annex 1, plate no. 1)

Evergreen tree up to 20 in height; crown at first pyramidal, broadly branched in mature trees. Native to Balkans, Crimea, Turkey and eastwards as far as Afghanistan. Indigenous to Cyprus, restricted to the Troodos range (1200-1650 m alt.).

Xylem

Bark
Pith
Pith shape triangular. Thick walled parenchyma cells present. Pits in transverse and in longitudinal cell walls. Primary vascular bundle not distinct.

Codified description
30 33 40 44 48 53 55 56 72 73 76 80 86 87 93 98 102 107 111 — B1.2 B2 B3 B4 B5 B5.2 B7.3 B10 B10.2 B14.1 B14.3 B16 — P1.2 P3.3 P9 P9.1 P10.2

**Juniperus foetidissima** Willd.
(Annex 1, plate no. 1)

Evergreen tree up to 20 in height; with conical or pyramidal crown. Native to Greece, Turkey, Caucasia and Syria. Indigenous to Cyprus, restricted to the Troodos range (1400-1950 m alt.).

Xylem
Transverse section: Growth ring boundaries distinct. Latewood tracheids thin walled (double wall thickness less than radial lumen diameter). Axial parenchyma present, diffuse and tangentially zonate.
Tangential section: Average ray height very low (up to 4 cells) to medium (5 to 15 cells). Rays exclusively uniseriate.

Bark

Pith
Pith shape round. Thick walled parenchyma cells present. Pits of two distinct size in transverse and in longitudinal cell walls. Primary vascular bundle not distinct.

Codified description
26 33 35 40 44 48 54 56 72 73 74 76 80 86 88 93 98 102 103 107 — B1.1 B4 B5 B5.2 B5.3 B 7.3 B14.1 B14.3 B16 B18 — P1 P3.3 P9 P9.1 P9.3 P10.2
**Juniperus phoenicea** L.
(Annex 1, plate no. 2)

Evergreen tree up to 10 in height; with conical crown. Widely distributed in the Mediterranean region. Indigenous to Cyprus, occurring in costal maquis (0-500 m alt.).

**Xylem**
Transverse section: Growth ring boundaries distinct. Latewood tracheids thick walled (double wall thickness larger than radial lumen diameter). Axial parenchyma present, tangentially zonate.
Tangential section: Average ray height very low (up to 4 cells). Rays exclusively uniseriate.

**Bark**

**Pith**
Pith shape polygonal. Thick walled parenchyma cells present. Pits in transverse and in longitudinal cell walls. Primary vascular bundle not distinct.

**Codified description**
26 33 35 40 44 55 56 72 74 76 80 86 88 93 98 102 107 — B1 B2 B3.1 B4 B5 B5.3 B7.3 B14.1 B14.3 B16 — P1.1 P3.3 P9 P9.1 P10.2

**Juniperus oxycedrus** L.
(Annex 1, plate no. 2)

Evergreen shrub or tree up to 8 m in height, with rounded or conical crown. Indigenous species thriving on rocky mountainsides (700-1500 m alt.). Widely distributed from southern Europe eastwards to the Caucasus and northern Iran.

**Xylem**
Transverse section: Growth ring boundaries distinct. Latewood tracheids thick walled (double wall thickness larger than radial lumen diameter).

Tangential section: Average ray height very low (up to 4 cells). Rays exclusively uniseriate.

Bark

Pith

Codified description
30 33 40 44 48 55 56 79 86 93 98 102 107 – B3 B4 B5 B5.2 B7.3 B10 B10.2 B11 B14.1 B14.3 B16 – P1 P3.3 P5 P9 P9.1 P10 P10.2

**Pinaceae**

*Cedrus brevifolia* (Hook. F.) Henry
(Annex 1, plate no. 2)

Evergreen trees up to 30 m in height. The crown, at first pyramidal, gradually becoming broad, with characteristics horizontal branching in older trees. Endemic to Cyprus, restricted to the Cedar Valley of the Pafos forest (900 - 1400 m alt.).

Xylem
Transverse section: Growth ring boundaries distinct. Latewood tracheids thick walled (double wall thickness larger than radial lumen diameter).


Tangential section: Average ray height high (from 16 to 30 cells). Rays exclusively uniseriate.
Bark

Pith

Codified description

Pinus brutia Ten.
(Annex 1, plate no. 3)

Evergreen tree up to 40 m in height. Indigenous to Cyprus, it is the dominant forest species on the island occurring almost everywhere (0-1400 m alt.). Native to southern Italy, eastwards to northern Iran and Caucasus.

Xylem

Bark
Pith

Codified description

*Pinus nigra* J.F. Arnold subsp. *pallasiana* (Lamb.) Holmboe
(Annex 1, plate no. 3)

Evergreen tree up to 40 m in height. Indigenous to Cyprus, in occurs on the highest slopes of Troodos where it forms extensive forests (1100-1400 m alt.). It also occurs in the Balkan Peninsula, Turkey, Caucasia, Crimea and the Carpathians.

Xylem
Transverse section: Growth ring boundaries distinct. Latewood tracheids thick walled (double wall thickness larger than radial lumen diameter). Axial intercellular resin canals present with epithelial cells thin-walled.
Tangential section: Average ray height medium (5 to 15 cells). Rays exclusively uniseriate. Radial intercellular resin canals present.

Bark

Pith
Pith shape polygonal. Heterocellular pith, with sclereids. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separated each other.

Codified description
**Pinus pinea** L.  
(Annex 1, plate no. 3)

Evergreen tree up to 30 m in height. Exotic to Cyprus, widely cultivated in gardens and plantations (0-140 m alt.). Native of the Mediterranean region and Portugal.

**Xylem**  
Transverse section: Growth ring boundaries distinct. Latewood tracheids thin walled (double wall thickness less than radial lumen diameter). Axial intercellular resin canals present. Epithelial cells thin-walled.  
Tangential section: Average ray height very low (up to 4 cells). Rays exclusively uniseriate. Radial intercellular resin canals present.

**Bark**  

**Pith**  

**Codified description**  

**Ephedraceae**  
(Annex 1, plate no. 4)

Evergreen, erect or climbing, much branched shrub, with stem up to 3 m long. Native species in the eastern Mediterranean basin. It occurs in maquis, garigue and on rocky slope (0-900 m alt.).
Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous, vessels predominantly solitary. Mean tangential diameter of earlywood vessels 20-50 μm, greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled, radial flat marginal fibers. Axial parenchyma extremely rare or not to recognizable, sometimes scanty paratracheal. Rays per millimeter 4-12.
Radial section: Foraminate perforation plates. Intervessel pits medium (7-10 μm in diameter). Earlywood vessel elements length greater than 500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright or square.
Tangential section: Ray width predominant 1 to 3 cells. Dark staining substances in ray cells.

Bark
Groups of sieve tube and collapsed sieve tubes present. Only some rays become slightly dilated. Fibers and sclereids present, both scattered or irregularly dispersed. Crystal sand. Phellem homogenous. Epidermis distinct in polarized light.

Pith
Pith shape roundish. Large cells in the center, smaller at the border of the pith. Primary vascular bundle clearly separate from one other.

Codified description
1 4 9 19 26 40.2 50.2 53.2 58 62 69 70.3 75 78 97 105 115 — B1 B2 B3.1 B5 B5.3 B6 B6.3 B7.3 B14.1 B14.3 — P1.1 P4.1 P10.1

_Ephedra nebrodensis_ Guss.
(Annex 1, plate no. 4)

Evergreen shrub up to 1 m in height. Indigenous to the Mediterranean countries and the countries eastwards to Iran, Afghanistan and central Asia. Rare in Cyprus. It occurs on rocky slopes, in maquis, and garigue (600-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels less than 20 μm, 5 – 20 earlywood vessels per square millimeter. Fibers thin to thick walled. Axial parenchyma diffuse and scanty paratracheal. Apotracheal parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 4-12.
Radial section: Foraminate perforation plates. Intervessel pits large (greater than 10 μm in diameter). Vessels-ray pits with distinct borders, similar to intervessel pits in size and shape throughout the ray cell. Earlywood vessel
elements length greater than 500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Crystal sand where?
Tangential section: Ray width predominant 1 to 3 cells.

Bark

Pith

Codified description
1 3 9 19 27 30 40.1 47 53.2 62 69 76 78 86 97 105 115 152 - B1 B2 B4 B6.3 B7.3 B11 B18 - P1 P2 P4 P5 P10.1 P10.2 P13

**Aceraceae**

*Acer obtusifolium* Sibth. & Sm.
(Annex 1, plate no. 4)

Small evergreen tree or large shrub up to 10 m in height. Mediterranean species, native to Cyprus. Thriving on rocky slopes and pine forests in mountain range (0-1200 m alt.).

Xylem
Transverse section: Growth ring distinct, wood diffuse-porous. Vessels predominantly solitary or in radial multiples of 2 to 4 elements. Mean tangential diameter of earlywood vessels 20-50 μm; greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled, marginal fibers radially flattened. Tension wood present. Axial parenchyma scanty paratracheal to vasicentric. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Intervessel pits alternate, large (greater than 10 μm diameter). Vessel-ray pits with distinct borders, similar to intervessel pits in size and shape throughout the ray cell. Helical thickenings in vessel elements. Earlywood vessel elements length up to 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). Central ray cells procumbent with one row of squared marginal cells. Prismatic crystals in axial parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and up to 5 cells wide. Some of the larger rays greater than 1 millimeter in height.
Bark

Pith
Pith shape roundish. Parenchyma cells in to distinct shapes: most of them polygonal thin walled, and few roundish thick walled. Cell content. Prismatic crystals present. Pits in transverse and in longitudinal cell walls. Some primary vascular bundle clearly separate from one other some other not distinct. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9 9.1 13 22 26 30 36 40.2 50.2 53.1 61 69 70.2 70.3 78 79 96 97 102 103 106 116.1 136 141.1 194 200 — B1 B2 B3.1 B4.1 B5 B5.2 B6.2 B7 B14.1 B14.3 — P1 P3.3 P4 P5 P6 P9 P9.1 P10.1 P10.2 P13

*Acer pseudoplatanus* L.
(Annex 1, plate no. 5)

Deciduous tree up to 30 m in height. Indigenous to northern and central Europe, Greece, Caucasus area and Armenia. Exotic to Cyprus. It can be found mainly in road side plantations on mountain range (1000-1700 m alt.).

Xylem
Transverse section: Growth ring distinct, wood diffuse-porous. Vessels predominantly solitary or in radial multiples of 2 to 4 elements. Mean tangential diameter of earlywood vessels 20-50 μm; greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled, marginal fibers radially flattened. Tension wood present. Axial parenchyma scanty paratracheal to vasicentric. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Intervessel pits alternate, large (greater than 10 μm diameter). Vessel-ray pits with distinct borders, similar to intervessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements. Earlywood vessel elements length up to 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). Central ray cells procumbent with one row of squared marginal cells. Prismatic crystals in axial parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and up to 5 cells wide. Some of the larger rays greater than 1 millimeter in height.

Bark
Groups of sieve tubes and collapsed sieve tubes present. Some rays become slightly dilated. Fibers and sclereids in tangential rows. Prismatic crystals.
Phellem homogeneous. Epidermis distinct in polarized light.

Pith
Pith shape roundish. Parenchyma cells in to distinct shapes: most of them polygonal thin walled, and few roundish thick walled. Cell content. Prismatic crystals present. Pits in transverse and in longitudinal cell walls. Some primary vascular bundle clearly separate from one other some other not distinct. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9 9.1 13 22 26 30 36 40.2 50.2 53.1 61 69 70.2 70.3 78 79 96 97 102 103 106 116.1 136 141.1 194 200 — B1 B2 B3.1 B4.1 B5 B5.2 B6.2 B7 B14.1 B14.3 - P1 P3.3 P4 P5 P6 P9 P9.1 P10.1 P10.2 P13

Amaranthaceae

*Bosea cypria* Boiss.
(Annex 1, plate no. 5)

Evergreen shrub, 1-2 m in height. Endemic to Cyprus, occurring on rocky ground, old stone walls and rocky sites with open vegetation (0-650 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pitting pseudoscalariform to reticulate and alternate, small (4-7 μm in diameter). Earlywood vessel elements length 350-800 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Prismatic crystals and druses present.
Tangential section: Rays of two distinct sizes: uniseriate and large 4 to 10 seriate rays. Wider rays height greater than 1 mm.

Bark
Groups of sieve tubes present. Fibers scattered or irregularly dispersed and grouped. Prismatic crystals and crystal sand present. Phellem/epidermis distinct in polarized light.
Pith
Pith shape round. Cells dimorphic. With prismatic crystals and druses. Pits of two distinct sizes, grouped in both longitudinal and transverse cell walls. Primary vascular bundles clearly separate from one another to not distinct. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9 9.1 13 20.1 22 25 40.2 50.2 53 56 58 61 69 78 89 96 98 102 103 105 116.1 133.1 134.1 136 144 — B1 B5 B5.3 B5.4 B7 B7.3 B7.4 B14.3 - P1 P4 P6 P6.2 P9 P9.1 P9.2 P9.3 P10.1 P10.2 P13

**Anacardiaceae**

*Pistacia atlantica* Desf.  
(Annex 1, plate no. 5)

A robust, deciduous tree up to 15 m in height with a massive trunk. It occurs in Greece, Turkey, Caucasus area, Iran, Pakistan and north Africa; indigenous to Cyprus. Found in abandoned fields, field margins and rocky slopes (0-1500 m alt.).

Xylem
Transverse section: Growth rings distinct. Ring porous wood. Vessels solitary, in short radial multiples and in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Fibers thin to thick walled, tension wood present. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 μm. Tyloses and other deposit in heartwood vessels. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one to 3 rows of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells. Tangential section: Gradual transition from uniseriate to 4 cells wide rays. Radial canals with epithelial cells.

Bark
Pith

Codified description
1 3 9 9.1 11 13 22 25 31 36 41 52.3 56 58 61 69 70.2 78 96 97 105 106 107 115 130 136 136.1 - B1 B2 B3.1 B4 B5 B5.2 B5.4 B6 B6.2 B6.4 B7 B10 B10.2 B14.1 B14.3 - P1 P4 P5 P6 P6.2 P9 P9.1 P10.1 P12

Pistacia lentiscus L.
(Annex 1, plate no. 6)

Evergreen, aromatic shrub or small tree up to 4 m in height. It occur in all the Mediterranean countries, in Portugal and Atlantic islands; it is indigenous to Cyprus. Very common on rocky sites, sand dunes and pine forests (0-800 m alt.).

Xylem
Transverse section: Growth ring boundaries distinct. Wood ring porous. Vessels in radial multiples of 4 or more elements, and in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 µm, 40 – 100 earlywood vessels per square millimeter. Fibers thin to thick walled, tension wood present. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Body ray cells procumbent with one row of upright or square marginal cells. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays uniseriate to 3 cells wide. Radial canals with epithelial cells.

Bark

Pith
Pith shape roundish. Thick walled parenchyma cells scattered in the pith. With prismatic crystals. Pits of two distinct sizes in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).
**Rhus coriaria L.**
(Annex 1, plate no. 6)

Deciduous shrub up to 3 in height. Twigs exuding milky latex when broken. It occurs throughout the Mediterranean and eastward to Iran; native to Cyprus. Common on rocky mountainsides, pine forests, maquis, garigue and vineyard sides (600-1600 m alt.).

**Xylem**
Transverse section: Growth ring distinct. Wood ring-porous. Vessels predominantly solitary, in diagonal and/or radial pattern. Mean tangential diameter of earlywood vessel lumina 100 – 200 µm; 20 – 40 earlywood vessels per square millimeter. Tyloses sclerotic common. Fibers thick to very thick walled; radial flat marginal fibers. Axial parenchyma diffuse in aggregates and vasicentric. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium to large (from 7 µm to greater than 10 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present, mostly in narrower vessel elements. Earlywood vessel elements length less than 350 µm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells.
Tangential section: Ray width predominant 1 to 3 cells.

**Bark**

**Pith**
**Schinus molle** L.
(Annex 1, plate no. 6)

Evergreen tree up to 10 m in height, with pendulous branches. A native of South America, it is cultivated in various Mediterranean countries; exotic to Cyprus. Common in roadside plantations *Sideritis* and gardens (0-600 m alt.).

**Xylem**


Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessel-ray pits with large horizontal or vertical apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 µm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. Uniseriate ray cells upright and/or square, multiseriate rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals and dark staining substances in ray parenchyma cells.

Tangential section: Rays uniseriate and up to 3 cells wide.

**Bark**


**Pith**


**Codified description**

1 5 10 11 13 22 24 32 36 40.2 53.1 58 60 61 65 69 70.2 78 96 97 105 109 115 136 136.1 - B2 B3.1 B4 B5 B5.3 B5.4 B7 B10 B14.1 B14.3 - P1 P4 P5 P6 P9 P9.1 P10.1 P10.2 P12 P13
Schinus terebinthifolius Raddi  
(Annex 1, plate no. 7)

Evergreen tree up to 15 m in height. A native of South America, it is cultivated in various Mediterranean countries, exotic to Cyprus. Common in roadside plantation and gardens (0-400 m alt.).

Xylem
Tangential section: Rays uniseriate and up to 3 cells wide. Intercellular radial canals with border cells.

Bark

Pith

Codified description
1 5 9 9.1 13 22 24 32 36 40.1 53.1 58 61 65 69 70.2 78 96 97 106 107 115 130 136 136.1 - B3.1 B4 B5 B5.4 B6 B6.3 B7 B10 B10.2 B11 B14.1 B14.3 - P1 P4 P6 P6.2 P8 P9 P9.1 P10.1 P12

Apocynaceae
Nerium oleander L.  
(Annex 1, plate no. 7)
Evergreen, laticiferous shrub 2-4 m in height. Widespread in the Mediterranean region. Native of Cyprus, very common along stream in coastal areas of the island (0-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary or in radial multiples of 2 to 4 or more elements. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Apotracheal parenchyma diffuse, and in narrow bands or lines up to three cells wide. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. Rays with procumbent, square and upright cells mixed throughout the ray. Few prismatic crystals in ray parenchyma cells.
Tangential section: Rays predominantly uniseriate. Ray width predominant 1 to 3 cells.

Bark
Groups of sieve tubes present. Sclereids scattered or irregularly dispersed. Gelatinous like fibers in groups. Prismatic crystals. With laticifers, secretory elements, oil ducts or mucilage ducts. Phellem homogeneous.

Pith

Codified description
1 5 9 9.1 10 13 22 24 30 40.2 50.2 53.1 61 65 69 76 86 96.1 97 109 116.1 136 136.1 — B1 B4.1 B6 B6.3 B7 B10 B14.1 — P1.1 P1.2 P2 P3 P3.1 P5 P6 P6.2 P9 P9.1 P10

*Thevetia neriifolia* (L.) Juss. ex Endl.
(No photomicrographs available)

Evergreen, laticiferous shrub or small tree 3-5 m in height. Native of America, widely cultivated in many parts of Cyprus, in the lowlands (0-300 m alt.) and sometimes naturalized.
Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays uniseriate to 1-3 cells wide.

Bark
Groups of sieve tube and collapsed sieve tubes present. Sclereids in tangential rows and scattered or irregularly dispersed Prismatic crystals. Phellem homogeneous. Phellem/epidermis distinct in polarized light.

Pith
Pith disappear in polarized light. Unilignified cells. Vascular bundles in the pith. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 5 10 13 22 24 30 40.2 52.3 61 69 70.2 78 96.1 97 105 116.1 - B1 B2 B3.1 B6.2 B6.3 B7 B14.1 B14.3 - P1.1 P3.4 P10 P10.1 P12

*Vinca major* L.
(Annex 1, plate no. 7)

Evergreen creeping subshrub, up to 1 m long. Native of western and central Europe and Mediterranean countries, considered adventive in Cyprus. It is found in gardens and fallow land (0-1600 m alt.).

Xylem
Transverse section: Only one ring in the observed sample. Vessels solitary and in radial multiples of 2 to 4 elements. Mean tangential diameter of earlywood vessels 20-50 μm. Fibers thin to thick walled. Axial parenchyma absent, extremely rare or not to recognizable. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description

Araliaceae

*Hedera helix* subsp. *poetarum* L.
(Annex 1, plate no. 8)

Evergreen climber with aerial roots. Native to Cyprus, growing in moist sites and along streams (100-1600 m alt.). It also occurs in temperate Europe and Asia.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Fibers thin to thick walled. Apotracheal parenchyma diffuse to scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Few inter-vessel pits scalariform. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. All ray cells procumbent, upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and up to 10 seriate. Larger rays height greater than 1 mm.

Bark
Pith
Pith disappear in polarized light. Pith shape round. Medullary sheath present. Unilignified cells that differ in diameter between the center and the border of the pith. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other.

Codified description
1 3 11 13 20 22 26 31 41 53.1 60 61 65 69 76 78 96 98 102 103 104 105 115 - B1 B2 B6 B6.2 B6.3 B14.1 B14.3 - P1 P2 P3.4 P4 P4.1 P9 P9.1 P10.1

Aristolochiaceae

Aristolochia sempervirens L.
(Annex 1, plate no. 8)

Evergreen climber up to 1(3) m in height, with a thick root stock. An indigenous species, growing among trees and shrubs (0-1200 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Unlignified rays cells.
Tangential section: Larger rays commonly greater than 10 seriate. Rays disappear in polarized light.

Bark

Pith
Unlignified cells present. Vascular bundles not distinct.

Codified description
1 3 9 13 22 26 39.1 40.2 45 50.2 52.3 62 69 78 99 100.2 109 114 - B1 B2 B5 B5.2 B6 B6.3 B14.1 B14.3 - P3.4 P10.2
Asclepiadaceae

*Cyprinia gracilis* (Boiss.) Browicz

(Annex 1, plate no. 8)

Deciduous, slender climber reaching greater than 8 m in height. Milky latex in twigs. The genus *Cyprinia* includes a single species, which is indigenous in Cyprus and southern Turkey. In Cyprus it is rather uncommon but not rare (0-1100 m alt.).

**Xylem**


Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 µm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate.

**Bark**

Collapsed sieve tubes. Sclereids scattered or irregularly dispersed and in groups. Prismatic crystals. With laticifers, secretory elements in ducts. Phellem homogeneous, distinct in polarized light.

**Pith**


**Codified description**

1 3 9 9.1 13 22 25 30 42 53.1 62 69 70.3 78 84 96 105 116.2 - B2 B6 B6.3 B6.4 B7 B10 B10.3 B14.1 B14.3 - P1.1 P1 P3.4 P4 P10 P12

Asteraceae

*Achillea cretica* L.

(Annex 1, plate no. 9)

88
Much branched, neatly rounded subshrub up to 50 cm in height. Indigenous to Crete, the Aegean islands and southwest Turkey. A rare species in Cyprus, occurring on rocky slopes near the sea (0-150 m).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Elongated crystals in ray cells.
Tangential section: Rays in a wide in gradual transition from uniseriate to 10 seriate. Larger rays more than 1 mm in height.

Bark
Groups of sieve tubes present. Larger rays become dilated. Fibers and sieve tubes in large groups between rays. Crystal sand.

Pith
Pith shape round. Crystal sand present. Primary vascular bundle clearly distinct from one other.

Codified description
1 5 9.1 11 13 22 25 40.2 45 50.2 58 60 61 69 78 89 96 97 98 102 105 114 136 136.1 - B1 B3.1 B5 B5.2 B5.4 B7.3 - P1 P6.4 P10.1

Ambrosia maritima L.
(Annex 1, plate no. 9)

Aromatic, annual or short-lived perennial herb. It occurs in the Mediterranean region, on sandy seashore or muddy canal banks (0-20 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated only along some radii. Wood diffuse porous. Vessels in radial multiples of 4 or more elements, and in clusters. Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Apotracheal parenchyma cells in
marginal or in seemingly marginal bands, thin walled, dark in polarized light. Less than 4 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright.

Tangential section: Rays of two distinct sizes: uniseriate and up to 10 seriate. Larger rays height greater than 1 mm.

Bark

Pith
Pith disappear in polarized light, round in shape. Not lignified cells trough the all pith. With prismatic crystals and crystals druses. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 1.1 5 10 11 13 22 25 30 40.2 45 50.2 56 60 61 69 78 89 89.1 96 98 102 103 105 114 - B1 B3.1 B5.3 B5.4 B7 B7.3 B14.1 B14.3 - P1 P3.4 P3.4 P6 P6.2 P10.1 P12 P13

_Artemisia arborescens_ L.
(Annex 1, plate no. 9)

Aromatic shrub up to 1 m in height. Widespread in the Mediterranean region. Adventive to Cyprus, found as a relict or escaped to cultivation in hedges, dry stone walls and field borders (50-1400 m alt.).

Xylem

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fine helical thickenings in vessel
elements present. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Most uniseriate rays composed by upright and/or square cells. Multiseriate rays with square, upright and few procumbent cells mixed throughout the ray. Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith
Pith shape round. With crystals druses and crystal sand. Pits grouped and of two distinct size both in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description

*Centaurea akamantis* T.Georgiades et Hadjikyriakou
(Annex 1, plate no. 10)

Subshrub with hanging or sub erect shoots up to 60 cm long. A very rare endemic to Cyprus, confined to the Akamas peninsula (50-100 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated only along some radii. Wood diffuse porous. Vessels predominantly in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels 20-50 μm. Vessels number in earlywood 100-200 per square millimeter. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal to vasicentric. Less than 4 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. All ray cells upright and/or square. Tangential section: Rays of two distinct sizes: uniseriate and up to 10 seriate. Larger rays height greater than 1 mm.
Bark

Pith
Pith shape roundish to pentagonal. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 1.1 5 11 13 22 25 30 39.1 40.2 50.1 60 61 65 69 70 78 79 96 98 102 103 105 114 - B1 B2 B3.1 B5.4 B7.3 B14.1 - P1.1 P9 P9.1 P10.1 P13

*Cichorium spinosum* L.
(Annex 1, plate no. 10)

Intricately branched subshrub up to 50 cm in height. Widely distributed from the Balearics east to Cyprus. Indigenous to the island, occurring on rock-crevices by the sea, and sometimes on sandy fields near the sea (0-200 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and up to 3 cells wide, the latter greater than 1 mm height.

Bark

Pith
Pith disappear in polarized light, polygonal in shape. Unilignified cells. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly
separated each other to not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arrangement in regular rows (radial section).

Codified description
1 5 10 11 13 22 25 30 40.2 45 50.2 60 61 78 89 89.1 96 97 102 103 105 116.2 - B1

*Helichrysum italicum* (Roth) G.Don
(Annex 1, plate no. 10)

Aromatic shrub up to 80 cm in height. Widely distributed in the Mediterranean region. Indigenous to Cyprus, occurring on rocky, usually igneous, mountainsides range (500-1800 m alt.).

**Xylem**


Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate to greater than 10 seriate. Larger rays greater that 1 mm in height.

**Bark**

Groups of sieve tubes present. Collapsed sieve tubes. Some rays become slightly dilated. Sclerenchyma cells both in phloem and cortex. Fibers in tangentially arranged in large groups with sieve tubes.

**Pith**

Pith shape round. Unilignified cells present. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).
Inula crithmoides L.
(Annex 1, plate no. 11)

Subshrub up to 80 cm in height. Occurring to western European and Mediterranean coasts and to the Atlantic islands. Indigenous to Cyprus, it is found near salt lakes in costal areas (0-50 m alt.).

Xylem
Transverse section: Only one ring in the observed sample. Vessels predominantly solitary or in short radial multiples, showing a dendritic pattern. Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate, the latter greater than 1 mm in height.

Bark

Pith
Pith shape round. Unilignified cells present. Crystal sand present. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).
**Inula viscosa** (L.) Aiton
(Annex 1, plate no. 11)

Viscid-gluinous, aromatic subshrub up to 1.5 m in height. Indigenous to the Mediterranean region and the Atlantic islands. Very common in Cyprus, occurring on disturbed grounds, along roadsides, hillsides, often in moist sites and near springs or rivers (0-1600 m alt.).

**Xylem**
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Rays of two distinct sizes: uniseriate and very large, commonly from 4 up to 10 seriate. Larger ray height greater than 1 mm.

**Bark**
Groups of sieve tubes present. Some rays become dilated. Fibers in tangential rows, scattered or irregularly dispersed. Fibers in large groups. Acicular crystals and crystal sand. Phellem homogeneous.

**Pith**

**Codified description**
1 4 5 9 13 22 25 30 40.2 45 50.2 53.1 60 61 69 78 96 98 102 103 105 114 — B1 B3.1 B5.2 B5.3 B5.4 B7.1 B7.3 B14.1 - P1 P4 P6.1 P9 P9.1 P9.2 P10.1 P12 P13

**Otanthus maritimus** (L.) Hoffmanns. et Link
(Annex 1, plate no. 11)

Subshrub up to 40 cm in height, with erect or sprawling, often much-branched stems. Indigenous to south-western Europe and the Mediterranean region. It occurs in sand dunes and sandy seashores (0 m alt.).
Xylem
Transverse section: Growth ring boundaries distinct only along some radii. Wood diffuse porous. Vessels solitary or in short radial multiples. Mean tangential diameter of earlywood vessels 20-50 μm. Vessels of two distinct diameter classes. Vessels number in early wood: 100-200 per square millimeter. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and up to 10 seriate. Larger rays height greater than 1 mm.

Bark
Groups of sieve tubes in radial rows. Fibers in tangential rows. Crystal sand present.

Pith
Pith shape round. Unilignified cells present. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
5 9.1 13 22 25 40.1 40.2 45 50.1 60 61 65 69 78 96 98 102 103 105 115 - B1 B1.2 B5 B5.2 B7.3 - P1 P3.4 P9 P10.1 P13

*Phagnalon rupestre* (L.) DC.
(Annex 1, plate no. 12)

Erected or sprawling, much-branched subshrub up to 50 cm in height. Indigenous to eastern Mediterranean region. In Cyprus it occurs in garigue, on dry and rocky sites (0-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels 20 μm to 50 μm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal to vasicentric. Apotracheal parenchyma in marginal or in seemingly marginal bands. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels
pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays of two distinct sizes: uniseriate and greater than 10 seriate. Larger rays height commonly greater than 1 mm.

Bark
Groups of sieve tubes present. Some rays become dilated. Sclerenchyma cells both in phloem and cortex. Groups of fibers and sieve tubes.

Pith
Pith shape roundish. Cells differ in diameter from the center to the border of the pith. Not lignified cells present. Cell content (gum, tannins, dark staining substances). Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9 13 22 25 30 40.2 45 50.2 58 60 61 69 70 78 79 89 96 99 102 103 105 115 - B1 B3.1 B4 B5.4 - P1 P3.4 P4.1 P5 P9 P9.1 P10.1 P13

_Ptilostemon chamaepeuce_ (L.) Less. var. _cyprius_ Greuter
(Annex 1, plate no. 12)

Evergreen shrub up to 1.3 m in height. The variety is endemic to Cyprus, occurring on rocky slopes and on rock fissures on calcareous and indigenous formations (50-1600 m alt.).

Xylem
Transverse section: Growth ring distinct. Wood semi-ring porous to diffuse-porous. Vessels in diagonal and/or radial pattern, predominantly in clusters. Mean tangential diameter of earlywood vessel lumina less than 50 μm. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common in heartwood vessels. Gums and other deposits in heartwood vessels and fibers. Fibers very thick walled, radial flat marginal fibers. Axial parenchyma scanty paratracheal to vasicentric. Apotracheal parenchyma in marginal or in seemingly marginal bands. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate. Intervessel pits medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays of two distinct sizes: uniseriate and 2-3 seriate. Larger rays greater than 1 mm in height.

Bark
Groups of sieve tube in radial rows. Collapsed sieve tubes. Fibers in tangential rows, scattered or irregularly dispersed. Phellem homogeneous.

Pith
Pith shape round. Cells differ in diameter from the center to the border of the pith. Cell content (dark staining substances). With crystals druses. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 4 5 7 8 11 13 22 26 30 40 50.2 52 56 58 61 70 70.3 78 79 89 96 97 103 109 115
— B1.2 B2 B5 B5.2 B5.3 — P1 P4.1 P5 P6.2 P9 P9.1 P10.1 P12 P13

Staehelina lobelii DC.
(Annex 1, plate no. 12)

Subshrub up to 60 cm in height, with numerous erect, slender stems, branched only in the region of inflorescences. A rare indigenous species, occurring on fissures of limestone rocks (500-800 m alt.). Found also in southern Turkey, Lebanon and Crete.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semiring porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4, and in clusters. Mean tangential diameter of earlywood vessels 20-50 μm. Fibers thin to thick walled. Radial flat marginal fibers. Axial parenchyma scanty paratracheal to vasicentric. Apotracheal parenchyma in marginal or in seemingly marginal bands. Less than 4 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 μm in diameter). Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals present.
Tangential section: Rays commonly 4 to 10 seriate.

Bark
Groups of sieve tubes present. Collapsed sieve tubes. Fibers in tangential rows and grouped.
Pith
Pith shape round. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 4 7 9.1 11 13 21 22 25 40.2 52.3 61 69 70.3 78 79 89 98 109 114 136 - B1 B2 B5 B5.2 B5.4 - P1 P3.3 P4 P9 P9.1 P10.1 P12

**Berberidaceae**

*Berberis cretica* L.
(Annex 1, plate no. 13)

Deciduous shrub, up to 1.5 m in height. Indigenous to Cyprus, grows in pine forests and on screen (900-1950 m alt.). It also occurs in mainland Greece, Crete, the Aegean islands and Turkey.

**Xylem**
Transverse section: Growth ring distinct and recognizable. Wood ring-porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4, and in clusters. Mean tangential diameter of earlywood vessels 20-50 µm; 20 — 40 earlywood vessels per square millimeter. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Less than 4 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell, or rounded with large apertures. Helical thickenings only in narrower vessel elements. Earlywood vessel elements length less than 350 µm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Larger rays commonly greater than 10 seriate. Ray height greater than 1 mm.

**Bark**
Groups of sieve tube in tangential rows. Only some rays become dilated. Sclereids in tangential rows and scattered or irregularly dispersed. Lignified cells in phellem.

**Pith**
Pith shape round. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged almost in regular rows (radial section).
Betulaceae

Alnus orientalis Decne.
(Annex 1, plate no. 13)

Deciduous tree up to 20 m in height. Indigenous to Cyprus, found abundantly along rivers and streams (0-1550 m alt.). Also indigenous to Turkey, Syria and Lebanon.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in radial multiples of 2 to 4 or more elements, and in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, 100-200 vessels per square millimeter in earlywood. Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers thin to thick walled. Tension wood present. Axial parenchyma diffuse. Apotracheal parenchyma in marginal or in seemingly marginal bands. Rays per millimeter 12-20.
Radial section: Scalariform perforation plates with greater than 10 bars. Inter-vessel pits opposite, minute (less than 4 μm in diameter). Earlywood vessels length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent.
Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tube and collapsed sieve tube present. Fibers in tangential rows, sclereids scattered or irregularly dispersed. Prismatic crystals and druses present. Phellem homogeneous, distinct in polarized light.

Pith

Codified description
Boraginaceae

Echium angustifolium Link ex Willk. & Lange
(Annex 1, plate no. 13)

Erect or sprawling perennial subshrub 10-60 cm high. Eastern Mediterranean plant, diffused from Greece to Egypt and Libya. Locally common on rocky and sandy seashores, roadsides, dry banks and hillside (0-1000 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids).
Tangential section: Larger rays commonly 4 to 10 seriate. Some rays disappear in polarized light.

Bark
Phloem uniform. Cell content in parenchyma cells.

Pith

Codified description
1 5 9 9.1 13 22 25 30 40.2 45 52.3 58 62 69 78 89 89.1 98 100.2 109 115 - B8 B11
- P1 P3.4 P10.2 P12

Lithodora hispidula (Sm.) Griseb. subsp. versicolor Meikle
(Annex 1, plate no. 14)

Evergreen much branched shrub, 1-1.5 m in height. Indigenous in Cyprus, very common in many areas with garigue vegetation or open forests (0-1000 m alt.). Indigenous also in Turkey and Syria.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-
ring porous to diffuse porous. Vessels in short radial multiples, and in clusters. Vessels cell wall thick (greater than 2 μm). Vessels of two distinct diameter classes. Mean tangential diameter of earlywood vessels less than 20 μm. Fibers thin to thick walled. Axial parenchyma diffuse and scanty paratracheal. Apotracheal parenchyma in marginal or in seemingly marginal bands. Less than 4 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Tangential section: Larger rays commonly 4 to 10 seriate.

Bark
Groups of sieve tubes present. Some rays became dilated. Sclerenchyma cells both in phloem and cortex. Fibers scattered or irregularly dispersed. Sclereids in tangential rows, scattered or irregularly dispersed. Cell content in parenchyma cells.

Pith

Codified description
1 4 5 9.1 11 13 21 22 25 30 36 39.1 40.1 45 52.3 62 69 76 78 89 98 109 114 - B1 B3.1 B4 B5 B5.3 B6 B6.2 B6.3 B11 - P1 P3.3 P4 P5 P9 P9.1 P10.1 P10.2 P12

_Onosma caespitosa_ Kotschy
(Annex 1, plate no. 14)

Evergreen subshrub. Endemic to Cyprus (300-900 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels in diagonal and/or radial pattern. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes. Fibers thin to thick walled. Parenchyma pervasive. Radial section: Simple perforation plates. Inter-vessel pits opposite, minute (less than 4 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 μm.
Tangential section: wood rayless

Bark

Pith
Pith shape round. Unilignified cells. Laticifers or intercellular canals. Primary vascular bundle not distinct.

Codified description
2 5 7 9 11 13 21 24 36 40.1 45 52.3 69 79.1 - B1 B2 B6.3 B7 B14.4 - P1 P3.4 P7 P10.2

Onosma fruticosa Sm.
(Annex 1, plate no. 14)

Much branched, evergreen shrub 20-80 cm in height. Endemic of Cyprus, found in many areas with garigue vegetation (0-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels in diagonal and/or radial pattern, predominantly in clusters. Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Apotracheal parenchyma in marginal or in seemingly marginal bands, dark in polarized light.
Radial section: Inter-vessel pits alternate, minute (less than 4 µm in diameter). Earlywood vessel elements length 100-200 µm. Fibers with distinctly bordered pits (fiber tracheids).
Tangential section: Wood rayless.

Bark
Phloem uniform. Dark staining substances in parenchyma cells.

Pith

Codified description
1 4 7 11 22 24 40.2 45 52.3 58 62 69 89 89.1 117 - B8 B11 - P1.1 P3.3 P5 P9.1 P10.1 P12
**Onosma mitis** Boiss. et Heldr.  
(Annex 1, plate no. 15)

Subshrub, 15-50 cm in height. Native of Cyprus and southern Turkey, rather unusual (400-900 m alt.).

**Xylem**
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Wood rayless.

Bark
Phloem uniform. Phellem homogeneous.

Pith

Codified description
1 5 9 13 22 25 40.1 40.2 45 52.3 58 61 69 78 89 89.1 117 - B8 B14.1 - P1 P3.4 P10.2

**Brassicaeae**

*Alyssum akamasicum* B.L.Burtt  
(Annex 1, plate no. 15)

A subshrub or perennial herb with erect or decumbent stems up to 40 cm long. Endemic to Cyprus. It occurs on rocky mountainsides and shrubberies with serpentines and ultrabasic rocks (0-400 m alt.).

**Xylem**
Transverse section: Growth ring distinct. Wood diffuse porous. Vessels in radial multiples of 2 to 4 common. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Greater than 200
vessels per square millimeter in earlywood. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal.
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 µm in diameter). Earlywood vessel elements length 50-100 µm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Wood rayless.

Bark
Groups of sieve tubes present. Collapsed sieve tubes. Sclereids in radial rows, scattered or irregularly dispersed sometimes in groups. Phellem homogeneous, distinct in polarized light.

Pith

Codified description
1 5 9.1 13 21 22 25 39.1 40.1 50.2 52.2 61 69 70 78 117 - B1 B2 B6.1 B6.3 B6.4 B14.1 B14.3 - P0 P1 P3.1

*Alyssum troodi* Boiss.
(Annex 1, plate no. 15)

A subshrub up to 30 cm in height. Endemic to Cyprus. It grows in rocky mountainsides of serpentine ultrabasic rocks (1200-1950 m alt.).

*Xylem*
Radial section: Simple perforation plates. Inter-vessel pits scalariform and alternate, small (4-7 µm in diameter). Earlywood vessel elements length 50-100 µm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Wood rayless.

*Bark*
Groups of sieve tube and collapsed sieve tubes present. Sclereids in radial rows, Sclereids scattered or irregularly dispersed or in groups. Phellem homogeneous, distinct in polarized light.
Pith

Codified description
2 5 9.1 13 20 22 25 39.1 40.1 50.2 52.2 61 69 70 78 89.1 89.2 — B1 B2 B6.1 B6.3 B6.4 B14.1 B14.3 — P1.1 P1.2 P4 P9 P9.1 P9.3 P10

*Alyssum cypricum* Nyar.
(Annex 1, plate no. 16)

A subshrub up to 30 cm in height. A species native to Cyprus. It grows on rocky mountainsides of serpentine ultrabasic rocks (1100 - 1950 m alt.). It grows also in Turkey.

Xylem
Transverse section: Growth ring distinct. Wood diffuse porous. Vessels in radial multiples of 2 to 4 or in clusters. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessels less than 20 µm. Gums and other deposits in heartwood vessels. Fibers very thick walled. Axial parenchyma scanty paratracheal. Less than 4 rays per millimeter. Successive cambia: concentric continuous.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Earlywood vessel elements length 50-100 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Ray width predominant 1 to 3 cells.

Bark
Collapsed sieve tubes. Fibers in radial groups.

Pith missing

Codified description
1 5 9.1 11 13 22 25 39.1 40.1 52.2 58 61 70 78 97 105 114 133.2 - B2 B5.1 - Pith missing

*Arabis cypria* Holmboe
(Annex 1, plate no. 16)

A subshrub up to 30 cm in height. Endemic to Cyprus, growing in crevices of limestone cliffs and rocks (300-900 m alt.).
Xylem
Radial section: Simple perforation plates. Inter-vessel pits scalariform, alternate, small (4-7 μm in diameter). Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Wood rayless.

Bark

Pith
Pith difficult to observe.

Codified description
2 5 9 9.1 11 13 20 22 25 39.1 40.1 50.2 53.1 61 69 70 79 89.1 89.2 - B1 B2 B14.1 B14.3 - Pith missing

Arabis purpurea Sibth. et Sm.
(Annex 1, plate no. 16)

A subshrub up to 30 cm in height. Locally very common Cypriot endemic. It occurs in crevices of igneous and calcareous rocks (400-1800 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits scalariform. Inter-vessel pits alternate, small (4-7 μm in diameter). Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Wood rayless.
Bark

Pith

Codified description
1 5 9 11 13 20 22 25 39.1 40.1 50.2 53.1 61 69 78 89.1 89.2 117 133
4 5

*Brassica hilaronis* Post
(Annex 1, plate no. 17)

Erected or spreading subshrub 50-80 cm high. Endemic to Cyprus, locally common in fissures of limestone cliffs in Pentadactylos mountain range (300-850 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary or in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels less than 20 μm, 40 – 100 earlywood vessels per square millimeter. Parenchyma scanty paratracheal, apotracheal parenchyma in marginal or in seemingly marginal bands. Parenchyma marginal thin walled, dark in polarized light. Rays per millimeter 4-12. Groups of sieve tubes into the marginal parenchyma bands.
Radial section: Simple perforation plates. Inter-vessel pits scalariform and alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers). Helical thickenings in ground tissue fibers. All ray cells upright and/or square.
Tangential section: Rays commonly 4 to 10 seriate.

Bark

Pith
tannins, dark staining substances). Pits in transverse and in longitudinal cell walls.

Codified description
1 5 9 9.1 13 20 22 26 30 40.1 49 52.2 61 64 78 89 89.1 98 105 115 - B1 B2 B3.1 B4 B6.4 B14.1 B14.3 - P2 P1 P3 P3.1 P3.3 P4 P5 P9 P9.1

_Erysimum kykkoticum_ Hadjikyriakou et Alziar
(Annex 1, plate no. 17)

Subshrub up to 50 cm in height, including the inflorescence stalk. Rare endemic species in Cyprus. A Chamaephytes which usually grows in crevices of igneous, diabase rocks, occasionally on vertical banks of abandoned tracks, of northern or eastern aspects (250-450 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits scalariform, minute (less than 4 μm in diameter). Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Wood rayless.

Bark
Groups of sieve tube and collapsed sieve tubes present. Phellem homogeneous, distinct in polarized light.

Pith

Codified description
2 5 9 13 20 24 39.1 40.1 50.2 58 61 69 89.2 117 133.2 - B1 B2 B14.1 B14.3 - P1 P3.4
Caesalpiniaceae

*Ceratonia siliqua* L.

(Annex 1, plate no. 17)

Evergreen tree up to 10-15 m. indigenous to Cyprus, mostly a constituent of maquis forests (0-600 m alt.) as wild and up to 100 m in cultivations. Widespread in the Mediterranean from Portugal to Syria.

Xylem
Transverse section: Growth ring distinct. Wood diffuse porous. Vessels solitary, in short radial multiples, and in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Vessels of two distinct diameter classes. Tyloses with thin wall common. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Apotracheal parenchyma diffuse in aggregates. Paratracheal parenchyma vasicentric, sometimes confluent. Rays per millimeter 12-20. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Septate fibers present. All monoseriate rays with upright and/or square cells. Multiseriate rays composed by procumbent cells with one row of square marginal cells. Prismatic crystals in axial parenchyma cells. Tangential section: rays width from moseriate to 10 seriate.

Bark

Pith

Codified description
1 5 9 9.1 11 13 22 25 30 41 45 53.1 56 58 65 69 70 77 79 83 96 98 105 106 116.1 136 141.1 - B1 B3.1 B4 B5.2 B5.3 B6.2 B7 B11 B14.1 B14.3 - P1.1 P4 P5 P6 P6.2 P9 P9.1 P10.1 P10.2 P12
Capparaceae

Capparis spinosa L.
(Annex 1, plate no. 18)

Much-branched, deciduous shrub up to 1.5 m in height. The variety canescens occur in Cyprus, growing on rocky slopes and in field margin, maquis, garigue and wasteland (0-900 m alt.). Also indigenous to the Mediterranean countries.

Xylem
Transverse section: Wood ring to semi-ring porous. Vessels predominantly solitary or in radial multiples of 2 to 4, or more. Mean tangential diameter of earlywood vessels 20-50 \( \mu \)m. Vessels of two distinct diameter classes, 40 – 100 earlywood vessels per square millimeter. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 \( \mu \)m in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 \( \mu \)m. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells mostly procumbent with one row of upright and/or square marginal cells. Uniseriate rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays uniseriate and predominant 1 to 4 cells.

Bark
Groups of sieve tube and collapsed sieve tubes present. Only some rays become dilated. Fibers and sclereids present, scattered or irregularly dispersed. Prismatic crystals. Phellem distinct in polarized light.

Pith

Codified description
3 4 9 9.1 10 13 22 24 30 40.2 45 49 52.3 60 61 69 78 96.1 97 106 109 116.2 – B1 B2 B3.1 B5 B5.3 B6 B6.3 B7 B14.3 – P1.1 P1 P2 P4.1 P6 P9 P9.1 P9.3 P10.1 P12 P13
Caprifoliaceae

Lonicera etrusca Santi
(Annex 1, plate no. 18)

Climber with stems up to 4 m long. Indigenous to Cyprus, growing on thickets pine forests and on rocky places (300-1500 m alt.). It also occurs in Mediterranean countries.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary and in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Radial flat marginal fibers. Axial parenchyma absent or extremely rare or not to recognizable, few scatter apotracheal parenchyma cells are present. Rays per millimeter 12-20.
Radial section: Simple perforation plates, small (4-7 μm in diameter). Vessel-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays uniseriate and up to 3 cells wide.

Bark

Pith

Codified description
1 5 9 9.1 13 25 30 36 40.2 53.1 58 60 62 69 70.3 75 76 96 97 105 109 116.1 - B4
B5.2 B14.1 B14.3 B14.4 - P1 P2 P3.4 P4 P9 P9.1 P9.3 P10.1 P10.2 P12
**Lonicera japonica** Thumb.
(Annex 1, plate no. 18)

Climber with stems up to 6 m long. Exotic to Cyprus occurring in gardens and hedges (0-500 m alt.). Cultivated in Mediterranean countries. Indigenous to south-east Asia.

**Xylem**
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with over 4 rows of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays uniseriate to 10 seriate.

**Bark**

**Pith**
Pith shape square to roundish. Medullary sheath present. Un lignified cells in the center of the pith, lignified parenchyma cells at its periphery. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

**Codified description**

**Viburnum opulus** L.
(Annex 1, plate no. 19)

Deciduous shrub up to 4 m in height. Exotic to Cyprus, found in gardens and hedges and elsewhere (500-1200 m alt.). Indigenous to southern Europe.

**Xylem**

Radial section: Scalariform perforation plates with greater than 40 bars. Intervessel pits opposite, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length greater than 500 μm. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray.

Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description

Viburnum tinus L.
(Annex 1, plate no. 19)

Evergreen shrub up to 7 m in height. Exotic to Cyprus, found in gardens and hedges and elsewhere (0-1400 m alt.). Indigenous to southern Europe.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous to semi ring porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessels less than 20 μm. Greater than 200 vessels per square millimeter in earlywood. Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers very thick
walled, marginal flat fibers. Apotracheal parenchyma diffuse, paratracheal parenchyma scanty. Apotracheal parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.

Radial section: Scalariform perforation plates with 20 – 40 bars. Intervessel pits medium (7-10 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length greater than 500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.

Tangential section: Rays uniseriate up to 3 cells wide.

Bark
Groups of sieve tubes present. Fibers scattered or irregularly dispersed. Prismatic crystals and druses present. Phellem homogeneous. Lignified cells in phellem.

Pith

Codified description
1 4 5 9 11 14 17 26 30 36 40.1 50.2 53.2 62 70 70.3 76 78 86 96 97 105 116.2 – B1 B5.3 B7 B7.2 B14.1 B14.4 – P1 P3 P3.3 P6.2 P9 P9.1 P9.2 P10.1 P10.2 P12 P13

**Caryophyllaceae**

*Dianthus cyprius* A.K. Jacks. et Turrill

(Photomicrographs not available)

Suffrutticose perennial, with sparse, pendulous and often curved branches, 1 m long. Endemic of Cyprus growing on limestone rocks and cliffs (350-750 m alt.).

**Xylem slide miss**
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: wood rayless
Bark
Groups of sieve tubes present. Fibers in tangential rows. Crystal sand.

Pith

Codified description
5 9.1 13 22 24 39.1 40.1 52.2 61 69 78 89.1 117 - B1 B5.2 B7.3 - P1 P2 P3.4 P4 P6.4 P10.2

*Silene fruticosa* L.
(Annex 1, plate no. 19)

A loosely tufted subshrub, 15-50 cm in height. A native of Cyprus growing in rock crevices and on old walls, with a limited distribution, although locally common in some areas (0-600 m alt.). It is also found in Malta, Sicily, Greece and Cyrenaica.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 \(\mu\)m). Mean tangential diameter of earlywood vessels 20-50 \(\mu\)m. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Apotracheal parenchyma in marginal or in seemingly marginal bands, with thin walled cells, dark in polarized light. Radial section: Simple perforation plates. Inter-vessel pits scalariform. Inter-vessel pits alternate, medium (7-10 \(\mu\)m in diameter). Helical thickenings only in narrower vessel elements. Earlywood vessel elements length 50-100 \(\mu\)m. Fibers with simple to minutely bordered pits (libriform fibers). Tangential section: Wood rayless.

Bark

Pith
Silene galataea Boiss.
(Annex 1, plate no. 20)

Subshrub 20-50 mm high. Endemic to Cyprus, it thrives on dry rocky slopes in Pine forests (750-1200 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 \( \mu \)m). Mean tangential diameter of earlywood vessels less than 20 \( \mu \)m. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled, in tangentially elongated groups. Parenchyma pervasive. Radial section: Simple perforation plates. Inter-vessel pits scalariform, small (4-7 \( \mu \)m in diameter). Earlywood vessel elements length 200-500 \( \mu \)m. Tangential section: Wood rayless.

Bark
Groups of sieve tube present, in tangential rows. Collapsed sieve tubes. Prismatic crystals.

Pith

Chenopodiaceae
Arthrocnemum macrostachyum (Moric.) Mois et Delponte
(Annex 1, plate no. 20)

Erect, much-branched subshrub 20-70 cm in height. An indigenous halophyte, occurring on edges of salt lakes and salt marshes (0-150 m alt.). Indigenous of the Mediterranean region, Red sea, Atlantic islands and south to Senegal.

Xylem
Transverse section: Growth distinct. Wood diffuse porous. Vessels solitary and in clusters. Vessels cell wall thick (greater than 2 \( \mu \)m). Mean tangential
diameter of earlywood vessels less than 20 μm. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal. Successive cambia: concentric arranged single vascular bundles.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 50-100 μm. Tangential section: Wood rayless.

Bark

Pith

Codified description
1 5 9 11 13 22 24 39.1 40.1 52.2 69 70 78 117 133.1 - B7.2 B8 B14.1 B14.3 - P1 P4 P10.2

Arthrocnemum perenne (Mill.) Moss
(Annex 1, plate no. 20)

Subshrub 10-50 in height. And indigenous halophyte, occurring on edges of alt lakes and salt marshes. Indigenous to Mediterranean region southern and western Europe, tropical and southern Africa.

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels predominantly solitary. Vessels predominantly in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Fibers thick walled to very thick walled. Axial parenchyma scanty paratracheal. Successive cambia: concentric arranged single vascular bundles, sometimes concentric continuous.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers). Tangential section: Wood rayless. Axial parenchyma and vessels storied.

Bark

Pith

Codified description
2 5 9 11 13 22 24 39.1 40.2 52.2 61 69 70 78 117 120 133.1 133.2 - B7 B8 B14.1 B14.3 - P1 P3.4 P9 P10.2

Atriplex halimus L.
(Annex 1, plate no. 21)

Erect shrub up to 2 m in height. Indigenous species occurring on sandy and rocky seashores and sometimes in dry sites inland (0-350 m alt.). Indigenous to the Mediterranean region.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Earlywood vessel elements length 50-100 µm. Fibers with simple to minutely bordered pits (libriform fibers). Prismatic crystals present.

Bark
Fibers in tangential rows. Prismatic crystals.

Pith

Codified description
1 5 9 13 22 25 39.1 40.2 45 52.2 61 69 70 78 117 120 133.1 136 - B5.2 B7 - P1 P4 P6 P6.2 P9 P9.1 P10 P10.1 P13
Atriplex semibaccata R.Br.
(Annex 1, plate no. 21)

Prostrate or sprawling subshrub with stem up to 50 cm long. It occur on waste ground and garigue, on brackish ground inland (30-250 m alt.). A native of Australia.

Xylem
Transverse section: Growth ring distinct. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Vessels of two distinct diameter classes: mean tangential diameter vessels less than 20 μm and up to 50 μm. Gums and other deposits in heartwood vessels. Fibers thick walled to very thick walled. Axial parenchyma scanty paratracheal. Successive cambia: concentric arranged single vascular bundles, sometimes connected in transverse section.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers). Prismatic crystals present.

Tangential section: wood rayless

Bark

Pith

Codified description
1 5 9 13 22 24 39.1 40.1 40.2 45 52.2 58 61 69 70 78 117 133.1 133.2 136 - B7 B8 B14.3 - P3 P3.3 P4 P6.2 P9 P9.1 P9.2 P9.3 P10 P10.1

Halimione portulacoides (L.) Aellen
(Annex 1, plate no. 21)

Sprawling much-branched subshrub 1,5 m in height. Indigenous species occurring on edges of salt lakes and sea shores. Indigenous to western Europe and the Mediterranean region.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary and in radial multiples of 2 to 4 common. Vessels cell
wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal. Successive cambia: concentric arranged single vascular bundles. 
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). 
Tangential section: Wood rayless.

Bark
Fibers scattered or irregularly dispersed. Druses present. Phellem homogeneous, distinct in polarized light. Lignified cells in phellem.

Pith

Codified description
1 5 9 9.1 13 22 24 39.1 40.1 45 50.2 52.3 61 69 70 78 117 133.1 - B5.3 B7.2 B14.1 B14.3 B14.4 - P1 P3 P3.3 P3.4 P9 P9.1 P10 P10.1 P12

*Halocnemum strobilaceum* (Pall.) Bieb.
(Annex 1, plate no. 22)

Erect much-branched subshrub up to 80 cm in height. An indigenous halophyte, occurring on edge of salt lakes and salt marshes. Also indigenous to the Mediterranean region and eastward to Asia.

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels in radial multiples of 2 to 4 common. Vessels predominantly in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Axial parenchyma scanty paratracheal. Successive cambia: concentric arranged single vascular bundles. 
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers). 
Tangential section: Wood rayless.
Bark
Phloem uniform.

Pith

Codified description
2 5 9.1 11 13 22 25 36 39.1 40.1 52.2 61 78 117 133.1 - B8 - P1.1 P3.4 P4 P9 P9.1 P10 P10.1 P12

Noaea mucronata (Forssk.) Asch. et Schwinf.
(Annex 1, plate no. 22)

Erect or sprawling, much-branched subshrub up to 60 cm in height. Indigenous to Cyprus, occurring on dry pastures, costal garigue, sand dunes and rocky slopes. (0-650 m alt.). Indigenous to the eastern Mediterranean region, north Africa and eastwards to central Asia.

Xylem

Bark
Phloem uniform. Layered phelloderm. Lignified cells in phellem.

Pith
Pith shape round. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other.

Codified description
1 5 9 9.1 13 24 39.1 40.1 52.3 61 69 70 78 117 133.1 - B8 B14.4 B18 - P1 P3.3 P4 P9 P9.1 P10.1
Suaeda aegyptiaca (Hasselq.) Zohary
(Annex 1, plate no. 22)

Erect, much branched subshrub up to 50 cm in height. A rare indigenous halophyte, occurring on edges of salt lakes and salt marshes (0 m alt.). It is indigenous to Palestine, Egypt, Arabia and eastwards to Iran.

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels in radial multiples of 2 to 4 or more. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels 20-50 μm. Fibers thin to thick walled. Axial parenchyma scanty paratracheal to vasicentric. Rays per millimeter 4-12. Successive cambia: concentric arranged single vascular bundles.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Ray width predominant 1 to 3 cells.

Bark
Phloem uniform. Druses and crystal sand present. Lignified cells in phellem.

Pith
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Vascular bundles in the pith. Primary vascular bundle clearly separate from one other.

Codified description
2 5 9.1 10 13 22 25 30 39.1 40.2 53.1 61 69 78 79 97 109 115 133.1 - B7.2 B7.3 B8 B14.4 - P1 P4 P9 P9.1 P10 P10.1

Suaeda vera Forssk. ex J.F.Gmel
(Annex 1, plate no. 23)

Evergreen, erect, much-branched shrub up to 80 cm in height. An indigenous halophyte, occurring on sandy costa, edges of salt lakes and rocky slopes (0-30 m alt.). Indigenous to the southern and western Europe, the Mediterranean region and the Atlantic islands.

Xylem
common. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessels less than 20 µm. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma sometimes scanty paratracheal, often confluent and in bands greater than three cells wide. Apotracheal parenchyma in marginal or in seemingly marginal bands. Successive cambia: concentric arranged single vascular bundles.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length 50-100 µm. Fibers with simple to minutely bordered pits (libriform fibers).

Tangential section: Wood rayless.

Bark
Phloem uniform.

Pith
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Vascular bundles in the pith. Primary vascular bundle clearly separate from one other.

Codified description
1 5 9 9.1 13 22 25 36 39.1 40.1 52.2 58 61 69 78 83 85 89 117 133.1 - B8 - P1 P4 P9 P9.1 P10 P10.1

Cistaceae

*Cistus creticus* L.

(Annex 1, plate no. 23)

Shrub up to 150 cm in height. It is indigenous to central and eastern Mediterranean countries as far as Palestine. Very common in Cyprus, growing on rocky slopes, in forests and shrub lands (0-1800 m alt.).

Xylem


Radial section: Simple perforation plates. Inter-vessel pits pseudoscalariform to reticulate and alternate. Inter-vessel pits small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape.
throughout the ray cell. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Tangential section: Rays of two distinct sizes: uniseriate and up to 3 cells wide.

Bark
Groups of sieve tubes present. Sclerenchyma cells both in phloem and cortex. Fibers in tangential rows. Druses present.

Pith
Pith shape round. Pith with thick walled parenchyma cells. Cells dimorphic. With crystals druses. Pits in longitudinal cell walls (radial section), transverse walls are missing. Primary vascular bundle clearly separate to not distinct each other.

Codified description
1 4 9 13 20.1 22 25 30 40.2 45 48 50.2 58 62 70 76 96 97 103 109 116.2 — B1 B4 B5 B5.2 B7.2 — P1 P3.3 P4 P6.2 P9 P10.1 P10.2

Cistus ladanifer L.
(Annex 1, plate no. 23)

Shrub up to 2 m in height. Native to western Mediterranean basin, it is a rare adventive species in Cyprus. It grows in open pine forests (250-800 m alt.)

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in rays and in axial parenchyma cells. Tangential section: Rays uniseriate and 1 to 3 cells wide.

Bark
Pith

Codified description
1 4 9 13 21 22 24 30 40.1 52.3 62 70 76 78 96 97 109 116.1 136 136.1 141.1 - B1 B2 B3.1 B5.2 B5.4 B7 B11 B14.1 B14.3 - P1 P3.3 P4 P5 P9 P9.1 P10.2 P12 P13

*Cistus monspeliensis* L.
(Annex 1, plate no. 24)

Shrub up to 1 m in height. It occurs in the Mediterranean countries and the Atlantic islands. On Cyprus it grows on rocky slopes, in forests and in shrub lands (0-600 m alt.), Cyprus is the easternmost boundary of the distribution of the species.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 350-800 μm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells.
Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith
Shrub up to 1 m in height. It occurs in the central and eastern Mediterranean countries. A common indigenous species to Cyprus thriving on rocky slopes, in forests and thickets (usually 0-300 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood diffuse porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels less than 20 µm. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Gums and other deposits in heartwood vessels and/or fibers. Fibers very thick walled. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 350-800 µm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays predominantly uniseriate, rarely more than 4 seriate.

Bark

Pith
**Fumana arabica** (L.) Spach.  
(Annex 1, plate no. 24)

Subshrub up to 60 cm in height. Stems usually wiry, spreading, sub erect, densely hairy. It occur in countries of the central and eastern Mediterranean and eastwards to Iran. Common species to Cyprus, thrives on rocky slopes and maquis and garigue (0-1200 m alt.).

**Xylem**  
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous, vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Fibers very thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter.  
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.  
Tangential section: Rays exclusively uniseriate.

**Bark**  
Groups of sieve tube and sieve tubes present. Fibers in tangential rows, scattered or irregularly dispersed. Phellem homogeneous, distinct in polarized light.

**Pith**  

Codified description  
1 5 9 13 21 22 24 30 39.1 40.1 52.3 62 70 78 96 105 116.2 — B1 B2 B5.2 B5.3 B14.1 B14.3 — P1 P2 P3.3 P4.2 P5 P9 P9.1 P10.2 P12 P13

**Fumana thymifolia** (L.) Verlot  
(Annex 1, plate no. 25)

Subshrub up to 25 cm in height. Young stems thinly or densely hairy. It occur in countries of the Mediterranean and eastwards to Iran. Common species to Cyprus, thrives on rocky slopes, sand dunes, maquis and garigue (0-1000 m alt.).
Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 50-100 µm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
1 4 9 11 13 21 22 24 30 40.1 52.2 58 62 70 76 78 89 89.1 96 99.2 105 116.2 - B1 B6.2 B6.3 B7 B11 B18 - P1 P2 P3.3 P5 P9 P9.1 P10.2

*Helianthemum obtusifolium* Dunal
(Annex 1, plate no. 25)

Subshrub up to 25 cm in height, with densely tomentose stems. Endemic to Cyprus. It grows on rocky slopes, in maquis and garigue (0-900 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Ray exclusively uniseriate.

Bark
Fibers scattered or irregularly dispersed. Prismatic crystals and druses present. Cell content in parenchyma cells.

Pith

Codified description
1 5 9 13 21 22 24 40.1 52.3 58 62 69 70 76 78 89 89.1 96 99.2 105 116.2 - B5.3 B7 B7.2 B11 - P1 P2 P5 P10.2 P12

*Helianthemum stipulatum* (Forssk.) C.Christens.
(Annex 1, plate no. 25)

Subshrub up to 40 cm in height, with densely tomentose stems. Indigenous to Egypt, Palestine, Syria and Turkey. On Cyprus it grows on sandy beaches and rocky slopes (0-200 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels less than 20 μm. Tyloses with thin wall common. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma diffuse, scantly paratracheal and in marginal or in seemingly marginal bands. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 50-100 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays uniseriate to 3 cells wide.

Bark
Collapsed sieve tubes. Sclereids in tangential rows and scattered or irregularly

Pith

Codified description
1 4 5 9 13 21 22 24 30 40.1 52.2 56 58 60 62 69 70 76 78 96 97 105 116.2 136.1 - B2 B6.2 B6.3 B7 B11 B14.1 B14.3 - P1 P2 P3.3 P5 P9.1 P10.2 P12

*Helianthemum syriacum* (Jacq.) Dum-Cours.
(Annex 1, plate no. 26)

Sub shrub up to 40 cm in height, with densely tomentose stems. Indigenous in the Mediterranean countries, In Cyprus it grows on sandy beaches and rocky slopes (0-800 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessels less than 20 µm. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 µm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Tangential section: Rays uniseriate and up to 3 cells wide.

Bark

Pith
Codified description
1 5 9 11 13 21 22 24 30 40.1 53.1 62 69 70 78 96.1 97 105 116.2 - B1 B3.1 B5.3 B7 B7.2 B11 B14.3 - P0.1 P1 P2 P5 P6 P6.2 P10.1 P10.2 P12

**Convolvulaceae**

*Convolvulus dorycnium* L.  
(Annex 1, plate no. 26)

Erect, much branched subshrub 30-80 cm in height, with distinctly hairy stem, especially towards the base. An eastern Mediterranean species, extending eastwards to Iran. On Cyprus it occurs on dry stony places and along road sides (0-300 m alt.).

**Xylem**
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 µm in diameter). Vessels-ray pits with distinct borders, similar to intervessels pits in size and shape throughout the ray cell. Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 100-200 µm. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Druses in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and up to 3 seriate. Larger rays height greater than 1 mm. Rays disappear in polarized light.

**Bark**

**Pith**
**Codified description**

1 4 11 13 22 26 30 31 39.1 41 45 52.3 62 78 79 89.1 96 97 100.2 102 103 109 116.1 144 145 – B1 B2 B3.1 B6.3 B7.2 B14.1 - P0.1 P1.1 P2 P3 P3.2 P3.4 P6 P9 P9.1 P10 P10.2

*Convolvulus oleifolius var. desertii Desr. Pamp.*

(Annex 1, plate no. 26)

Subshrub up to 50 cm in height, with erect or spreading, densely hairy stems, branched from the base. It is found in Libya and Cyprus, restricted to dry, rocky, calcareous slopes (150-200 m alt.).

**Xylem**


Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate and 1 to 3 cells wide.

**Bark**


**Pith**


With crystals druses. Vascular bundles in the pith. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.
Convolvulus oleifolius var. pumilus Desr. Pamp.
(Annex 1, plate no. 27)

Dwarf, much branched subshrub up to 15 cm in height, forming dense, rounded tufts. On Cyprus it is restricted to the coastal area around Cape Greko (0-20 m alt.). Found also in Libya.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 μm in diameter). Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Druses in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and 2-3 cells wide. Larger rays height greater than 1 mm. Rays disappear in polarized light.

Bark

Pith

Codified description
1 3 9 9.1 13 21 22 25 39.1 40.2 53.1 62 69 70 78 89 89.1 96 97 100.2 102 103 105 116.2 144 145 - B1 B2 B3.1 B7.2 B10 B10.2 B14.1 - P1 P2 P3.4 P4 P10 P10.2 P12 P13

Convolvulus oleifolius var. oleifolius Desr.
(Annex 1, plate no. 27)

Subshrub up to 50 cm in height, with erect or spreading, densely hairy stems, branched from the base. Indigenous to central eastern Mediterranean countries. On Cyprus it grows on garigue and on dry, rocky slopes (0-700 m alt.).
Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary and in clusters. Vessels cell wall thick (greater than 2 \( \mu m \)). Mean tangential diameter of earlywood vessels 20-50 \( \mu m \). Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 \( \mu m \) in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 \( \mu m \). Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Druses in axial parenchyma cells.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description

Dipsacaceae
*Pterocephalus multiflorus* Poech subsp. *multiflorus*
(Annex 1, plate no. 27)

Much branched, low shrub up to 1 m in height with erect or spreading branches. Endemic to Cyprus. It occurs in phrygana, on rocky slopes, maquis and open pine forests (150-1900 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous. Vessels in diagonal and/or radial pattern or in clusters. Mean tangential diameter of earlywood vessels 20-50 \( \mu m \). Vessels of two distinct diameter classes; 40 – 100 earlywood vessels per square millimeter. Fibers thin to thick
walled. Axial parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.  
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 350-800 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.  
Tangential section: Rays predominantly uniseriate.  

Bark  
Groups of sieve tube in radial rows. Prismatic crystals and acicular present.  
Pith  

Codified description  
1 4 7 11 13 22 25 30 31 36 40.2 45 49 53 62 69 76 78 96.1 105 116.2  B1 B1.2  
B7 B7.1 – P1 P4.1 P6.2 P9 P9.1 P10.2 P13  

*Pterocephalus multiflorus* Poech. subsp. *obtusifolius* Holmboe  
(Annex 1, plate no. 28)  

Much branched, low shrub up to 1 m in height with erect or spreading branches. Endemic to Cyprus. It occurs on dry calcareous slopes (0-800 m alt.).  

Xylem  
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous to semi-ring porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessels less than 20 μm. Greater than 200 vessels per square millimeter in earlywood. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter.  
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length greater than 500 μm. Fibers with distinctly bordered pits (fiber tracheids). Helical thickenings in ground tissue fibers. All ray cells upright and/or square.  
Tangential upright and/or square.  
Tangential section: Rays uniseriate and 4 to 10 seriate.  

Bark  
Groups of sieve tubes present. Groups of sieve tube in radial rows. Collapsed
sieve tubes. Prismatic crystals. Phellem not clearly distinct.

Pith

Codified description
1 3 4 9 11 13 22 24 36 40.1 50.2 53.2 58 62 64 69 78 96 98 105 116.2 - B1 B1.2 B2 B7 B14 - P1.1 P3.3 P4 P6.2 P9 P9.1 P10.2

*Scabiosa cyprica* Post
(Annex 1, plate no. 28)

Shrub up to 1.2 m in height. An endemic species, occurring on dry slopes in garigue and open pine forests (150-1200 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 µm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
1 4 9 13 22 25 30 40.2 53.1 62 69 70.3 75 76 96 105 116.2 - B1 B2 B3.1 B7 B18 - P1 P4 P9 P9.1 P9.2 P9.3 P10.1 P10.2 P12
**Elaeagnus angustifolia** L.
(Annex 1, plate no. 28)

Deciduous shrub or small tree up to 8 m in height. An adventive species in Cyprus, naturalized on uncultivated slopes and cultivated in gardens, parks and road side plantations as ornamental (0-1400 m alt.). Native to western Asia extending eastwards up to northern China.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels in diagonal and/or radial pattern, solitary, in clusters or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Fibers thin to thick walled. Tension wood present. Axial parenchyma diffuse. Axial parenchyma scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Less than 4 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Earlywood vessel elements length 100-200 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells procumbent. Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Rays of two distinct sizes: uniseriate and up to 10 seriate.

Bark

Pith

Codified description
1 3 7 9 9.1 11 13 22 25 30 39 41 52.3 60 62 69 70.2 76 78 86 96 98 103 104 106 114 - B1 B1.1 B2 B6.2 B6.3 B7.3 B11 B14.1 B14.3 - P1.1 P4 P5 P6.4 P9 P9.1 P9.2 P10.2
Arbutus andrachne L.  
(Annex 1, plate no. 29)

Evergreen shrub or small tree, 3-5(10) m in height, with characteristic fissured bark, variable in colour and fissures pattern long the growing season. Native to Cyprus, common in medium and high altitude (700-1500 m). Indigenous to Mediterranean countries from Albania to Palestine, and from Crimea to the Caucasus.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels predominantly solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessels 20-50 μm, greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma diffuse and scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers), septate fibers present. Ray cells upright and/or square, in some ray with 1-3 row of upright and/or square marginal cells.
Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith

Codified description
1 4 9 9.1 13 22 25 30 36 40.2 50.2 53.1 61 65 69 76 78 96 97 105 106 107 115 — B1 B1.1 B2 B3.1 B6.3 B7 B14.1 B14.3 — P1 P3.3 P4 P9 P9.1 P10.2 P12 P13

Arbutus unedo L.  
(Annex 1, plate no. 29)

Evergreen shrub, 3-5 m in height, with a characteristic fissured bark. Native to Cyprus, with a limited distribution, found only in Akamas peninsula (30-80 m
It is common in south-east Europe towards western Ireland and in the Mediterranean countries as far as Turkey.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, large (greater than 10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 350-800 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Rays of two distinct sizes: uniseriate and 2-3 seriate. Larger rays height greater than 1 mm.

Bark

Pith

Codified description
1 4 11 13 22 27 31 36 40.2 50.2 53 56 58 61 69 70 78 96 97 103 105 106 116.2 — B1 B1.2 B7 B14.1 B14.3 — P1 P4.1 P6 P9 P9.1 P9.3 P10.2 P13

_Erica sicula_ Guss.
(Annex 1, plate no. 29)

Plant: Evergreen shrub up to 65 cm in height. Native to Cyprus, with limited distribution (250-850 m alt.). It is also found in Sicily, southern Turkey, Lebanon and Libya.

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Mean tangential diameter of earlywood vessels less than 20 μm. Tyloses with thin wall common. Gums and other deposits in heartwood vessels. Fibers thick
to very thick walled. Axial parenchyma diffuse. Axial parenchyma scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Rays with procumbent, square and upright cells mixed throughout the ray.

Tangential section: Rays of two distinct sizes: predominant 1 to 3 cells and larger rays commonly 4 to 10 seriate.

Bark

Pith
Pith shape square. Thick walled parenchyma cells present. Cells dimorphic. Cell content (gum, tannins, dark staining substances). Pits in transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct.

Codified description
2 5 13 21 22 24 30 40.1 52.3 56 58 61 69 70 76 78 86 96 97 98 103 105 109 116.2 - B3.1 B4 B5.2 B5.3 B11 B14.1 B14.3 - P1.4 P3.3 P4 P5 P9 P9.1 P10.1 P10.2

**Euphorbiaceae**

*Euphorbia hierosolymitana* Boiss.
(Annex 1, plate no. 30)

Evergreen, glabrous shrub up to 1 m in height. A very rare indigenous species to Cyprus, occurring on dry slopes in garigue and maquis (100-500 m alt.) An eastern Mediterranean species.

Xylem
Transverse section: Only one ring. Wood diffuse porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 4 or more common. Mean tangential diameter of earlywood vessels less than 20 µm. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits scalariform. Inter-vessel pits opposite, minute (less than 4 μm in diameter). Vessel-ray pits with large horizontal or vertical apertures. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
5 7 10 13 20 21 24 32 40.1 52.3 61 69 75 96 105 116.2 - B1 B4.1 B6.2 B7.3 B14.1 B14.3 – P1 P3.4 P6.2 P9 P9.1 P10 P10.1 P12

_Euphorbia thompsonii_ Holmboe
(Annex 1, plate no. 30)

Evergreen, robust, erect and tomentose subshrub. A rare indigenous species occurring on dry slope in garigue, maquis and pine forests (50-400 m alt.). An eastern Mediterranean species restricted to Cyprus and southern Turkey.

Xylem

Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate.
Bark
Pith disappear in polarized light. Pith shape round. Unilignified cells. Primary vascular bundles clearly separate from one another to not distinct.

Pith

Codified description
2 5 7 10 13 22 26 31 40.1 52.3 61 69 76 78 89 96 105 116.1 - B1 B6.3 B7.3 B10 B10.2 B14.1 B14.3 - P1 P3.4 P10.1 P10.2

*Ricinus communis* L.
(Annex 1, plate no. 30)

Deciduous shrub up to 5 m in height. An adventive species, occurring on wetland all over Cyprus (0-500 m alt.). Probably native to northeast tropical Africa, but widely cultivated and naturalized in the warmest part of the world.

Xylem
Transverse section: Only one ring. Vessels solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 – 100 µm, 40 – 100 earlywood vessels per square millimeter. Fibers thick to very thick walled. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith
Codified description
B14.3 – P1 P4.1 P6.2 P9 P9.1 P9.3 P10.1 P12

**Fagaceae**

*Quercus coccifera* L. subsp. *calliprinos* (Webb) Holmboe
(Annex 1, plate no. 31)

Evergreen shrub or small tree up to 10 m in height. Indigenous to Cyprus, found in maquis and pine forests (100-1300 m alt.). Also native to Turkey, Syria and Palestine.

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, vessels number in early wood: 100-200 per square millimeter. Tyloses with thin wall common. Fibers very thick walled, tension wood present. Axial parenchyma scanty paratracheal and vasicentric. Apotracheal parenchyma in narrow bands or lines up to three cells wide.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits with large horizontal or vertical apertures. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells procumbent. Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in ray parenchyma cells and in axial parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Aggregate rays present.

**Bark**

**Pith**
Pith shape triangular. Thick walled parenchyma cells present. Cells dimorphic center/border of the pith and cells dimorphic in the center of the pith. With prismatic crystals. Pits of two distinct size in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other or not distinct. Axial cells arranged in regular rows (radial section).
**Quercus infectoria** Oliv. subsp. *veneris* (A.Kern.) Holmboe
(Annex 1, plate no. 31)

Semi-deciduous shrub or small tree up to 20 m in height. Indigenous to Cyprus, occurring in the mountains and in the lowlands (0-1700 m alt.). Indigenous to Turkey and eastwards to Iran.

**Xylem**
Growth ring boundaries clearly demarcated. Wood ring porous. Vessels in diagonal and/or radial pattern, predominantly solitary. Mean tangential diameter of earlywood vessel lumina 100 – 200 μm, vessels number in early wood: 100-200 per square millimeter. Tyloses with thin wall common. Fibers thin to thick walled, tension wood present. Axial parenchyma diffuse and vasicentric. Axial parenchyma in marginal or in seemingly marginal bands.
Radial section: Simple perforation plates. Inter-vessel pits alternate. Vessel-ray pits rounded or angular with large apertures. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent. Prismatic crystals present.
Tangential section: Rays of two distinct sizes: uniseriate and larger rays commonly greater than 10 seriate. The latter ray height greater than 1 mm.

**Bark**

**Pith**
Frankeniaceae

*Frankenia hirsuta* L.
(Annex 1, plate no. 31)

Procumbent subshrub. Indigenous to Cyprus, found along sandy shores (0-200 m alt.). Widespread in the Mediterranean.

**Xylem**
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Fibers thin to thick walled. Parenchyma pervasive. Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 200-500 μm. Tangential section: Wood rayless

**Bark**

**Pith**

**Codified description**
2 5 9 13 22 24 39.1 40.1 53.1 69 79.1 117 - B1 B2 B6.3 B7 B7.2 B14.1 B14.3 B18 - P1.1 P1 P3.4 P4 P10.2

Guttiferae

*Hypericum hircinum* L.
(Annex 1, plate no. 32)

Much branched, deciduous shrub up to 2 m in height. A rather rare native to Cyprus, growing mostly on shades and moist sites, often near streams (300-700 m alt.). Indigenous also in most other Mediterranean countries, and Arabia.

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma diffuse. Rays per millimeter 12-20. Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-
vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Fibers with simple and bordered pits, septate fibers present. All ray cells upright and/or square. Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tube and collapsed sieve tubes present. Some rays become dilated. With ducts. Phellem homogeneous.

Pith

Codified description
1 3 9.1 13 22 26 30 40.2 53.1 58 61 62 65 69 76 96 105 106 116.1 — B1 B2 B3.1 B10 B10.2 B14.1 — P1 P3.3 P4 P5 P9.1 P10.2 P12

*Hypericum confertum* (Choisy) G.Don
(Annex 1, plate no. 32)

Subshrub up to 35 cm in height. It thrives on rocky ground in pine forests (1200-1950 m alt.). Indigenous also to south and west Turkey, Syria and Lebanon.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous to semi-ring porous. Vessels in radial multiples of 2 to 4 and in clusters. Mean tangential diameter of earlywood vessels less than 20 μm. Gums and other deposits in heartwood vessels. Fibers thin to very thick walled. Axial parenchyma diffuse. Axial parenchyma in marginal or in seemingly marginal bands composed of thin walled cells, dark in polarized light. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 50-100 μm. Fibers with simple and distinctly bordered pits. All ray cells upright and/or square. Tangential section: Rays uniseriate to 1 to 3 cells wide.

Bark
Groups of sieve tube and collapsed sieve tubes present. Some rays become dilated. With secretory elements in ducts. Phellem homogeneous.
Pith
Pith disappear in polarized light, round in shape.

Codified description
1 3 4 9.1 11 13 22 24 30 36 40.1 52.2 58 61 62 69 70 76 89 89.1 96.1 97 105
116.2 – B1 B2 B3.1 B10 B10.2 B14.1 – P1.1 P1

Juglandaceae
Juglans regia L.
(Annex 1, plate no. 32)

Deciduous tree up to 25 m in height. A cultivated plant in Cyprus, but often found wild on moist sites (500-1400 m alt.). Native of the Balkan Peninsula and central Asia.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semiring porous. Vessels solitary or in radial multiples of 2 to 4 common, mean tangential diameter of earlywood vessel lumina 100 – 200 μm, 40 – 100 earlywood vessels per square millimeter. Tyloses with thin wall common. Fibers thin to thick walled. Axial parenchyma diffuse. Axial parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, large (greater than 10 μm in diameter). All forms of vessel-ray pits: from rounded or angular with large apertures to large horizontal or vertical apertures. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent.
Tangential section: Rays generally 2 to 3 seriate, rarely uniseriate or up to 10 seriate.

Bark

Pith
Labiateae

*Ballota integrifolia* Benth.
(Annex 1, plate no. 33)

Deciduous shrub up to 150 cm in height. Endemic to Cyprus found on rocky slopes, in shrubland and field margins (0-700 m alt.).

**Xylem**
Transverse section: Growth ring distinct and recognizable. Wood ring porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not recognizable. Axial parenchyma scanty paratracheal. Rays 12-20 to greater than 20 per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, large (greater than 10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length less than 350 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and 2-3 seriate. Larger rays height greater than 1 mm.

**Bark**
Groups of sieve tubes present. Sclerenchyma cells both in phloem and cortex. In cortex fibers grouped. In phloem sclereids in tangential rows. Prismatic crystals present. Phellem homogeneous. In adult bark fiber not observed; sclereids in tangential rows and scattered or irregularly dispersed.

**Pith**
Calamintha incana (Sibth. & Sm.) Boiss.
(Annex 1, plate no. 33)

Strongly aromatic, usually prostrate, much branched, deciduous subshrub with stem up to 60 cm long. Native to Cyprus, found along roadsides and on fallow land, sand dunes and rocky slopes (0-1500 m alt.) Also indigenous to the eastern Mediterranean.

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to greater than 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Rays exclusively uniseriate.

Bark

Pith missing

Codified description
2 5 7 9.1 10 13 22 24 30 40.2 50.2 61 69 75 96 105 116.2 - B1 B7.3 B11 B18 - Pith missing

Lavandula angustifolia Mill.
(Annex 1, plate no. 33)

Aromatic shrub up to 100 cm in height. Adventive to Cyprus, found scattered throughout some areas but better know as an ornamental plant. Thrives on well-drained soils and in sunny places (0-1400 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-
ring porous to diffuse porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels less than 20 μm. Vessels number in early wood: 100-200 per square millimeter. Fibers thin to thick walled. Tension wood present. Axial parenchyma scantly paratracheal.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings only in narrower vessel elements. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate to 3 cells wide.

Bark

Pith
Pith shape polygonal. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Pits grouped. Pits of two distinct size. Primary vascular bundles clearly separate from one another to not distinct. Axial cells arranged in regular rows (radial section).

Codified description

*Micromeria nervosa* (Desf.) Benth.
(Annex 1, plate no. 34)

Much branched subshrub up to 50 cm in height. Native to Cyprus, growing in thickets and phrygana (0-600 m alt.). Also indigenous to the Mediterranean countries.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in radial multiples of 4 or more common. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter. Stem lobed.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Ray exclusively uniseriate.
Bark

Pith
Pith shape square. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 5 10 13 22 24 30 40.2 50.2 61 69 75 96 99.2 105 116.2 - B1 B8 B11 B14.3 - P1.4 P3.3 P4 P9.1 P10.1 P12

*Micromeria cypria* Kotschy
(Annex 1, plate no. 34)

Usually prostrate, much branched subshrub up to 15 cm in height. Endemic to Cyprus, occurring in crevices of limestone rocks on the Pentadactylos mountain range (300-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Axial parenchyma in marginal or in seemingly marginal bands. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Phloem uniform.

Pith
Pith shape square. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Pits grouped. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).
**Micromeria chionistrae** Meikle  
(Annex 1, plate no. 34)

Sub erected or sprawling subshrub up to 30 cm in height. Endemic to Cyprus, very common in crevices of ophiolite rocks on the Troodos mountain range (400-1500 m alt.).

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels solitary and in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Axial parenchyma in marginal or in seemingly marginal bands. Stem lobed. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

**Bark**
Groups of sieve tubes present. Phloem almost uniform. Phellem/epidermis distinct in polarized light.

**Pith**

**Micromeria myrtifolia** Boiss. et Hohen  
(Annex 1, plate no. 35)
Erect, much branched subshrub up to 50 cm in height. Indigenous to Cyprus, occurring in forests, thickets, and phrygana (0-1200 m alt.). Also indigenous to the Mediterranean countries and eastwards to Iran.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Phloem uniform. Cell content in parenchyma cells.

Pith

Codified description
1 4 9.1 10 13 22 24 30 40.1 50.2 58 61 69 75 96 99.2 105 116.2 - B8 B11 - P1.4 P4 P5 P9 P9.1 P9.2 P9.3 P10.1 P10.2 P12 P13

*Nepeta troodi* Holmboe
(Annex 1, plate no. 35)

Erect or sprawling subshrub up to 50 cm in height. Endemic to Cyprus, locally common in rocky mountainsides and in pine forests (1000 - 1950 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels in radial multiples of 2 to 4 and in clusters. Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in
earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Stem lobed. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tube and collapsed sieve tubes present. Sclereids in tangential rows or scattered and irregularly dispersed. Prismatic crystals.

Pith

Codified description

Origanum cordifolium (Aucher et Montbret ex Benth.) Vogel
(Annex 1, plate no. 35)

Aromatic much branched subshrub up to 60 cm in height. Endemic to Cyprus, growing on moist, rocky places along stream sides, on igneous formations (200-900 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.
Bark
Groups of sieve tubes present. Druses present. Phloem uniform.

Pith

Codified description
1 4 5 7 9.1 13 22 24 40.2 50.2 61 69 78 89 96 105 116.2 - B1 B7.2 B8 - P1 P9 P9.1 P9.2 P9.3 P10.2 P13

*Origanum dubium* Boiss.
(Annex 1, plate no. 36)

Aromatic shrub up to 10 cm in height. Indigenous to Cyprus, growing on rocky places and in maquis, garigue and pine forests (200-1000 m alt.). Also indigenous to Turkey.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
1 4 9 9.1 13 22 25 30 40.2 50.2 61 69 70.3 75 89 96 105 116.2 - B7.1 B8 B11 - P1.4 P4 P9 P9.1 P9.2 P9.3 P12 P13

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**Origanum majorana L.**
(Annex 1, plate no. 36)

Much branched aromatic shrub up to 100 cm in height. Endemic to Cyprus, it grows in shrubland, pine forests and rocky places (0-900 m alt.).

**Xylem**
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Rays exclusively uniseriate.

**Bark**

**Pith**

**Codified description**

**Phlomis brevibracteata** Turril
(Annex 1, plate no. 36)

Shrub up to 1,5 m in height. Endemic to Cyprus, growing in maquis and garigue, mainly on limestone formations (300-900 m alt.).

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate to 1 to 3 cells wide.

Bark
Groups of sieve tubes present. Sclereids in tangential rows and scattered or irregularly dispersed. Crystal sand. Layered phelloderm.

Pith

Codified description

Phlomis cypria Post. var. cypria Meikle
(Annex 1, plate no. 37)

Shrub up to 1.5 m in height. Endemic to Cyprus, occurring in to varieties. It occurs in shrubland and on limestone slopes in the eastern parte of the Pentadactylos range (150-750 m alt.).

Xylem

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate to 3 cells wide.
Bark
Fibers scattered or irregularly dispersed. Phellem/epidermis distinct in polarized light.

Pith
Pith shape square. With acicular crystals. Pits in transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 3 7 9.1 11 13 22 25 36 40.2 52.3 61 69 70.3 78 79 96 97 105 116.1 - B5.3 B14.3 - P1.4 P6.1 P9 P9.1 P10.1 P10.2 P12

**Phlomis cypria** Post var. *occidentalis* Meikle
(Annex 1, plate no. 37)

Shrub up to 1.5 m in height. Endemic to Cyprus, occurring in to varieties. It occurs in shrubland mainly in ophiolite formations (150-750 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels in diagonal and/or radial pattern or in clusters. Mean tangential diameter of earlywood vessels 20-50 μm, vessels number in early wood: 100-200 per square millimeter. Fibers thin to thick walled, radial flat marginal fibers. Axial parenchyma scanty paratracheal, apotracheal parenchyma in marginal or in seemingly marginal bands. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays uniseriate to 3 cells wide.

Bark
Sclereids scattered or irregularly dispersed.

Pith
Phlomis lunariifolia Sm.
(Annex 1, plate no. 37)

Shrub up to 2 m in height. Indigenous to Cyprus, found in shrublands (0-500 m alt.). Also found in southern Turkey.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays uniseriate to 3 cells wide.

Bark
Groups of sieve tubes present. Sclereids scattered or irregularly dispersed. Crystal sand. Cell content in parenchyma cells.

Pith

Prasium majus L.
(Annex 1, plate no. 38)
Erect or scrambling shrub, with stem up to 4 long. Common indigenous species in Cyprus, occurring in maquis, garigue, forests and occasionally in rocky crevices (0-700 m alt.). Occurs throughout the Mediterranean.

Xylem
Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous. Vessels in diagonal and/or radial pattern. Vessels solitary or in radial multiples of 2 to 4. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable; axial parenchyma scanty paratracheal in earlywood. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 350 µm. Fibers with simple to minutely bordered pits (libriform fibers); septate fibers present. All ray cells upright and/or square.
Tangential section: Rays predominantly uniseriate, few 2-3 seriate.

Bark
Groups of sieve tube in tangential rows. Collapsed sieve tubes. Fibers in tangential rows and scattered or irregularly dispersed. Prismatic crystals, druses and crystal sand present. In adult bark fibers arrangement in tangential rows only.

Pith

Codified description
1 4 7 9.1 13 22 25 30 39.1 40.2 45 50.2 52 61 65 69 75 78 96.1 97 105 116.1 – B1 B1.1 B2 B5.2 B5.3 B7 B7.2 B7.3 – P1 P4 P4.1 P6 P6.1 P9 P9.1 P9.3 P10.2 P12 P13

Salvia fruticosa Mill.
(Annex 1, plate no. 38)

Strongly aromatic shrub up to 120 cm in height. Very common indigenous species in Cyprus, growing on rocky places, shrublands and pine forests. (0-1500 m alt.). Also occur in the eastern Mediterranean region, from Italy to Palestine.
Xylem
Transverse section: growth ring distinct and recognizable. Wood semi-ring-porous, vessels in diagonal and radial pattern, predominantly solitary. Mean tangential diameter of earlywood vessels 50 – 100 m, vessels of two distinct diameter classes. Greater than 100 earlywood vessels per square millimeter. Tyloses with thin wall common. Fibers thin to thick walled. Axial parenchyma scanty paratracheal and in marginal or in seemingly marginal bands. Stem lobed. Rays per millimeter 12-20.
Radial section: simple perforation plates. Inter-vessel pittings pseudoscalariform to reticulate or alternate. Inter-vessel pits medium (7-10 μm in diameter). Earlywood vessel elements length up to 350 μm. Vascular and vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: rays exclusively uniseriate. Ray width predominant 1 to 3 cells.

Bark
Adult bark only: Groups of sieve tube in radial rows. Distinct rays dilatations. Sclereids in tangential rows. Prismatic crystals and druses present.

Pith
Pith shape round. Cells dimorphic center/border of the pith. Crystal sand. Pits in transverse and in longitudinal cell walls (radial section). Pits of two distinct size. Primary vascular bundles clearly separate from one another to not distinct. Axial cells arranged in regular rows (radial section).

Codified description
1 4 7 9 13 20.1 22 26 41 45 50 52 56 60 61 69 78 89 96 97 99.2 105 116.1 - bark missing - P1 P4.1 P6.4 P9 P9.1 P9.3 P10.1 P10.2 P13

Salvia willeana (Holmboe) Hedge
(Annex 1, plate no. 38)

Strongly aromatic subshrub up to 60 cm in height. Endemic to Cyprus, occurring on rocky places and in pine forests and shrublands. Confined to the ophiolite formations on the Troodos mountain range (1000-1950 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous to semi-ring porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels 20-50 μm, vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vessel-ray pits with large horizontal or vertical apertures. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate to cells wide. Rays of two distinct sizes.

Bark
Groups of sieve tubes present. Crystal sand. Tannins and/or other cell content in parenchyma cells. Layered phelloderm.

Pith

Codified description
1 3 4 9 13 22 24 30 32 40.2 45 50.2 56 58 61 69 75 78 96 97 99.2 103 105 116.2 — B1 B7.3 B11 B18 — P1 P4 P9 P9.1 P10.1 P10.2 P12

*Salvia lanigera* Poir.
(Annex 1, plate no. 39)

Strong-smelling subshrub up to 40 con in height. Indigenous to Cyprus, growing in shrublands, sandy places and san dunes (0-200 m alt.). Also occur in north Africa, Palestine and eastward to Iran and Saudi Arabia.

Xylem
Transverse section: Only one ring. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pittings pseudoscalariform to reticulate. Inter-vessel pits alternate, small (4-7 μm in diameter). Earlywood vessel elements length less than 50 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate. Rays confluent with ground tissue.
Bark

Pith missing

Codified description
9.1 13 20.1 22 25 40.2 50.2 52.1 60 61 69 75 96 100.1 105 116.2 - B1 B2 B7.1 B11 - Pith missing

*Salvia dominica* L.
(Annex 1, plate no. 39)

Strongly aromatic shrub or subshrub up to 100 cm in height. Rare, indigenous species to Cyprus, occurring on rocky places (20-150 m alt.). Also occur in Syria, Palestine and Egypt.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and up to 3 cells wide. Larger rays height greater than 1 mm.

Bark
Groups of sieve tubes present. Collapsed sieve tubes. Sclereids in tangential rows, scattered or irregularly dispersed. Acicular crystals.

Pith
Pith shape square. Cells dimorphic. With acicular crystals. Pits in transverse and in longitudinal cell walls. Pits of two distinct size. Primary vascular bundles clearly separate from one another to not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).
Erect, much branched aromatic shrub up to 50 cm in height. Rare, indigenous species in Cyprus, growing on limestone and igneous rocks (200-300 m alt.). It also occurs in Sardinia, Greece and countries of the eastern Mediterranean.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
1 3 4 9.1 11 13 22 25 30 40.2 45 50.1 61 69 78 96 105 116.2 - B7.1 B8 B18 - P1 P3.3 P5 P9 P9.1 P10.1 P12

Scutellaria sibthorpii Boiss. et Reut. ex Boiss.
(Annex 1, plate no. 40)

Erect or sprawling subshrub up to 50 cm in height. Endemic to Cyprus, found on rocky calcareous hillsides, sometimes on coastal garigue (0-60 m alt.).
Xylem
Transverse section: Only one ring. Vessels solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessels less than 20 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4–7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays uniseriate to 3 cells wide.

Bark
Groups of sieve tubes present. Fibers scattered or irregularly dispersed. Crystal sand. Phellem homogeneous.

Pith
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Pits grouped and in two distinct size. Primary vascular bundles clearly separate from one another to not distinct.

Codified description
9 9.1 13 22 25 30 40.1 50.2 61 69 75 96.1 97 105 116.2 - B1 B5.3 B7.3 B14.1 - P1 P4 P9 P9.1 P9.2 P9.3 P10.1 P10.2

*Sideritis cypria* Post
(Annex 1, plate no. 40)

Subshrub up to 60 cm in height. Endemic to Cyprus, growing in crevices of south-facing limestone cliffs on Pentadactylos mountain range (300–900 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4–7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and up to 3 cells wide.
Bark

Pith

Codified description

*Teucrium micropodioides* Rouy
(Annex 1, plate no. 40)

Strongly aromatic subshrub up to 20 cm in height, usually forming low, domed bushes. Common, endemic species in Cyprus, found on rocky places, in maquis, garigue and pine forest (0-900 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood diffuse-porous. Vessels in radial multiples of 2 to 4 or in clusters. Mean tangential diameter of earlywood vessels less than 20 µm. Greater than 100 earlywood vessels per square millimeter. Gums and other deposits in heartwood vessels and/or fibers. Fibers thin to very thick walled. Radial flat marginal fibers. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in marginal or in seemingly marginal bands. Greater than 20 rays per millimeter. Stem lobed.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 350-800 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate.

Bark
Collapsed sieve tubes. Acicular crystals and crystal sand present. Tannins and/or other cell content in parenchyma cells.

Pith
Pith shape round, with thick walled parenchyma cells. Cells dimorphic center/border of the pith. Cell content (dark staining substances). Pits in
transverse and in longitudinal cell walls, grouped in longitudinal cell walls. Primary vascular bundle not distinct. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 5 9.1 11 13 22 25 30 40.1 50 53 58 61 69 70 70.3 76 78 89 96 99.2 105 116.2 – B2 B7.1 B7.3 B11 – P1 P3.3 P4.1 P5 P9 P9.1 P9.2 P10.2 P12

Teucrium creticum L.
(Annex 1, plate no. 41)

Shrub up to 2 m in height. Common indigenous species in Cyprus, occurring in maquis and garigue and on rocky places. (0-900 m alt.). Also occurs in the east Mediterranean region from Turkey to Lebanon.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous to semi-ring porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thick walled to very thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Fibers with simple to minutely bordered pits (libriform fibers). Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 3 4 7 9.1 13 22 25 30 39 40.2 45 50.2 61 69 70 75 78 96.1 97 116.2 - B7.3 B8 B11 - P1 P4 P9 P9.1 P10.1 P10.2 P12 P13
Teucrium cyprium Boiss. subsp. cyprium
(Annex 1, plate no. 41)

Strongly aromatic subshrub up to 10 cm in height. Endemic species in Cyprus. It
occurs in two subspecies: 1) cyprium, restricted to rocky mountainsides and
pine forests of the Troodos range (300-1900 m alt.); 2) kyreniae, restricted to
rocky and cliffy places of the Pentadactylos mountain range (0-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-
ring porous to diffuse porous. Vessels predominantly solitary. Mean tangential
diameter of earlywood vessels less than 20 µm. Vessels of two distinct diameter
classes. Greater than 200 vessels per square millimeter in earlywood. Fibers
thin to thick walled. Axial parenchyma absent or extremely rare or not
recognizable. Axial parenchyma scanty paratracheal. Greater than 20 rays per
millimeter. Stem lobed.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute
(less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to
inter-vessels pits in size and shape throughout the ray cell. Helical thickenings
in vessel elements present. Fibers with distinctly bordered pits (fiber tracheids).
Helical thickenings in ground tissue fibers. All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tubes present. Crystal sand. Phloem uniform. Cell content in
parenchyma cells. Layered phelloderm.

Pith
Pith missing

Codified description
1 4 5 9 13 22 24 30 36 40.1 45 50.2 62 64 69 75 78 96 99.2 105 116.2 - B1 B7.3
B8 B11 B18 - pith missing

Teucrium cyprium Boiss. subsp. kyreniae Boiss. P.H. Davis
(Annex 1, plate no. 41)

Strongly aromatic subshrub up to 10 cm in height. Endemic species in Cyprus. It
occurs in to subspecies: 1) cyprium, restricted to rocky mountainsides and pine
forests of the Troodos range (300-1900 m alt.); 2) kyreniae, restricted to rocky
and cliffy places of the Pentadactylos mountain range (0-900 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-
ring porous. Vessels in diagonal and/or radial pattern. Vessels predominantly in clusters. Mean tangential diameter of earlywood vessels 20-50 µm. Greater than 200 vessels per square millimeter in earlywood. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma absent or extremely rare or not recognizable. Stem lobed. Greater than 20 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Fibers with distinctly bordered pits (fiber tracheids). Helical thickenings in ground tissue fibers. All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate.

Bark

Pith
Pith missing

Codified description
1 4 7 11 13 22 24 30 36 40.2 50.2 58 62 64 69 70 75 96 99.2 105 116.2 - B1 B7.3 B8 B11 B18 - Pith missing

*Teucrium divaricatum* subsp. *canescens* Heldr. (Celak.) Holmboe
(Annex 1, plate no. 42)

Subshrub up to 50 cm in height. A common endemic species to Cyprus, growing in maquis, garigue and rocky places (0-1600 m alt.).

Xylem

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Fibers with simple to minutely bordered pits (libriiform fibers). All ray cells upright and/or square.

Tangential section: Rays of two distinct sizes: uniseriate to 3-4 cells wide.
Bark

Pith

Codified description
1 3 4 9 9.1 13 22 25 30 40.2 45 50.2 61 69 75 78 89 96.1 97 103 105 116.1 - B6.3 B7.3 B11 B18 - P1 P4 P9 P9.1 P10.2 P12

*Teucrium kotschyanum* Poech.
(Annex 1, plate no. 42)

Subshrub up to 80 cm in height. It grows on rocky, igneous mountainsides (500-1500 m alt.). Indigenous to Cyprus, it occurs also in the Aegean islands and Turkey.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels predominantly in clusters. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Gums and other deposits in heartwood vessels. Fibers thick walled to very thick walled. Axial parenchyma absent or extremely rare or not recognizable. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Rays exclusively uniseriate.

Bark

Pith
Pith shape square. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.
**Thymus capitatus** (L.) Hoffmanns

*(Annex 1, plate no. 42)*

Much branches, aromatic subshrub, forming lo-domed mats, up to 50 cm in height. It is very common on rocky slopes, disturbed ground and occasionally sand dunes (0-900 m alt.). Indigenous to Cyprus, it occurs throughout the Mediterranean countries.

**Xylem**

Transverse section: Growth ring distinct and recognizable. Wood diffuse porous. Vessels in diagonal and/or radial pattern, predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Gums and other deposits in heartwood vessels and/or fibers. Fibers thin to very thick walled. Axial parenchyma scanty paratracheal to vasicentric. Axial parenchyma in marginal or in seemingly marginal bands. Stem lobed. Rays 12-20 to greater than 20 per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length less than 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays exclusively uniseriate.

**Bark**

Groups of sieve tubes present. Prismatic and acicular crystals present. In adult bark only few acicular crystals.

**Pith**

Pith shape polygonal. With thick walled parenchyma cells. Cells dimorphic center/border of the pith. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate to not distinct each other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).
**Thymus intiger** Griseb.
(Annex 1, plate no. 43)

Much branched, aromatic subshrub, with erect or prostate branches, sometimes rooting, up to 10 cm in height. Endemic to Cyprus, growing on rocky slopes and in shrublands and pine forests (100-1700 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous to diffuse porous. Vessels solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Gums and other deposits in heartwood vessels and/or fibers. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Stem lobed. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Earlywood vessel elements length less than 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Phloem uniform. Prismatic and acicular crystals present.

Pith missing

Codified description
1 4 5 9 9.1 13 22 26 40.2 50.2 52 56 58 61 69 75 96 99.2 105 116.2 - B7 B7.1 B8 -
Pith missing

**Lauraceae**

*Laurus nobilis* L.
(Annex 1, plate no. 43)

Evergreen, deciduous shrub or small tree up to 10 (12) m in height. Indigenous species, occurring on moist, rocky grounds, usually near streams and springs (0-1300 m alt.). Indigenous to the Mediterranean region and Crimea.

Xylem
Transverse section: distinct growth rings, diffuse porous, vessels solitary or in clusters. Mean tangential diameter of earlywood vessels lumina 50-100 m; 20-40 earlywood vessels per square millimeter. Fibers thin to thick walled, tension wood present. Axial parenchyma scanty paratracheal. 4-12 rays per millimeter.
Radial section: simple and scalariform perforation plates with less than 10 bars, small intervessel pits alternate; vessels ray pits rounded and reticulate. Earlywood vessel elements length 350 m to 800 m. Fibers with minutely pits, many septate fibers. Body ray cells procumbent with one row of square marginal cells. Prismatic and elongated crystals in ray cells. Tangential section: rays width predominantly 1 to 3 cells. Oil cells associated with ray parenchyma.

Bark
Groups of sieve tube present, distinct rays dilatation only for some rays, groups of fibers linked by tangential rows of sclereids. With laticifers. Phellem distinct in polarized light. In adult bark the fibers are not presents, few acicular crystals in phloem.

Pith
Pith round in shape. Cells dimorphic in the center and in the border. Elongated prismatic crystals present. Pits in transverse and longitudinal cell walls.

Codified description
1 5 9 9.1 13 14 15 22 25 31 41 48 52 53 61 65 69 70.2 78 97 106 115 124 136.1 151 — B1 B3.1 B5.4 B6.2 B10 B10.3 B14.3 — P1 P4.1 P4.2 P6 P9 P9.1

Malvaceae
_Hibiscus rosa-sinensis_ L. (Photomicrographs not available)

Evergreen shrub up to 4 m in height. Exotic to Cyprus, possibly native to China. Frequently cultivated in Cyprus, mostly in urban areas (0-400 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessel lumina 100 — 200 μm. Greater than 200 vessels per square millimeter in earlywood. Fibers very thick walled. Axial parenchyma diffuse and vasicentric. Radial section: Simple perforation plates. Inter-vessel pits alternate. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Ray width predominant 1 to 3 cells. Larger rays commonly 4 to 10 seriate.

Bark
Groups of sieve tubes present. Some rays become dilated. Sclerenchyma cells

Pith

Codified description
2 9.1 13 22 42.5 61 70 76 79 97 98 106 - B1 B3.1 B4 B5.2 B5.4 B7 B14.1 B14.3 - P1 P3 P4.2 P5 P6.2 P7 P9 P9.1 P9.2 P9.3 P10.2 P12 P13

Lavatera bryoniiifolia Mill.
(Annex 1, plate no. 43)

Erect subshrub, up to 1 m in height. Native to Cyprus, growing on dry slopes with garigue vegetation and near streams (100-800 m alt.). Indigenous also to Greece and Palestine.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite, large (greater than 10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm.

Bark

Pith
Pith, shape round. Cells dimorphic. With crystals druses. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one
other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9.1 11 13 21 27 30 40.2 50.2 52 61 69 79 83 96 98 102 103 105 115 — B1 B1.2 B3.1 B5 B5.4 B7.2 B14.1 B14.3 — P1 P4 P6.2 P9 P9.1 P10.1 P12 P13

Mimosaceae

Acacia saligna (Labill.) H.L.Wendl.
(Annex 1, plate no. 44)

Evergreen shrub or tree, about 3-5 m in height. Native to Australia, in Cyprus it can be found in most of the cities in the lowlands, especially along road (0-700 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent. Prismatic crystals in axial parenchyma cells. Tangential section: Rays uniseriate and up to 3 cells wide.

Bark

Pith
Prosopis fracta (Banks & Sol.) J.F. Macbr.
(Annex 1, plate no. 44)

Deciduous, spiny shrub, 30-100 cm in height. Indigenous to Cyprus, very common on field sides in Mesaoria central plain (0-700 m alt.). It is also indigenous to Egypt, Libya, Turkey and eastwards to Afghanistan.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits scalariform. Inter-vessel pits opposite, small (4-7 μm in diameter). Septate fibers present. Rays with procumbent, square and upright cells mixed throughout the ray. Acicular crystals.
Tangential section: Aggregate rays.

Bark
Groups of sieve tubes in radial rows. Fibers in radial rows and grouped. Sclereids in tangential rows. Laticifers or intercellular canals. Phellem not clearly distinct.

Pith
**Moraceae**

*Ficus carica* L.

(Annex 1, plate no. 44)

Deciduous shrub or tree, 4-6 m in height. Indigenous to Cyprus, cultivated at 0-1500 m altitudes. Wild plants common on moist, cold cave or rocky sites and close to streams.

Xylem

Transverse section: Growth ring distinct and recognizable. Wood diffuse-porous. Vessels in radial multiples of 2 to 4 common. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, in some rings 100 – 200 μm; 40 – 100 earlywood vessels per square millimeter. Fibers thin to thick walled. Tension wood present. Axial parenchyma vasicentric. Axial parenchyma bands greater than three cells wide. Rays per millimeter 4-12. Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length less than 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in axial parenchyma cells.

Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm.

Bark

Groups of sieve tube in tangential rows. Only some rays become dilated. Prismatic crystals present. With laticifers, secretory elements, oil ducts or mucilage ducts. Tannins and/or other cell content in parenchyma cells. Phellem homogeneous and distinct in polarized light.

Pith


Codified description

1 5 9.1 13 22 26 31 39.1 41 42 49 52 61 69 70.2 79 85 96 98 102 103 109 115 — B1 B1.1 B3.1 B7 B10 B11 B14.1 B14.3 — P1.1 P1 P4.1 P6 P10.1 P10.2 P12 P13 P14
**Ficus sycomorus** L.  
(Annex 1, plate no. 45)

Mostly evergreen tree (sometimes leafless for a short time), 8-20 m in height. Native to Ethiopia and north east Africa, cultivated in Cyprus since a long time (0-200 m alt.).

**Xylem**

Transverse section: Growth rings indistinct or absent. Vessels solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 100 – 200 µm. Less than 5 earlywood vessels per square millimeter. Fibers thin to thick walled. Tension wood present. Apotracheal parenchyma diffuse. Axial parenchyma vasicentric often confluent or in bands greater than three cells wide. Rays per millimeter 4-12.

Radial section: Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell, with large horizontal or vertical apertures. Earlywood vessel elements length 200-500 µm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one to 4 rows of upright and/or square marginal cells. Prismatic crystals present in axial parenchyma cells.

Tangential section: Rays of two distinct sizes, larger rays commonly 4 to 10 seriate.

**Bark**


**Pith**


**Codified description**

2 9 9.1 22 24 30 32 42 46 53.1 61 69 70.2 76 79 83 85 98 103 106 107 115 136 141.1 - B3.1 B6.3 B7 B10 B10.2 B11 B14.1 B14.3 - P1 P3 P3.3 P3.4 P4.1 P6 P6.2 P9 P9.1 P9.3 P10.1 P12
**Morus alba** L.
(Annex 1, plate no. 45)

Deciduous tree up to 15 m in height. Native to China, commonly found as wild in many areas of Cyprus. Very commonly cultivated in the island (0-1400 m alt.).

**Xylem**

Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels solitary and in clusters. Vessels number in early wood: 100-200 per square millimeter. Tyloses with thin wall common. Fibers thin to thick walled. Tension wood present. Axial parenchyma scanty paratracheal to vasicentric, sometimes confluent. Rays per millimeter 4-12.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings only in narrower vessel elements. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Body ray cells procumbent with over 4 rows of upright and/or square marginal cells. Prismatic crystals in ray and in axial parenchyma cells.

Tangential section: Rays uniseriate and 4 to 10 seriate.

**Bark**

Groups of sieve tubes present. Collapsed sieve tubes. Sclerenchyma cells both in phloem and cortex. Sclereids in tangential rows and in groups. Prismatic crystals and crystal sand. With laticifers, secretory elements, oil ducts or mucilage ducts. Phellem homogeneous. Phellem/epidermis distinct in polarized light.

**Pith**

Pith shape round. Unilignified cells. With prismatic crystals. Pits in transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description


**Myrtaceae**

*Callistemon lanceolatus* DC.
(Annex 1, plate no. 45)
Evergreen tree up to 10 m in height. Exotic to Cyprus, found mainly in parks and gardens (0-300 m alt.). Native to Australia.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays uniseriate to 3 cells wide. Oil cells associated with ray parenchyma.

Bark
Groups of sieve tubes present. Some rays become dilated. Sclerenchyma cells both in phloem and cortex. Sclereids in tangential rows and scattered or irregularly dispersed. Prismatic crystals. Phellem homogeneous, distinct in polarized light.

Pith

Codified description
1 4 9 13 21 25 31 40.2 50.2 53.1 61 69 76 96 97 109 115 124 — B1 B3.1 B4 B6.2 B6.3 B7 B14.1 B14.3 — P1.1 P3 P3.1 P5 P6 P9 P9.1 P10.2 P13

_Eucalyptus camaldulensis_ Dehnh.
(Annex 1, plate no. 46)

Evergreen tree up to 30 m in height. Exotic to Cyprus, native to Australia, cultivated almost elsewhere in Cyprus (0-650 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels solitary and in radial multiples of 2 to 4 common. Vessels number in early wood: 100-200 per square millimeter. Tyloses with thin wall common.
Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Rays per millimeter 12-20.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 \( \mu \text{m} \) in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 100-200 \( \mu \text{m} \). Fibers with distinctly bordered pits (fiber tracheids). All ray cells procumbent. Prismatic crystals in axial parenchyma cells.

Tangential section: Rays uniseriate up to 3 cells wide.

Bark

Pith

Codified description
2 5 9 9.1 13 22 24 31 50.1 52.3 56 58 62 69 70 76 78 96 97 104 116.1 136 141.1 - B1 B1.1 B2 B3.1 B4 B5.2 B6.3 B7 B10 B10.2 B11 — P1.1 P2 P3 P3.2 P3.4 P5 P6 P6.2 P8 P9 P10 P10.1 P10.2 P12

_Eucalyptus gomphocephala_ DC.
(Annex 1, plate no. 46)

Evergreen tree up to 45 m in height. Native to western Australia, found in plantations (0-500 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels in diagonal and/or radial pattern, solitary and in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 — 100 \( \mu \text{m} \). Vessels of two distinct diameter classes. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in axial parenchyma cells.

Tangential section: Rays uniseriate and up to 3 cells wide.

Bark

Pith

Codified description
2 5 7 9 9.1 13 22 25 31 41 45 53.1 58 62 69 70 76 78 96 97 106 116.2 136 141.1 - B4 B5.4 B6.3 B7 B14.1 B14.3 - P1.1 P2 P3 P3.2 P3.4 P5 P6 P8 P9 P10 P10.1 P10.2 P12

_Eucalyptus salubris_ F.Muell.
(Annex 1, plate no. 46)

Evergreen tree up to 20 m in height. Exotic to Cyprus, found in plantation (0-300m alt.). Native to western Australia.

Xylem

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Body ray cells procumbent with one row of upright and/or square marginal cells.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
2 5 9 13 22 25 31 40.1 45 53.1 58 62 70 76 78 96 105 106 116.2 - B1 B2 B4 B5.3 B7 B10 B10.2 B11 B14.1 B14.3 - P1.1 P1.2 P2 P3 P3.2 P3.4 P5 P6.2 P8 P9 P10.2 P12

_Eucalyptus torquata_ Luehm.
(Annex 1, plate no. 47)

Evergreen tree up to 10 m in height. Native from Australia, found in plantations (0-300 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes. Gums and other deposits in heartwood vessels. Fibers very thick walled. Axial parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Body ray cells procumbent with one row of upright and/or square marginal cells.
Tangential section: Rays exclusively uniseriate.

Bark
Fibers scattered or irregularly dispersed. Prismatic crystals. Cell content in

Pith

Codified description
2 5 9 13 22 25 31 39.1 40.1 45 53.1 58 62 70 76 78 96 105 106 116.2 - B5.3 B7 B11 B14.1 B14.3 - P1 P2 P3 P3.2 P3.4 P5 P6 P8 P9 P10 P10.2 P12

*Melaleuca almillaris* (Sol. ex Gartn.) Sm.

(Annex 1, plate no. 47)

Evergreen shrub or tree up to 14 m in height. Native to Australia, found in parks (0-200 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with one to 4 rows of upright and/or square marginal cells. Tangential section: Rays exclusively uniseriate.

Bark

Pith
transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9 13 21 22 24 30 40.2 45 53.1 60 62 69 70 76 78 84 96 106 107 116.1 - B1 B3.1 B4 B5.2 B7 B11 B14.1 B18 - P1.1 P2 P3.2 P3.3 P4 P5 P9 P9.1 P10.1 P10.2 P12 P13

*Myrtus communis* L.
(Annex 1, plate no. 47)

Evergreen shrub up to 3 m in height. Indigenous to Cyprus, occurring throughout the island, along river banks, near spring and moist places (0-1500 m alt.). It also occurs in the Mediterranean countries and eastwards to India.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels 20-50 µm, vessels of two distinct diameter classes, vessels number in early wood: 100-200 per square millimeter. Fibers thick to very thick walled, radial flat marginal fibers. Axial parenchyma diffuse (sometimes close to vessels: scanty paratracheal) and in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 µm. 68, 69, 70?? Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells.
Tangential section: Rays uniseriate and 1 to 3 cells wide.

Bark

Pith
Oleaceae

*Olea europaea* L.

(Annex 1, plate no. 48)

Evergreen shrub or tree 2-10(15) m in height. Native to Cyprus, growing wild in many areas (0-1000 m alt.). It is also widely cultivated in all the part to the island up to 700 m alt. Widespread in the Mediterranean region.

Xylem

Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm, greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common, gums and other deposits in heartwood vessels and/or fibers. Fibers thick to very thick walled. Axial parenchyma vasicentric.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray.

Tangential section: Rays of two distinct sizes: uniseriate to 3 cells wide.

Bark


Pith

**Phillyrea latifolia** L.
(Annex 1, plate no. 48)

Evergreen shrub or small tree up to 4 m in height. A rare native to Cyprus (400-800 m alt.). Widespread in the Mediterranean region.

**Xylem**


Radial section: Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present.

Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells.

Tangential section: Rays uniseriate or 1 to 3 cells wide.

**Bark**

Groups of sieve tube and collapsed present. Sclerenchyma cells both in phloem and cortex. Fibers in groups, sclereids in tangential rows. Phellem homogeneous, distinct in polarized light.

**Pith**


Primary vascular bundle not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

**Codified description**

1 5 7 8 22 25 30 40.2 50.1 53.1 60 61 69 78 79 83 89 96 97 106 115 — B1 B2 B4 B5 B5.4 B6 B6.2 B14.1 B14.3 — P1 P3.3 P4 P9 P9.1 P10.2 P12 P13

**Syringa vulgaris** L.
(Annex 1, plate no. 48)

Deciduous shrub 4-7 m in height. Native to the Balkan peninsula and eastern Europe, grown in gardens, mainly in mountainous areas (100-1700 m alt.).

**Xylem**

Transverse section: Growth ring boundaries clearly demarcated. Wood semi-
ring porous. Vessels solitary and radial multiples of 2 to 4. Mean tangential diameter of earlywood vessels 20-50 μm. Vessels of two distinct diameter classes. Fibers thick to very thick walled. Radial flat marginal fibers. Axial parenchyma absent or extremely rare or not to recognizable. Axial parenchyma scanty paratracheal. Rays per millimeter 12-20. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Rays uniseriate and up to 3 cells wide.

Bark

Pith missing

Codified description
1 4 9 9.1 13 22 25 30 40.2 45 53.1 69 70 70.3 75 78 96 97 106 116.1 - B1 B2 B4 B5.2 B6.3 B7 B14.1 B14.3 - Pith missing

**Papilionaceae**

*Alhagi graegorum* Boiss.
(Annex 1, plate no. 49)

**Xylem**
Transverse section: Growth rings indistinct or absent. Vessels solitary and in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Vessels of two distinct diameter classes. Tyloses with thin wall common. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells. Tangential section: Rays of two distinct sizes: uniseriate an 2-3 cells wide. Larger rays height greater than 1 mm.
Bark missing

Pith missing

Codified description
2 9 9.1 13 22 25 30 41 45 52.3 56 58 61 69 78 96 97 102 103 105 116.2 136 136.1
- Bark missing - Pith missing

Alhagi maurorum Medik.
(Annex 1, plate no. 49)

Xylem
Transverse section: Growth rings indistinct or absent. Vessels solitary and in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma scanty paratracheal to vasicentric, sometimes confluent. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and greater than 10 seriate.

Bark

Pith

Codified description
2 9 9.1 13 22 25 30 41 45 52.3 61 69 78 79 83 96 98 103 105 116.1 - B1 B3.1 B4
B5.4 B7 B10 B11 B14.1 B14.3 - P1 P1.1 P4.1 P5 P6 P9 P10.1 P12
Anagyris foetida L.  
(Annex 1, plate no. 49)

Deciduous shrub up to 3 m in height. Native to Cyprus, usually occurring on limestone slopes with shrubby vegetation (0-1200 m alt.). Indigenous also in many others Mediterranean countries and eastwards to Iran and Arabia.

Xylem
Radial section: Earlywood vessel elements length 100-200 µm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays commonly 4 to 10 seriate.

Bark

Pith

Codified description
1 4 41 45 52.3 58 60 61 70 76 79 83 89 98 106 109 115 136 136.1 – B1 B2 B4 B5.4 B6.4 B14.1 B14.3 - P1 P3.3 P4 P9 P9.1 P10.1 P12 P13

Argyrolobium uniflorum (Dec.) Jaub. & Spach  
(Annex 1, plate no. 50)

Subshrub 5-20 cm in height. A rare native to Cyprus, recorded in garigue vegetation in northern Cyprus (0-100 m alt.). Indigenous to north Africa, Syria, Palestine, Lebanon and Turkey.
Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels less than 20 μm. Fibers very thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and greater than 10 seriate. Larger rays height greater than 1 mm.

Bark

Pith
Pith shape triangular. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct. Axial cells arranged in regular rows (radial section).

Codified description
1 5 7 9.1 13 22 25 30 40.1 52.2 61 70 78 96 99 102 103 105 116.2 136 136.1 - B2
B5.3 B7 B14.1 B14.3 B18 - P1.2 P3.3 P4 P9 P9.1 P10.1 P10.2 P13

*Astragalus echinus* subsp. *echinus* DC.
(Annex 1, plate no. 50)

A much branched subshrub, up to 60 cm in height. It occurs in to subspecies: *chionistrae* which is endemic and restricted to the highest part of Troodos forests (1800-1900 m alt.), and *echinus*, which is locally common at mid altitudes (400-1250 m alt.): it is also indigenous to Syria, Lebanon and Palestine.

Xylem
Transverse section: Growth ring distinct and recognizable to indistinct. Wood ring-porous to semi-ring porous. Vessels predominantly in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessel lumina 50 – 100 μm; vessels of two distinct diameter classes; 5 – 20 earlywood vessels per square millimeter. Fibers thin to very thick walled. Apotracheal parenchyma diffuse in aggregates or in narrow bands or lines up to three cells
wide. Paratracheal parenchyma scanty paratracheal. Axial parenchyma in marginal or in seemingly marginal bands. Less than 4 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits scalariform to alternate, large (greater than 10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 350 μm. Body ray cells procumbent with over 4 rows of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells.
Tangential section: Larger rays commonly greater than 10 seriate, height greater than 1 mm. Rays disappear in polarized light.

Bark

Pith

Codified description
1 2 3 4 11 13 20 22 27 30 39.1 41 45 47 52 69 70 77 78 86 89 99 100.2 102 108 114 — B1 B3 B4 B6 B6.2 B7 B14.1 B16 — P1 P4 P5 P13

Calycotome villosa (Poir.) Link
(Annex 1, plate no. 50)

Deciduous, spinose shrub up to 3 m in height. Native to Cyprus, locally very frequent (0-1000 m alt.). Widespread in the Mediterranean countries.

Xylem
Transverse section: Growth ring distinct and recognizable, but clearly demarcated rings only along some radii. Wood semi-ring porous. Vessels in intra-annual tangential bands and in diagonal and/or radial pattern. Vessels in radial multiples of 4 or more common or in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessel lumina less than 50 μm. Vessels of two distinct diameter classes; 20 — 40 earlywood vessels per square millimeter. Gums and other deposits in heartwood vessels. Fibers very thick walled. Axial parenchyma diffuse in aggregates and vasicentric to confluent. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length less than 350 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform
fibers). Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Ray width predominant 1 to 3 cells. Rays of two distinct sizes.

Bark
Groups of sieve tube in radial rows. Sclereids scattered or irregularly dispersed. Prismatic crystals. Tannins and/or other cell content in parenchyma cells. Phellem homogeneous. In adult bark sclereids in tangential rows and phellem heterogeneous.

Pith
Pith shape round. Cells dimorphic center/border of the pith. Pits in transverse and longitudinal cell walls (radial section). Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 1.1 4 6 7 10 11 13 22 26 36 39.1 40 45 48 52 58 60 61 70 77 79 83 97 103 109

*Coronilla emerus* L. subsp. *emeroides* (Boiss. et Spruner.) Holmboe
(Annex 1, plate no. 51)

Erect and much branched shrub up to 2 m in height. It occurs on shades cliffs and in crevices of limestone rocks in Pentadactylos range (300-800 m alt.). Indigenous in the Mediterranean region from south Italy to west Syria.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays uniseriate and 1 to 3 cells wide.

Bark
Groups of sieve tubes present. Collapsed sieve tubes. Distinct rays dilatations.
Sclereids scattered or irregularly dispersed and in groups. Prismatic crystals. Phellem homogeneous. Phellem/epidermis distinct in polarized light.

Pith

Codified description
2 5 7 13 22 25 30 36 40.2 45 52.3 58 70 76 79 89 96 97 109 116.1 - B1 B2 B3 B6.3 B6.4 B7 B14.1 B14.3 - P1.1 P1 P3.4 P4 P9 P9.1 P10.1 P12

*Genista sphacelata* Decne subsp. *crudelis* (Meikle) Chrtek & B.Slavík
(Annex 1, plate no. 51)

Much branched, armed, erected shrub up to 3 m in height. Native to Cyprus, it occurs in two subspecies: *crudelys* is and endemic to Cyprus, confined to Troodos (1200-1800 m alt.); *sphacelata* has a much wider distribution on the island (0-1000 m alt.). It is also indigenous to the Aegean islands, Lebanon and Palestine.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Ray width predominant 1 to 3 cells.

Bark
Some rays become dilated. Sclerenchyma cells both in phloem and cortex. Fibers and sclereids in tangential rows.

Pith
Pith shape round. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly
separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
2 9 11 13 21 25 31 36 40.2 45 52.3 58 61 70 83 85 97 106 109 115 B3.1 B4 B5.2 B6.2 P1 P3.3 P4 P9 P9.1 P10.1 P12 P13

*Genista sphacelata* Decne subsp. *sphacelata*
(Annex 1, plate no. 51)

Much branched, armed, erected shrub up to 3 m in height. Native to Cyprus, it occurs in two subspecies: *crudelys* is and endemic to Cyprus, confined to Troodos (1200-1800 m alt.); *sphacelata* has a much wider distribution on the island (0-1000 m alt.). It is also indigenous to the Aegean islands, Lebanon and Palestine.

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels in diagonal and/or radial pattern or in clusters. Vessels cell wall thick (greater than 2 \( \mu \)m). Vessels of two distinct diameter classes, mean tangential diameter of earlywood vessels 20-50 \( \mu \)m, 40 – 100 earlywood vessels per square millimeter. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled, radial flat marginal fibers. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 \( \mu \)m in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 \( \mu \)m. Fibers with simple to minutely bordered pits (libriform fibers). Parenchyma-like fiber bands alternating with ordinary fibers. Body ray cells procumbent with one row of upright and/or square marginal cells.
Tangential section: Ray width predominant 1 to 3 cells. Rays of two distinct sizes. Low rays storied, high rays not storied. Axial parenchyma and/or vessel elements storied.

**Bark**

**Pith**
Pith shape round. Cells dimorphic. With crystals druses. Pits in transverse and
in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 4 7 11 13 22 25 30 36 39.1 40.2 45 49 52.3 58 61 67 69 70 70.3 78 97 103 106 115 119 120 — B1 B3.1 B4 B5.2 B6.2 B7.1 B10 B10.2 B14.1 B14.3 B18 — P1 P4 P6.2 P9 P9.1 P10.1 P13

_Glycyrrhiza glabra_ L.
(Annex 1, plate no. 51)

Erect subshrub up to 1 m in height. An adventive species, present in Cyprus as a relict of cultivations (0-300 m alt.). Widespread in the Mediterranean coastal countries.

**Xylem**
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays of two distinct sizes: uniseriate and 2-3 cells wide. Larger rays height greater than 1 mm.

**Bark**

**Pith**
Erect or sub erect subshrub up to 30 cm in height. An endemic species to Cyprus, occurring on eroded limestone or sand-stone slopes with garigue vegetation (150-600 m alt.)

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Fibers very thick walled. Parenchyma pervasive. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits scalariform, large (greater than 10 μm in diameter). Vessel-ray pits with large horizontal or vertical apertures. Earlywood vessel elements length 50-100 μm. Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals present.
Tangential section: Rays commonly 4 to 10 seriate. Rays disappear in polarized light.

Bark

Pith
Pith disappear in polarized light. Pith shape round. Heterocellular pith. Thick walled parenchyma cells present. Unilignified cells. Primary vascular bundles clearly separate from one another to not distinct.

Codified description
2 5 9 13 20 27 32 39.1 40.1 52.2 70 79.1 98 100.2 109 115 136 - B1 B2 B4 B5.2 B6.3 B7 B14.4 - P1 P3 P3.3 P3.4 P10.1 P10.2

Ononis spinosa L. (Boiss.) subsp. leiosperma Sirjaev
(Annex 1, plate no. 52)
Erect subshrub up to 80 cm in height. Native to Cyprus, common locally on moist, but also dry and stony soils (0-1300 m alt.). It is also found in other east Mediterranean countries towards Iran.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels solitary and in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Fibers very thick walled. Axial parenchyma diffuse and scanty paratracheal to vasicentric. Apotracheal parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in rays and in axial parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm. Axial parenchyma and/or vessel elements storied. Fibers storied.

Bark

Pith
Pith shape round. Cells dimorphic center/border of the pith. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 3 9 9.1 13 22 25 30 40.2 53.1 61 70 76 78 79 86 96 98 102 103 109 115 120 121 136 136.1 141.1 - B1 B2 B3.1 B5.2 B7 B14.3 - P1 P4.1 P9 P9.1 P10.1 P12

*Spartium junceum* L.
(Annex 1, plate no. 52)

Deciduous scoparioid shrub up to 2 m in height. Native of the Mediterranean countries, a constituent of the xerophytic, sclerophyllous maquis vegetation. In Cyprus it is found only as cultivated for ornament (0-1500 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-

Radial section: Simple perforation plates. Inter-vessel pits alternate. Helical thickenings in vessel elements present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent.

Tangential section: Ray width predominant 1 to 3 cells. Larger rays commonly 4 to 10 seriate. Axial parenchyma and vessel elements storied.

Bark
Groups of sieve tube and collapsed sieve tubes present. Sclereenchyma cells both in phloem and cortex. Fibers in tangential rows and grouped. Sclereids scattered or irregularly dispersed. Prismatic crystals. Phellem/epidermis distinct in polarized light.

Pith

Codified description
1 4 8 11 13 22 36 41 50.1 58 61 69 70.2 79 89 97 98 104 120 - B1 B2 B4 B5.2 B5.4 B6.3 B7 B14.3 - P1 P4 P6 P9 P9.1 P10.1 P12 P13

**Phytolaccaceae**

*Phytolacca pruinosa* Fenzi
(Annex 1, plate no. 53)

Erect deciduous subshrub up to 1.5 m in height. Indigenous to Cyprus, occurring on rocky slopes and open forests in the Troodos range (800-1750 m alt.). An eastern Mediterranean species it occurs in Lebanon, Syria, and Turkey.

Xylem

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to
inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. All ray cells upright and/or square. Prismatic crystals present.

Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith

Codified description
9 9.1 13 22 24 30 40.2 53.1 60 69 78 96 97 105 116.1 136 - B1 B3.1 B5.2 B7.1 B7.3 B14.1 B14.3 - P1 P3 P3.4 P9 P9.1 P10 P12

**Platanaceae**

*Platanus orientalis* L.

(Annex 1, plate no. 53)

Deciduous tree, more than 30 m in height. Native to Cyprus, growing along streams and other moist places (0-1700 m alt.). It is also indigenous to southern Europe and western Asia as far as Kashmir.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in radial multiples of 2 to 4 or in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled, radial flat marginal fibers. Axial parenchyma diffuse and scanty paratracheal. Less than 4 rays per millimeter.

Radial section: Simple and scalariform perforation plates, scalariform perforation plates with 20 – 40 bars. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm, fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells.

Tangential section: Larger rays commonly greater than 10 seriate. Ray height greater than 1 mm.
Bark

Pith
Pith round in shape. Cells dimorphic. With prismatic crystals and druses. Pits grouped in transverse cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9.1 11 13 14 17 22 26 31 41 50.2 53.1 62 69 70 70.3 76 78 99 102 106 114 136 136.1 — B1 B2 B5 B5.2 B7 B14.1 B14.3 — P1 P4 P6 P6.2 P9.1 P9.2 P10.1 P13

**Plumbaginaceae**

*Plumbago auriculata* Lam.
(Annex 1, plate no. 53)

Evergreen, sub erected or scrambling shrub, with up to 2 m long shoots. Native to south Africa, frequently grown in gardens and park in Cyprus (0-500 m alt.).

**Xylem**
Transverse section: Only one ring. Wood semi-ring porous. Vessels in radial multiples of 4 or more common. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessels less than 20 µm. Vessels of two distinct diameter classes. Fibers thick walled to very thick walled. Axial parenchyma scanty paratracheal. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Ray width predominant 1 to 3 cells.

**Bark**

**Pith**
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).
**Plumbago europaea L.**
(Annex 1, plate no. 54)

Perennial, sub erected subshrub up to 1 m in height. Native to Cyprus, not very common, found along field boundaries, and road sides (0-1000 m alt.). It is also indigenous in southern Europe and other Mediterranean countries as far as Afghanistan.

**Xylem**

Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 \( \mu m \)). Mean tangential diameter of earlywood vessels less than 20 \( \mu m \). Vessels of two distinct diameter classes. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma scanty paratracheal.

Radial section: Simple perforation plates. Inter-vessel pits scalariform, small (4-7 \( \mu m \) in diameter). Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 \( \mu m \). Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers).

Tangential section: Wood rayless.

**Bark**

Groups of sieve tubes present. Collapsed sieve tubes. Fibers in tangential rows.

**Pith missing**

**Polygonaceae**

*Polygonum equisetiforme* Sm.
(Photomicrographs not available)

Sprawling or decumbent subshrub with 50-100 cm long shoots. A species indigenous to Cyprus, common on field margins, costal areas and on stony slopes (0-1000 m alt.). A Mediterranean species extending eastwards to Iran.
Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present.
Tangential section: Rays uniseriate to 3 cells.

Bark
Groups of sieve tube and collapsed sieve tubes present. Sclerenchyma cells both in phloem and cortex. Fibers in radial rows. Druses present. With laticifers, secretory elements, oil ducts or mucilage ducts.

Pith

Codified description
1 5 9 9.1 13 22 24 40.2 45 52.3 61 65 69 78 96 97 — B1 B2 B4 B5.1 B7.2 B10 - P1 P3.4 P4 P10.2

Punicaceae
Punica granatum L.
(Annex 1, plate no. 54)

Much branched, deciduous, spinose shrub up to 7 m in height. Adventive to Cyprus, it occurs on field margins and roadsides (0-1200 m alt.). Native to Iran, Afghanistan, and south east Turkey.

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits
(libriform fibers). Septate fibers present. All ray cells upright and/or square. Prismatic crystals in ray and in axial parenchyma cells. Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
1 5 9 9.1 13 22 24 30 40.2 52.3 61 65 69 70.2 78 96 105 116.1 136 136.1 141.1 - B3.1 B6.3 B7.2 B11 B14.1 B14.3 - P1.1 P1.4 P3.4 P5 P6 P6.2 P10.2 P12

**Ranunculaceae**
*Clematis cirrhosa* L.
(Annex 1, plate no. 54)

Climber, evergreen with stems up to 5 m long. A common, native species to Cyprus, which occur in forests, maquis, and garigue (0-900 m alt.). Also native to the Mediterranean countries and eastwards to Syria.

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels solitary and in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma diffuse and scanty paratracheal to vasicentric. Axial parenchyma in narrow bands or lines up to three cells wide. Less than 4 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 100-200 μm. Vascular and/or vasicentric tracheids present Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Larger rays commonly 4 to 10 seriate.
Bark
Groups of sieve tubes present. Collapsed sieve tubes. Fibers grouped. Sclereids in tangential rows and scattered or irregularly dispersed. Layered phellem.

Pith
Pith shape round. Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
2 5 9 11 13 22 24 31 41 45 52.3 60 61 69 76 79 86 98 105 114 - B1 B2 B5.4 B6.2 B6.3 B16 - P1 P3.3 P4 P9 P9.1 P10.1 P13

*Clematis vitalba* L.  
(Annex 1, plate no. 55)

A climber with 8-10 m long stems. Adventive species to Cyprus, restricted to ravines and hedges (0-1600 m alt.). Indigenous to central and south Europe and eastwards to Afghanistan.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Growth rings indistinct or absent. Wood ring porous. Vessels solitary and in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessel lumina 100 – 200 μm. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Less than 4 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Vessel-ray pits with large horizontal or vertical apertures. Earlywood vessel elements length 100-200 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays commonly greater than 10 seriate. Rays disappear in polarized light. Ray height greater than 1 mm.

Bark

Pith
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other.
Rhamnaceae

*Rhamnus alaternus* L.
(Annex 1, plate no. 55)

Evergreen shrub or small tree up to 4 m in height. Indigenous to Cyprus, occurring on maquis and pine forests (0-1100 m alt.). It also occurs in the Mediterranean countries.

**Xylem**

Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in dendritic pattern, predominantly solitary. Mean tangential diameter of earlywood vessels less than 20 µm, greater than 200 vessels per square millimeter in earlywood. Fibers thick to very thick walled. Axial parenchyma vasicentric sometimes confluent. Apotracheal parenchyma in marginal or in seemingly marginal bands. Rays per millimeter 12-20.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 µm. Vascular and/or vasicentric tracheids present. Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Acicular crystals.

Tangential section: Ray width predominant 1 to 3 cells.

**Bark**


**Pith**

Pith shape polygonal. Cells dimorphic. With acicular crystals. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other and not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description

1 2 3 9 11 13 21 22 24 32 39.1 42 52.3 60 62 69 78 99 100.2 102 109 114 - B3.1 B4 B4.1 B6.2 B14.3 - P1 P4 P9 P9.1 P10.1

*Rhamnus oleoides* sub sp. *graecus* (Boiss. Et Reut.) Holmboe
(Annex 1, plate no. 55)
Semi-evergreen shrub up to 3 m in height. A common indigenous plant to Cyprus, growing on rocky mountainsides shrublands and pine forests (0-1000 m alt.). It also occurs in Greece and Turkey.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in diagonal and in dendritic pattern. Mean tangential diameter of earlywood vessels 20-50 µm, vessels number in early wood: 100-200 per square millimeter. Tyloses with thin wall common. Fibers thick to very thick walled, tension wood present. Axial parenchyma scanty paratracheal to vasicentric, confluent in latewood.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). Parenchyma-like fiber bands alternating with ordinary fibers. Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells. Tangential section: Rays uniseriate to 3 cells wide.

Bark
Groups of sieve tube and collapsed sieve tubes present. Some rays become dilated. Sclereids in groups. Prismatic crystals present. Phellem homogeneous, distinct in polarized light.

Pith
Pith shape round. Thick walled parenchyma cells present. Cells dimorphic. Pits only in transverse cell walls, grouped. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 5 7 8 13 22 25 30 36 40.2 50.1 52.3 56 61 67 69 70 70.2 78 79 83 96 97 106

Zizyphus lotus (L.) Lam.
(Annex 1, plate no. 56)

Deciduous shrub up to 2 m in height. A very common indigenous species to Cyprus, which occur in fields wastelands and roadsides (0-500 m alt.). Also indigenous to other Mediterranean countries.
Xylem

Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary and in radial multiples of 2 to 4 common. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessel lumina 50 — 100 μm, 20 — 40 earlywood vessels per square millimeter. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal to vasicentric. Rays per millimeter 12-20.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in ray parenchyma cells.

Tangential section: Rays exclusively uniseriate.

Bark


Pith


Codified description

1 5 9 9.1 13 22 24 30 39.1 41 48 52.3 60 61 69 70 78 79 96 109 116.1 136 136.1 - B1 B2 B3.1 B4 B5.2 B5.4 B6.3 B6.4 B7 B11 B14.1 B14.3 - P1 P4.1 P5 P6 P10.1 P12 P13

Zizyphus spina-christi (L.) Willd.

(Annex 1, plate no. 56)

Evergreen tree up to 14 in height. Rare, adventive species to Cyprus, found in plantations (0-200 m alt.). It also occurs in Egypt, Ethiopia, Somalia, the Middle East and eastern India.

Xylem

Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels solitary and in radial multiples of 2 to 4
common. Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Fibers thick to very thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Earlywood vessel elements length 200-500 µm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray. Tangential section: Rays uniseriate and 1 to 3 cells wide.

Bark

Pith

Codified description

Zizyphus zizyphus (L.) Meikle
(Annex 1, plate no. 56)

Deciduous shrub or small tree up to 7 m in height. Adventive to Cyprus, occurring in hedges and gardens (0-500 m alt.). Possibly indigenous to central and east Asia.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 — 100 µm. Fibers thin to thick walled. Axial parenchyma scanty paratracheal to vasicentric. Rays per millimeter 12-20. Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length
100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate to 3 cells wide.

Bark
Groups of sieve tubes present. Sclerenchyma cells both in phloem and cortex. Fibers in tangential rows. Prismatic crystals and druses present. Tannins and/or other cell content in parenchyma cells. Phellem homogeneous, distinct in polarized light.

Pith
Pith disappear in polarized light. Pith shape round. Cells dimorphic. Laticifers or intercellular canals. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other or not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 S 9 9.1 13 22 25 30 41 52.3 61 69 78 79 96.1 97 105 116.1 – B1 B4 B5.2 B7 B7.2 B11 B14.1 B14.3 – P1.1 P1 P4 P7 P9 P9.1 P10.1 P10.2 P12 P13

Rosaceae
Cotoneaster racemiflorus (Desf.) C.Koch var. nummularius (Fisch. et Meyer) Dippel (Annex 1, plate no. 57)

Deciduous or semi evergreen shrub up to 2 m in height. An indigenous plant, restricted to the highest part of Troodos (1000-1950 m alt.). It also occurs in Greece, Turkey, Caucasia, Syria, Lebanon northern Iraq and western Iran.

Xylem

Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell and rounded or angular with large apertures. Helical thickenings in vessel elements present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells
upright and/or square. Rays with procumbent, square and upright cells mixed throughout the ray. 
Tangential section: Rays uniseriate to 3 cells wide.

Bark 

Pith 

Codified description

Crataegus azarolus L. 
(Annex 1, plate no. 57)

Deciduous small tree or shrub up to 10 m in height. An indigenous species, common almost everywhere (0-1500 m alt.). Also found in the Mediterranean region and eastwards to Iran.

Xylem 
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels 20-50 μm, greater than 200 vessels per square millimeter in earlywood. Fibers thin to thick walled. Axial parenchyma diffuse, scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter. 
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in axial parenchyma cells.
Tangential section: Rays uniseriate to 3 cells wide.
Bark

Pith
Pith shape round. Thick walled parenchyma cells present. With prismatic crystals. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 5 9 13 22 25 31 36 40.2 50.2 53.1 62 69 76 78 86 96 97 106 116.2 136 141.1 — B1 B1.1 B2 B4 B5 B5.2 B6 B6.2 B7 B14.1 B14.3 — P1 P3.3 P6 P9 P9.1 P10.1 P13

Crataegus monogina Jacq.
(Annex 1, plate no. 57)

Deciduous, spreading shrub up to 7 m in height. An indigenous species occurring almost everywhere in Cyprus (0-1800 m alt.). It occurs also in Europe and western Asia.

Xylem
Transverse section: Growth ring distinct and recognizable. Wood diffuse-porous. Vessels predominantly solitary or in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm; 40 – 100 earlywood vessels per square millimeter. Fibers thin to very thick walled. Axial parenchyma diffuse. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 350-800 μm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in axial parenchyma cells.
Tangential section: Ray width predominant 1 to 3 cells.

Bark
Pith
Pith shape round. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description

*Crataegus sinaica* Boiss.
(Annex 1, plate no. 58)

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels 20-50 μm. Fibers thick to very thick walled. Axial parenchyma diffuse to scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in axial parenchyma cells.
Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith

Codified description
Cydonia oblonga Mill.
(Annex 1, plate no. 58)

Deciduous small tree or shrub up to 10 m in height. Indigenous in Caucasia, Turkey and Iran. Cultivated in Cyprus for its fruits. Wild plants are noted (200 – 1200 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent. Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Rays uniseriate to 1-2 cells wide.

Bark

Pith

Codified description
1 4 9 13 22 25 30 36 40.2 50.2 53.1 61 69 70.3 76 86 96 97 104 106 116.1 - B4 B5.2 B7 B14.1 B14.3 B18 - P1 P3.3 P4 P5 P9 P9.1 P10.1 P10.2 P12 P13

Prunus armeniaca L.
(Annex 1, plate no. 58)

Deciduous tree up to 8 m in height. Native of central Asia, an adventive species in Cyprus, widely cultivated for its edible fruits (0-900 m alt.).
**Xylem**

Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels solitary and in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, 40 – 100 earlywood vessels per square millimeter. Tyloses with thin wall common. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Helical thickenings in vessel elements present. Fibers with simple to minutely bordered pits (libriform fibers) and with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray.

Tangential section: Rays of two distinct sizes: uniseriate and up to 10 cells wide.

**Bark**


**Pith**


**Codified description**


**Prunus dulcis** (Mill.) D.A.Webb

(Annex 1, plate no. 59)

Deciduous shrub or tree up to 8 m in height, sometimes with spine-tipped twigs (especially in wild specimens). Native to central and northwest Asia, it is cultivated in Cyprus for its fruits, frequently found as an escape from cultivations (0-1600 m alt.).

**Xylem**

Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous. Vessels solitary and in radial multiples of 4 or more. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm; 40 – 100 earlywood vessels
per square millimeter. Fibers very thick walled. Axial parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length less than 350 µm. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Druses in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm.

Bark
Groups of sieve tubes present. Only some rays become dilated. Prismatic crystals and druses present. Tannins and/or other cell content in parenchyma cells. Phellem homogeneous.

Pith

Codified description
1 4 9 10 13 22 26 31 36 41 49 52 62 70 76 96 98 102 103 107 116.2 — B1 B3.1 B7 B7.2 B11 B14.1 — P1 P3.3 P4 P6.2 P9 P9.1 P10.1 P10.2 P12 P13

_Pyracantha coccinea_ M.Roem.
(Annex 1, plate no. 59)

Evergreen, spiny shrub up to 3 m in height. Native of southern Europe eastward to Iran. Cultivated in Cyprus as ornamental in gardens and parks (0-1400 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels predominantly solitary. Mean tangential diameter of earlywood vessels less than 20 µm, vessels number in early wood: 100-200 per square millimeter. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell, sometimes rounded or angular.
with large apertures. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Tangential section: Rays uniseriate to 3 cells wide.

**Bark**

**Pith**

**Codified description**
1 4 9 13 22 25 30 31 40.1 50.1 62 69 70 76 78 86 96.1 97 109 116.2 — B2 B5.4 B14.1 B14.3 — P1 P3.3 P4 P6 P9 P9.1 P10.1 P12 P13

*Pyrus communis* L.
(Photomicrographs not available)

Deciduous tree up to 10 m in height. In Cyprus it is cultivated on a limited scale, especially in the more elevated valleys (200-1700 m alt.).

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels predominantly in clusters. Mean tangential diameter of earlywood vessels less than 20 µm. Vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Fibers thick to very thick walled. Radial flat marginal fibers. Axial parenchyma diffuse and scanty paratracheal. Apotracheal parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter) to medium (7-10 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vessel-ray pits rounded or angular with large apertures. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals present. Tangential section: Rays uniseriate to 3 cells wide.
Bark
Groups of sieve tube and collapsed sieve tubes present. Sclerenchyma cells both in phloem and cortex. Sclereids in tangential rows and scattered or irregularly dispersed. Prismatic crystals. Phellem homogeneous. Phellem/epidermis distinct in polarized light.

Pith

Codified description

*Pyrus malus* L.
(Annex 1, plate no. 59)

Deciduous tree up to 10 m in height. Native throughout Europe, the Caucasus, Turkey and northern Iran. Cultivated in Cyprus for its edible fruits, especially at high altitudes. Wild plants are found along roadsides on the Troodos range (100-1800 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vessel-ray pits rounded or angular with large apertures. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells.
Tangential section: Rays of two distinct sizes: uniseriate or 2-4 cells wide.
Bark
Groups of sieve tube and collapsed sieve tubes present. Sclerenchyma cells both in phloem and cortex. Sclereids in tangential row and scattered or irregularly dispersed. Prismatic crystals. Phellem homogeneous, distinct in polarized light.

Pith

Codified description

*Pyrus syriaca* Boiss.
(Annex 1, plate no. 60)

Deciduous tree up to 10 m in height, with rounded or spreading crown. Indigenous to eastern Mediterranean region, eastwards to Iran. In Cyprus it thrives on hillsides, river banks and fields (100-1500 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels solitary or in clusters. Vessels of two distinct diameter classes. Mean tangential diameter of earlywood vessels 20-50 µm. Greater than 200 vessels per square millimeter in earlywood. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Apotracheal parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vessel-ray pits rounded or angular with large apertures. Fibers with distinctly bordered pits (fiber tracheids). Ray cells procumbent and square mixed. Prismatic crystals in axial parenchyma cells.
Tangential section: Rays uniseriate to 3 cells wide.

Bark
Groups of sieve tube and collapsed sieve tubes present. Sclerenchyma cells

Pith

Codified description
1 4 5 9 11 13 22 25 30 31 40.2 45 50.2 62 69 70 76 86 96.1 97 104 105 116.2 136 141.1 – B1 B2 B4 B5.2 B5.4 B7 B14.1 B14.3 - P1 P3.3 P4 P5 P6 P6.2 P9 P9.1 P10.1 P10.2 P12 P13

*Rosa canina* L.
(Annex 1, plate no. 60)

Deciduous shrub up to 4 m in height. Branches erected or arched, strongly armed with curved or hooked prickles. Indigenous to Europe and western Asia, in Cyprus it occurs on the Troodos range (600-1900 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood ring-porous; vessel predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 100 – 200 µm; 5 – 20 earlywood vessels per square millimeter. Tyloses with thin wall common. Fibers thin to thick walled. Fibers very thick walled. Axial parenchyma diffuse and scanty paratracheal. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 350-800 µm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Prismatic crystals present in ray parenchyma cells.
Tangential section: Rays uniseriate and 4 to 10 seriate. Ray height greater than 1 mm. Rays of two distinct sizes.

Bark
Pith
Pith round in shape. Cells dimorphic in the center of the pith. With crystals druses. Pits in transverse and in longitudinal cell walls (radial section). Primary vascular bundles clearly separate from one another to not distinct.

Codified description
1 3 4 9 21 22 25 30 39 40.2 50.2 52 60 62 69 70 76 78 96 98 102 103 105 109 116.2 136 — B2 B3.1 B5 B5.4 B6.2 B7.2 B14.1 B14.3 — P1 P4 P4.2 P6.2 P9 P9.1 P10.1 P10.2

*Rosa chionistrae* H. Lindb.
(Annex 1, plate no. 60)

Deciduous shrub up to 3 m in height. Branches erected or arched, armed with curved or hooked prickles. Endemic to Cyprus, restricted to the Troodos area (1100-1950 m alt.).

Xylem
Transverse section: Growth rings boundaries clearly demarcated, ring porous, vessels predominantly solitary. Mean tangential diameter of earlywood vessels lumina 100-200 m, 20-40 earlywood vessels per square millimeter. Tyloses with thin wall present. Fibers very thick walled, radial flat marginal fibers. Axial parenchyma diffuse and scanty paratracheal. 4-12 rays per millimeter. Radial section: Simple perforation plates, medium size alternate intervessel pits, vessels-rays pits with distinct border and similar to intervessel pits in shape and size. Helical thickenings in vessels element, Earlywood vessel elements length 350-800 m. Vascular and vasicentric tracheids present, fibers with distinct border pits. Body ray cells procumbent with 1-3 rows of square marginal cells. Prismatic crystals in ray parenchyma cells. Tangential section: Larger rays commonly 8-10 seriate, rays height greater than 1 millimeter, rays dimorphism.

Bark
Groups of sieve tube present, only few rays become dilated, fibers in tangential rows, crystal druses, phellem homogeneous, distinct in polarized light. In adult bark sclerenchyma cells in both phloem and cortex.

Pith
Pith round to polygonal, visible to naked eyes. Cells dimorphic, crystal druses, pits in cell walls, axial arrangement of cells in regular rows. Primary vascular bundles clearly separate from one another.

Codified description
1 3 9 13 22 26 30 36 41 48 53 56 60 62 69 70 70.3 76 78 98 102 103 106 107 115 136 136.1 — B1 B3.1 B5.2 B7.2 B14.1 B14.3 — P1 P4 P6.2 P9 P9.1 P10.1 P13
Deciduous shrub up to 3 m in height. Branches erected or arched, armed with strong, curved or hooked prickles. Widely cultivated in Cyprus, it occurs as a relict of cultivation in several places (0-1700 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous to semi-ring porous. Vessels solitary and in clusters. Mean tangential diameter of earlywood vessel lumina 50 — 100 µm. Vessels number in early wood: 100-200 per square millimeter. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). Helical thickenings in ground tissue fibers. All ray cells upright and/or square. Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals present.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm.

Bark

Pith

Codified description

Rosa damascena Mill.
(Annex 1, plate no. 61)

Rubus discolor Weihe et Nees
(Annex 1, plate no. 61)
Evergreen shrub up to 2 m in height. An adventive species in Cyprus, occurring mainly in the Troodos area (800-1800 m alt.). A native of Europe, the Caucasus, Turkey and Lebanon.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Wood semi-ring porous. Vessels solitary and in radial multiples of 2 to 4 or in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 µm. Vessels of two distinct diameter classes. Vessels number in early wood: 100-200 per square millimeter. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Rays with procumbent, square and upright cells mixed throughout the ray.
Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm.

Bark

Pith

Codified description

Rubus sanctus Schreb
(Annex 1, plate no. 61)

Shrub up to 2 m in height, with spiny and distinct angled stem. Indigenous to western and central Europe eastward to Afghanistan. A common species growing in Cyprus in moist places, in almost every part of the island (0-1600 m alt.).
Xylem
Transverse section: Growth ring distinct and recognizable. Wood ring-porous to semi-ring porous. Vessels solitary or in radial multiples of 2 to 4. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Vessels of two distinct diameter classes; 40 – 100 earlywood vessels per square millimeter. Fibers thin to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 350-800 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). Rays with procumbent, square and upright cells mixed throughout the ray. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate; larger rays commonly greater than 10 seriate. Larger ray height greater than 1 mm.

Bark

Pith

Codified description
1 3 4 9 9.1 13 22 26 30 41 45 49 53 60 62 69 70 76 78 96 99 102 103 109 115 136.1 – B1 B5 B5.2 B7 B7.2 B14.1 B14.3 – P1.3 P4 P6 P9 P9.1 P10.1 P12

Sarcopoterium spinosum (L.) Spach
(Annex 1, plate no. 62)

Small, much branched shrub up to 1,5 m in height. Widely distribute in the eastern Mediterranean, and eastwards to Sardinia. In Cyprus it thrives in garigue and impoverished areas, where it is frequently the dominant species. It is very common in most part of the island (0-1250 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous to diffuse porous. Vessels in diagonal and/or radial pattern and in
clusters. Mean tangential diameter of earlywood vessels 20-50 μm. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Fibers thin to very thick walled. Axial parenchyma extremely rare or not to recognizable, diffuse and scanty paratracheal in earlywood.

Radial section: Simple perforation plates. Inter-vessel pits alternate, large (greater than 10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 350 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present. All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells.

Tangential section: Rays of two distinct sizes: uniseriate and 4 to 10 seriate. Larger rays height greater than 1 mm.

Bark
Groups of sieve tubes present. Collapsed sieve tubes. Few prismatic crystals present. Phellem/epidermis distinct in polarized light. In adult bark: groups of sieve tubes in radial rows, some rays become dilated, fibers scattered or irregularly dispersed or in groups.

Pith
Pith shape round. With thick walled parenchyma cells. Cells dimorphic center/border of the pith. With small prismatic crystals and few druses. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate to not distinct each other. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
1 4 5 7 11 13 22 27 30 40.2 50.2 52 56 60 61 65 69 70 75 76 78 96 98 102 103 105 136.1 — B1 B2 B7 B14.3 — P1 P3.3 P4.1 P6 P6.2 P9 P9.1 P10.1 P10.2 P12 P13

Sorbus aria (L.) Crantz subsp. cretica (Lindl.) Holmboe
(Annex 1, plate no. 62)

Deciduous shrub or small tree up to 15 m in height, with broadly ovoid or pyramidal crown. Native to south Europe and east Mediterranean, in Cyprus it is restricted to the highest parts of Troodos (1000-1950 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood diffuse-porous with vessel predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 50 — 100 μm. Vessels of two distinct diameter classes; 40 — 100 earlywood vessels per square millimeter. Fibers thin to very thick walled. Axial parenchyma diffuse. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 350-800 µm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Tangential section: Ray width predominant 1 to 3 cells.

Bark
Groups of sieve tubes present. Collapsed sieve tubes. Fibers scattered or irregularly dispersed. Sclereids in tangential rows. Prismatic crystals. Phellem homogeneous. Tannins and/or other cell content in phellem cells.

Pith
Pith shape roundish to polygonal. With thick walled parenchyma cells. Cells dimorphic center/border of the pith. Pits in transverse and in longitudinal cell walls. Pits in transverse cell walls. Primary vascular bundle clearly separate from one other. Axial cells arranged in regular rows (radial section).

Codified description
1 5 11 13 30 36 41 45 49 53 61 69 70 76 97 106 115 — B1 B2 B5 B5.3 B6 B6.2 B7 B11 B14.1 — P1 P3.3 P4.1 P9 P9.1 P10.1 P13

Rubiaceae
Asperula cypria Ehrend.
(Annex 1, plate no. 62)

Much branched subshrub up to 60 cm in height. A very common endemic in Cyprus, occurring in hillsides and mountain range all over the islands (0-1200 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous to diffuse-porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 2 to 4 or in clusters. Mean tangential diameter of earlywood vessels less than 20 µm. Vessels of two distinct diameter classes; 40 — 100 earlywood vessels per square millimeter. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length less than 350 µm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tubes present. Collapsed sieve tubes.

Pith
Pith shape polygonal. Cells dimorphic center/border of the pith. Pits in transverse cell walls, longitudinal cell walls missing.

Codified description
1 4 5 7 9.1 11 13 22 25 31 40.1 45 49 52 62 69 75 96 105 116.2 - B1 B2 — P1.1 P4.1 P9.1

_Putoria calabrica_ (L.f.) DC.
(Annex 1, plate no. 63)

Small, much branched, prostate shrubs usually less than 15 cm in height. In occurs in the Mediterranean countries, in Cyprus it thrives on mountain range (300-1500 m alt.).

Xylem
Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessel lumina less than 50 μm. Vessels of two distinct diameter classes. Vessels number in early wood: 100-200 per square millimeter. Gums and other deposits in heartwood vessels and/or fibers. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Axial parenchyma in marginal or in seemingly marginal bands. Greater than 20 rays per millimeter. Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 350-800 μm. Vascular and/or vasicentric tracheids present. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays predominantly uniseriate, some up to 3 cells wide.

Bark
Phloem uniform.

Pith
Pith shape round. Cells dimorphic center/border of the pith. Pits in transverse and longitudinal cell walls (radial section), sometimes grouped.
Rubia laurate (Holmboe) Airy Shaw
(Annex 1, plate no. 63)

Trailing or climbing species up to 100 cm long. Endemic to Cyprus, growing in pine forests and thickets (0-1400 m alt.).

Xylem

Bark

Pith

Rubia tenuifolia d’Urv.
(Annex 1, plate no. 63)

Climbing shrub with tetragonal stems up to 3 m long. It occur in Greece, Turkey, Syria and Iraq. It thrives almost all over Cyprus (0-1500 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessels 20-50 µm. Fibers thin to thick walled, radial flat marginal fibers. Axial
parenchyma diffuse and scanty paratracheal. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to intervessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tube and sieve tubes present. Phelloids present. Acicular crystals and crystal sand. Layered phelloderm.

Pith

Codified description
1 3 9 11 13 22 26 30 36 40.2 53.1 62 69 70.3 76 78 96 105 116.2 — B1 B2 B4.1 B7.1 B7.3 B18 — P1 P2 P4 P10.2

**Rutaceae**

*Citrus aurantium* L.
(Annex 1, plate no. 64)

Evergreen up to 6 m in height. Native to tropical and subtropical Asia, but it is cultivated since ancient times in all Mediterranean countries. Cultivated species found in gardens all over Cyprus (0-1000 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels predominantly solitary. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels 20-50 μm. Vessels of two distinct diameter classes. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits opposite and alternate, minute (less than 4 μm in diameter). Earlywood vessel elements length 200-500 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent. Body ray cells procumbent with one row of
upright and/or square marginal cells. Prismatic crystals in axial parenchyma cells.
Tangential section: Rays uniseriate to 3 cells wide.

Bark
Groups of sieve tube and collapsed sieve tubes present. Some rays become dilated. Sclerenchyma cells both in phloem and cortex. Fibers in tangential rows and grouped. Sclereids scattered or irregularly dispersed. Prismatic crystals. With laticifers or intercellular canals. Phellem/epidermis distinct in polarized light.

Pith

Codified description
1 4 5 9 13 21 22 24 39.1 40.2 45 53.1 58 61 69 70 76 78 86 96 97 104 106 115 136 141.1 – B1 B2 B3.1 B4 B5.2 B5.4 B6.3 B7 B10 B10.3 B14.3 – P1.2 P3.3 P4.2 P5 P6 P9 P9.1 P10.1 P10.2 P12

_Citrus limon_ (L.) Burm.f.
(Annex 1, plate no. 64)

Evergreen tree up to 6 m in height. A cultivated species, with great economic importance for Cyprus. Sometimes planted in gardens, and street in urban areas (0 – 600 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate. Helical thickenings in vessel elements present. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Body ray cells procumbent with over 4 rows of upright and/or square marginal cells.
Tangential section: Rays exclusively uniseriate.
Bark

Pith

Codified description
2 4 9 13 22 36 39.1 40.2 50.2 60 61 70 76 89 96 105 108 - B1 B2 B3.1 B4 B5.2 B5.4 B7 B10 B10.2 B14.1 B14.3 - P1.2 P4.1 P6 P6.1 P9 P9.1 P10.1 P10.2 P12

*Citrus sinensis* (L.) Osbeck
(Annex 1, plate no. 64)

Evergreen tree up to 6 m in height. A cultivated species, with great economic importance for Cyprus. Sometimes planted in gardens, and street in urban areas (0 – 600 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels 20-50 μm. Vessels of two distinct diameter classes. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in marginal or in seemingly marginal bands. Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells procumbent. Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in axial parenchyma cells. Tangential section: Rays uniseriate to 1 to 3 cells wide.

Bark
Pith

Codified description
1 5 9 9.1 13 22 24 30 40.2 45 52.3 58 61 69 70 76 78 89 96 97 104 106 136 141.1 - B1 B2 B3.1 B5.4 B7 B10 B10.2 B14.1 B14.3 - P1.2 P3.3 P4 P5 P6 P6.2 P9 P9.1 P10.1 P10.2 P12

*Ruta chalepensis* L.
(Annex 1, plate no. 65)

Foetid smelling subshrub up to 80 cm in height. Native to Mediterranean countries and Atlantic islands. In Cyprus it occurs on rocky places and cliffs (0-800 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Druses present.
Tangential section: Rays of two distinct sizes: uniseriate and up to 3 cells wide.

Bark

Pith
Deciduous tree up to 30 m in height. Native of Europe, Mediterranean countries and eastward to central Asia. In Cyprus it thrives in most places, along streams and rivers (0-1400 m alt.).

**Xylem**


Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length greater than 500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells.

Tangential section: Rays exclusively uniseriate.

**Bark**


**Pith**


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**Salicaceae**

*Salix alba* L.

(Annex 1, plate no. 65)

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**Codified description**

2 5 7 9.1 11 13 22 25 30 36 40.1 52.3 58 61 69 78 96 97 103 105 116.1 144 - B1
B2 B3.1 B5.3 B7.2 B14.1 B14.3 - P1 P4 P5 P6.2 P9 P9.1 P10.1 P10.2
Sapindaceae

Dodonaea viscosa (L.) Jacq.
(Annex 1, plate no. 65)

Evergreen shrub up to 4 m in height. Indigenous to tropical and subtropical zones, especially of Australia. Adventive to Cyprus that occurs in hedges, field margins, roadsides and sometimes in scrublands (0-500 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
**Scrophulariaceae**

*Antirrhinum majus* L.

(Annex 1, plate no. 66)

**Xylem**

Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels predominantly solitary or in radial multiples of 2 to 4 common and in clusters. Mean tangential diameter of earlywood vessels 20-50 µm. Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Less than 4 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Prismatic crystals in ray parenchyma cells.

Tangential section: Rays of two distinct sizes: ray width predominant 1 to 3 cells. Larger rays commonly greater than 10 seriate. Ray height greater than 1 mm. Rays of two distinct sizes.

**Bark**


**Pith**


**Codified description**


**Odontites cypria** Boiss.

(Annex 1, plate no. 66)

Subshrub 15-60 cm in height, with branched stem which are often violet or purple. An endemic species, occurring in garigue and pine forest (0-1600 m alt.).

**Xylem**

Transverse section: Growth ring distinct and recognizable. Wood semi-ring porous. Vessels predominantly solitary, or in radial multiples of 2 to greater
than 4 common. Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes; 40 – 100 earlywood vessels per square millimeter. Gums and other deposits in heartwood vessels and/or fibers. Fibers thin to thick walled. Axial parenchyma absent or extremely rare or not to recognizable. Greater than 20 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 350 μm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Ray width predominant 1 to 3 cells.

Bark
Phloem uniform.

Pith

Codified description
1 4 9.1 10 13 22 26 30 40.1 45 49 52 58 61 69 70.2 75 97 105 116.2 - B8 - P1 P4.1 P5 P6 P13

**Solanaceae**

*Lycurium ferocissimum* Miers

(Appenix 1, plate no. 66)

Much branched shrub up to 6 m in height, with twigs modified into spines. A naturalized adventive species, native to south Africa, usually occurring in coastal area and inland (0-200 m alt.). Introduced to Cyprus near the beginning of the 20th century.

**Xylem**


Radial section: Simple perforation plates. Inter-vessel pits alternate, medium (7-10 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 350-800 μm. Fibers
with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Crystal sand present.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

Codified description
1 5 7 8 11 13 22 26 30 36 40.2 50 53 62 69 76 78 96 105 116.1 — B7.3 B8 B14.1 — P1.1 P1 P3 P4 P6.4 P10.2 P13

_Nicotiana glauca_ Graham
(Annex 1, plate no. 67)

Evergreen, loosely branched shrub 6-10 m in height. An adventive species in Cyprus, naturalized along roadsides and waste ground (0-800 m alt.). Native to south America.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semiring porous to diffuse porous. Vessels in diagonal and/or radial pattern. Vessels in radial multiples of 4 or more common. Mean tangential diameter of earlywood vessels 20-50 μm. Fibers thick to very thick walled. Axial parenchyma diffuse. Axial parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits scalariform. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Rays uniseriate and up to 3 cells wide.

Bark
Pith

Codified description
1 4 5 7 10 13 20 22 24 31 40.2 53.1 60 61 68 69 76 86 96 97 105 116.1 B1 B2 B3.1 B5.3 B7.3 B14.1 B14.3 - P3.2 P3.4 P4 P6.3 P9 P9.1 P9.2 P10 P12 P13

*Withania somnifera* (L.) Dunal
(Annex 1, plate no. 67)

Erect shrub up to 1.5 m in height, steams not much-branched, densely covered with stellate hairs. Native to the southern Europe, western Asia, the Atlantic islands and throughout Africa. In Cyprus it occurs in waste ground (mainly at archaeological sites) (0-200 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous, vessel predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, in two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma scanty paratracheal and vasicentric. Rays per millimeter 12-20.
Radial section: Inter-vessel pits alternate, small (4-7 μm in diameter). Vessel-ray pits rounded or angular with large apertures. Earlywood vessel elements length 200-500 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.
Tangential section: Ray width predominant 1 to 3 cells.

Bark
Groups of sieve tube and collapsed sieve tubes present. Some rays become diluted. Crystal sand. Phellem/epidermis distinct in polarized light.

Pith

Codified description
1 5 11 22 25 31 41 45 53.1 60 61 69 78 79 97 105 116.1 - B1 B2 B3.1 B7.3 B14.3 - P1.1 P1.4 P4 P9 P9.1 P10
Styracaceae

*Styrax officinalis* L.
(Annex 1, plate no. 67)

Deciduous shrub or small tree, 2-6 m in height, with sub-spherical crown. Widespread in the Mediterranean from France eastward to Palestine. In Cyprus locally common in many areas (0-1300 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm, vessels of two distinct diameter classes. Greater than 200 vessels per square millimeter in earlywood. Tyloses with thin wall common. Fibers thin to thick walled, radial flat marginal fibers. Axial parenchyma diffuse, apotracheal parenchyma scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 4-12.
Radial section: Scalariform perforation plates with less than 10 bars. Intervessel pits alternate. Intervessel pits small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length greater than 500 μm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Prismatic crystals present in axial parenchyma cells.
Tangential section: Rays mostly uniseriate, some ray 1 to 3 cells wide. Larger rays commonly 4 to 10 seriate.

Bark

Pith

Codified description
1 5 9 11 14 15 22 25 30 41 45 50.2 53.2 56 61 69 70.3 76 78 86 96 97 98 107 115 136 141.1 — B3.1 B7 B8 B14.1 B14.3 — P1 P4.1 P9 P9.1 P9.3 P10.2
Tamaricaceae
*Tamarix aphylla* (L.) H. Karst
(Annex 1, plate no. 68)

Evergreen tree up to 12 m in height, with narrow, sometimes columnar crown. An exotic species, introduced in the 1940’s, native of Egypt and the Arabian peninsula. In Cyprus, it is cultivated mostly as a wind break on farmlands, on the lowlands (0-600 m alt.).

**Xylem**
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in diagonal and/or radial pattern. Vessels predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 50 – 100 μm. Gums and other deposits in heartwood vessels. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Less than 4 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with 1-4 row of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays of two distinct sizes: uniseriate and greater than 10 seriate. Axial parenchyma and/or vessel elements storied.

**Bark**

**Pith**

**Codified description**
1 5 7 11 13 22 24 30 41 52.3 58 60 61 69 78 96 99 103 106 107 114 120 136 136.1 - B1 B2 B4 B5.2 B5.4 B6.3 B11 B14.1 B14.3 - P1.1 P3 P3.1 P5 P9 P9.1 P10.1

*Tamarix dalmatica* Baum
(Annex 1, plate no. 68)
A shrub up to 1.5-3 in height. An apparently rare native to Cyprus, recorded at the southern coastal area (0-200 m alt.). It is also native in other east Mediterranean countries.

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels in radial multiples of 2 to 4 common. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessel lumina 50 – 100 µm. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 50-100 µm. Vascular and/or vasicentric tracheids present. All ray cells procumbent.
Tangential section: Larger rays commonly greater than 10 seriate. Axial parenchyma and/or vessel elements storied.

Bark

Pith missing

Codified description
1 4 9.1 13 22 24 30 36 39.1 41 52.2 60 69 78 99 104 115 120 - B1 B3.1 B4 B5.2 B5.4 B6.1 B6.3 B11 B14.1 B14.3 - Pith missing

_Tamarix smyrnensis_ Bunge
(Annex 1, plate no. 68)

A lax, deciduous shrub or small tree up to 4 m in height. Native of southern Europe and the eastern Mediterranean as far as Afghanistan. In Cyprus it grows along streams, marshy grounds and moist places on sand dunes, rocky areas and along roadsides (0-1400 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous to diffuse porous. Vessels solitary and in radial multiples of 2 to 4 common. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessels 20-50 µm. Vessels number in early wood: 100-200 per
square millimeter. Fibers thin to thick walled. Axial parenchyma scanty paratracheal to parenchyma vasicentric. Rays per millimeter 4-12.

Radial section: Simple perforation plates. Inter-vessel pits scalariform and alternate, minute (less than 4 μm in diameter) and large (greater than 10 μm in diameter).?? Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). Rays with procumbent, square and upright cells mixed throughout the ray.

Tangential section: Larger rays commonly 4 to 10 seriate. Ray height greater than 1 mm. Axial parenchyma and/or vessel elements storied. Fibers storied.

Bark


Pith

Thick walled parenchyma cells present. Cells dimorphic. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other.

Codified description

1 4 5 9 9.1 13 20 22 24 27 30 39.1 40.2 50.1 52.3 61 69 78 79 98 102 109 115 120 121 - B1 B2 B4 B5.2 B5.3 B6.3 B14.1 B14.3 - P3.3 P4 P9 P9.1 P10.1

_Tamarix tetragyna_ Ehrenb.

(Annex 1, plate no. 69)

Deciduous shrub or small tree, 5-15 m in height. Indigenous to Egypt, Palestine, Turkey and eastwards to Afghanistan. In Cyprus it grown on damp sites with fresh or saline water, mostly by streams and marshy ground (0-300 m alt.).

Xylem


Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length less than 50 μm. Fibers with simple to minutely bordered pits.
(libriform fibers). All ray cells procumbent. Prismatic crystals in ray parenchyma cells.
Tangential section: Larger rays commonly 4 to 10 seriate. Axial parenchyma and/or vessel elements storied.

Bark

Pith
Pits in transverse cell walls.

Codified description
1 4 9 11 13 22 24 30 40.2 52.1 58 61 69 78 79 98 104 115 120 136 136.1 - B1 B2
B4 B5.2 B5.3 B14.1 B14.3 - P1 P3.3 P4 P5 P9 P9.1

*Tamarix tetrandra* Pall. ex Bieb.
(Annex 1, plate no. 69)

Deciduous shrub, 1.5 – 3 m in height. Indigenous to southern Russia, the Balkan peninsula, Turkey, Palestine and Egypt. In Cyprus it is locally common along (0-400 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels solitary and in radial multiples of 2 to 4 common. Vessels predominantly in clusters. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessel lumina 50 – 100 µm. Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Less than 4 rays per millimeter. Rays per millimeter 4-12.
Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 50-100 µm. Vascular and/or vasicentric tracheids present.
Tangential section: Larger rays commonly greater than 10 seriate.

Bark
Groups of sieve tubes present. Groups of sieve tube in radial rows. Sclerenchyma cells both in phloem and cortex. Fibers in tangential rows.

Pith

Codified description
1 4 9 9.1 11 13 22 24 30 39.1 41 45 52.2 60 69 78 99 114 115 - B1 B1.2 B4 B5.2 B6.1 B6.3 B7.3 B14.1 B14.3 - P1 P3.3 P4 P5 P9 P9.1 P10.2 P12

**Thymelaeaceae**

*Thymelaea hirsuta* (L.) Endl. (Annex 1, plate no. 69)

Erected or sprawling, evergreen, shrub up to 1.5 m in height. A Mediterranean species, indigenous to Cyprus occurring on sandy banks and grass steppes (0-50 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semi-ring porous. Vessels in diagonal or in dendritic pattern, vessels in radial multiples of 4 or more common. Mean tangential diameter of earlywood vessels less than 20 μm. Gums and other deposits in heartwood vessels. Fibers thick to very thick walled. Axial parenchyma diffuse and scanty paratracheal. Apotracheal parenchyma in narrow bands or lines up to three cells wide. Greater than 20 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 100-200 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square. Tangential section: Rays exclusively uniseriate.

Bark
Groups of sieve tube and collapsed sieve tubes present. Some rays become dilated. Prismatic crystals.

Pith
Evergreen, much branched shrub up to 1 m in height, with compact, scoparioid form. An eastern Mediterranean species, in Cyprus it occurs on slope with garigue and maquis vegetation (0-800 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood semiring porous. Vessels in diagonal and/or in dendritic pattern. Vessels predominantly in clusters. Vessels cell wall thick (greater than 2 μm). Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes, 40 – 100 earlywood vessels per square millimeter. Fibers very thick walled. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 12-20.
Radial section: Simple perforation plates. Inter-vessel pits opposite, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 50-100 μm. Fibers with simple to minutely bordered pits (libriform fibers).
Tangential section: Rays exclusively uniseriate.

Bark

Pith
Ulmaceae

_Celtis australis_ L.

(Annex 1, plate no. 70)

Deciduous tree up to 20 m in height. Indigenous to Cyprus, with limited distribution, although in some parts it is locally common (0-1400 m alt.).

Xylem

Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous. Vessels solitary or in clusters. Mean tangential diameter of earlywood vessel lumina 100 – 200 µm, 40 – 100 earlywood vessels per square millimeter. Tyloses with thin wall common. Fibers thin to thick walled, tension wood observed. Axial parenchyma vasicentric and confluent, parenchyma bands greater than three cells wide. Less than 4 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, medium size (7-10 µm in diameter). Vessel-ray pits rounded or angular with large apertures. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with mostly 2-4 rows of upright and/or square marginal cells. Prismatic crystals present in ray parenchyma cells. Tangential section: Rays of two distance size: uniseriate and greater than 10 seriate. Later rays height greater than 1 mm.

Bark


Pith


Codified description


_Celtis tournefortii_ Lam.

(Annex 1, plate no. 70)
Deciduous tree or shrub, 2-8 m in height. Indigenous in the eastern Mediterranean countries, it rarely occur in Cyprus (600-1400 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Earlywood vessel elements length 100-200 μm. Fibers with simple to minutely bordered pits (libriform fibers). Body ray cells procumbent with one row of upright and/or square marginal cells. Prismatic crystals in ray parenchyma cells.
Tangential section: Rays uniseriate and up to 10 seriate.

Bark

Pith

Codified description

_Ulmus canescens_ Melville
(Annex 1, plate no. 70)

Deciduous tree, 5-10 m in height, with open crown. Indigenous in Mediterranean countries from Italy to Palestine. A rare indigenous tree in Cyprus (0-500 m alt.).
Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood diffuse porous. Vessels in diagonal and/or radial pattern. Vessels predominantly in clusters. Mean tangential diameter of earlywood vessel lumina 100 – 200 µm. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal to vasicentric sometimes confluent. Less than 4 rays per millimeter.
Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 200-500 µm. Vascular and/or vasicentric tracheids present. All ray cells procumbent. Prismatic crystals in axial parenchyma cells.
Tangential section: Larger rays commonly 4 to 10 seriate.

Bark

Pith
Pith shape round. Medullary sheath present. Thick walled parenchyma cells present. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other. Tracheary elements of metaxylem in distinct radial rows.

Codified description
1 5 7 11 13 22 25 30 36 42 53.1 60 69 70 78 79 83 98 104 114 136 141.1 - B5.2 B5.3 B7 B11 B14.1 B14.3 - P1 P2 P3.3 P9 P9.1 P10.1 P12

Verbenaceae

Lantana camara L.
(Annex 1, plate no. 71)

Evergreen shrub up to 2 m in height. Branches angular, hairy, frequently prickly with very short, recurved prickles. Native to tropical America, in Cyprus it is commonly cultivated as ornamental and sporadically found as an escape from cultivation (0-1200 m alt.).

Xylem
Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels solitary or in radial multiples of 2 to 4 or more. Vessels cell wall thick (greater than 2 µm). Mean tangential diameter of earlywood vessels 20-50 µm.
Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma scanty paratracheal. Greater than 20 rays per millimeter.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 µm. Fibers with simple to minutely bordered pits (libriform fibers). All ray cells upright and/or square.

Tangential section: Rays uniseriate to 3 cells wide.

Bark

Pith
Pith shape square. Cells dimorphic. With crystals druses. Pits grouped in transverse and in longitudinal cell walls. Primary vascular bundles clearly separate from one another to not distinct. Tracheary elements of metaxylem in distinct radial rows. Axial cells arranged in regular rows (radial section).

Codified description
2 5 9 9.1 10 13 22 24 30 39.1 40.2 45 53.1 61 69 78 96.1 97 105 116.2 — B1 B2

Vitex agnus-castus L.
(Annex 1, plate no. 71)

Deciduous, aromatic shrub 1-3 m in height. Native to southern Europe and the Mediterranean region. In Cyprus it is locally common in moist places (0-800 m alt.).

Xylem
Transverse section: Growth ring boundaries clearly demarcated. Wood ring porous to semi-ring porous. Vessels in radial multiples of 2 to 4 or in clusters. Vessels of two distinct diameter classes, mean tangential diameter of earlywood vessel lumina 100 – 200 µm, vessels number in early wood: 100-200 per square millimeter. Fibers thick to very thick walled. Axial parenchyma scanty paratracheal. Rays per millimeter 4-12.

Radial section: Simple perforation plates. Inter-vessel pits alternate, small (4-7 µm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings in vessel elements present. Earlywood vessel elements length 100-200 µm. Fibers with simple to minutely bordered pits (libriform fibers), septate fibers present. Body
ray cells procumbent with one row of upright and/or square marginal cells. Raphides present.
Tangential section: Ray width predominant 1 to 3 cells.

Bark
Groups of sieve tube and collapsed sieve tube present. Some rays become dilated. Fibers grouped, sclereids scattered or irregularly dispersed. Crystal sand. Phellem homogeneous, distinct in polarized light.

Pith

Codified description
1 3 4 9.1 11 13 22 25 30 36 42 45 50.1 52.3 61 65 69 70 78 97 106 115 149 — B1

Vitaceae
Vitis vinifera L.
(Annex 1, plate no. 71)

Deciduous climber with stem up to 6 m long, distinctly swollen at the nodes. It is supposed to be indigenous to southeast and central Europe and the countries of the Caucasus area. It also occurs in the Mediterranean countries, were it is cultivated since Romans time. It occurs in Cyprus as an adventive and a cultivated plant (0-1500 m alt.).

Xylem
Radial section: Simple perforation plates. Inter-vessel pits scalariform, large (greater than 10 μm in diameter). Vessel-ray pits with large horizontal or vertical apertures. Earlywood vessel elements length greater than 500 μm. Vascular and/or vasicentric tracheids present. Fibers with simple to minutely bordered pits (libriform fibers). Septate fibers present.
Tangential section: Rays of two distinct sizes: uniseriate and greater than 10 seriate.
Bark

Pith
Pith shape round. Cells dimorphic. With acicular crystals. Pits in transverse and in longitudinal cell walls. Primary vascular bundle clearly separate from one other.

Codified description
1 3 9 9.1 13 20 27 32 43 53.2 60 61 65 69 70.3 76 78 79 96 99 103 114 - B4 B5.2 B7 B14.1 B14.3 - P1 P4 P6.1 P9 P10.1

**Zygophyllaceae**

*Fagonia cretica* L.
(Annex 1, plate no. 72)

Sprawling or scrambling subshrub, 20-50 cm in height. Common in the Mediterranean region and the Atlantic islands. Indigenous to Cyprus, with a limited distribution, growing on dry slopes with maquis or garigue vegetation (0-300 m alt.).

Xylem
Radial section: Simple perforation plates. Intervessels pits minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Earlywood vessel elements length 200-500 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square.
Tangential section: Rays exclusively uniseriate.

Bark

Pith

**Codified description**

5 9 13 24 30 39.1 40.2 50.2 53.1 62 69 78 96 105 116.2 - B1 B3.1 B5.4 B7 – P1 P2 P3.4 P9 P9.1 P9.2 P9.3 P10.2

**Zygophyllum album** L.

(Annex 1, plate no. 72)

Much branched shrub up to 2 m in height, with open crown. Widespread in the Mediterranean towards Arabia and northern Africa. Indigenous to Cyprus common locally on rocky and sandy seashores and salt-marshes by the coast (0 m alt.).

**Xylem**

Transverse section: Growth rings indistinct or absent. Wood diffuse porous. Vessels predominantly solitary. Vessels in radial multiples of 2 to 4 common. Mean tangential diameter of earlywood vessels less than 20 μm. Vessels of two distinct diameter classes. Fibers thin to thick walled. Axial parenchyma diffuse and scanty paratracheal. Axial parenchyma in narrow bands or lines up to three cells wide. Rays per millimeter 12-20.

Radial section: Simple perforation plates. Inter-vessel pits alternate, minute (less than 4 μm in diameter). Vessels-ray pits with distinct borders, similar to inter-vessels pits in size and shape throughout the ray cell. Helical thickenings only in narrower vessel elements. Earlywood vessel elements length 100-200 μm. Fibers with distinctly bordered pits (fiber tracheids). All ray cells upright and/or square. Rays with procumbent, square and upright cells mixed throughout the ray.

Tangential section: Rays uniseriate to 3 cells wide.

**Bark**

Groups of sieve tube and collapsed sieve tubes present. Some rays become dilated. Sclerenchyma cells both in phloem and cortex. Fibers scattered or irregularly dispersed. Druses present. Phellem homogeneous, distinct in polarized light.

**Pith missing**

**Codified description**

2 5 9.1 13 22 24 30 39 40.1 45 52.3 62 69 76 78 86 96 97 105 109 116.1 - B1 B2 B3.1 B4 B5.3 B7.2 B14.1 B14.3 - Pith missing
3. Ecological wood and bark anatomy of trees and shrubs from Cyprus

Scientists often make correlations between wood anatomical features and physical and biotic factors in the nearby environment. These relationships form a basis to hypothesize adaptive strategies as drivers of much of the wood anatomical diversity that has resulted through evolution (Carlquist 1975). The extensive material collected and anatomically described in this thesis offered a unique opportunity to analyze the anatomies of trees, shrubs, dwarf shrubs, and climbers for ecological trends.

The current study applied these principles to the entire woody flora of a geographically well-defined region, in order to investigate the diversity of wood and bark anatomy in relation to biological and ecological factors. The provenance of these species ranges in elevation from the sea level to 1952 m above it. Depending on rainfall and substrate, the sites from which the plants were collected range from very dry and hot to wet and cold, and include coastal habitats where high salinity causes physiological drought despite an apparently wet habitat to rocky sites. Plant life forms range from woody chamaephyte, nanophanerophyte, to phanerophyte, and climbers. The number of sampled species, and the ecological range in the material studied is certainly large enough to justify such an analysis.

Detailed wood anatomical comparisons have been made for ecologically defined florulas in Australia (Carlquist 1977), Southern California (Carlquist & Hoekman 1985), and Israel (Baas et al. 1983, Fahn et al. 1986).

The aim of this analysis is to show how the products of the secondary growth vary in relation to taxonomy, life form, and ecology.

Materials and methods

Range descriptions in the standard reference of the Cyprus’ woody flora (Meikle 1979, 1985; Tsintides et al. 2003) were used to chose a sampling area that was representative of the geographic distribution and habitat range for each species, and then at that site, we sampled one individual. The individual chosen appeared normal, healthy, and was one of the tallest individuals of that species.
at that site. A portion of one stem was cut near the plant’s base (with the height dependent on the plant’s stature), and from this location we took a segment 5-8 cm tall including bark. A 5-8 cm tall segment of a 2-5 years old twig was also cut to have juvenile bark and pith. The disks were stored in a sealed plastic bag to which we added several drops of 40% ethanol and kept at 3-4°C until they were sectioned.

The samples were from woody chamaephytes (perennial dwarf shrubs with a woody stem with plant height less than 80 cm), nanophanerophyte (plants 80-300 cm in height, shrub), phanerophyte (plant height greater than 300 cm, tree), and climbers (not self-supporting plants).

We made thin sections (15-25 µm) using disposable blades and a sliding Reichert microtome in each of two wood anatomy laboratories: at the Dept. Land, Environment, Agriculture and Forestry - University of Padova in Italy, and at the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) in Switzerland. The sections were stained with astra blue and safranin, dehydrated with alcohol and xylene, and mounted in Canada balsam (Chaffey 2002; Schweingruber 2007). General wood anatomy was described, including wood IAWA characters (Wheeler et al. 1989). General bark anatomy was also described by following a specific codified bark anatomical feature list (Crivellaro 2012) which comprehends 33 anatomical features.

For this paper, we report only on few wood anatomical characters grouped by three main stem biological functions defined as conductive, mechanical, and storage one. For each one of them we selected some representative wood anatomical features that define wood properties related to each specific function. Wood hydraulic features were described by wood porosity (ring-porous, semi-ring porous, and diffuse porous wood), vessel groupings (vessels mostly solitary, vessels in radial multiples, and vessel in clusters), presence or absence of helical thickenings, and vessel diameters. Classification of vessel diameters was listed following IAWA features, adding the two following classes: 40.1 — tangential diameter of earlywood vessels less than 20 µm, and 40.2 — tangential diameter of earlywood vessels 20-50 µm (instead of IAWA feature number 40).

Fiber wall thickness (after Wheeler et al. 1989), presence of tension wood, and number of rays per millimeter were listed to describe stem mechanical features.
Storage features involved axial and radial parenchyma tissues describing axial parenchyma presence, and its association with vessels (apotracheal or paratracheal) in any distribution form. Radial parenchyma was described by raylessness, ray width classes, the presence of rays of two distinct sizes, and ray cellular composition (homogenous and/or heterogeneous rays).

Wood density was measured on stem sample portions after the bark and the pith were removed. Fresh wood volume was measured using Archimedes’ principal by immersing the segment in a beaker containing distilled water on a balance. Once fresh wood volume was measured, the sample was dried at 100°C for 48 hours, and after that the wood anhydrous mass was determined. Wood density was calculated on anhydrous mass/fresh volume ratio basis (g/cm³).

Bark anatomical features describe sieve tube morphology and distribution, sclerenchyma tissue presence and arrangement, ray features, presence of crystals and secretory structures, features related to appearance under polarized light, and phellem and phelloderm structures (Annex 3).

We then compared the presence or the absence of wood and bark anatomical features in relation to ecological, biological and taxonomical factors.

The ecological factors considered were mean annual temperature (MAT, °C), mean annual precipitation (MAP, mm) collected from the nearest meteorological station to each sampling site, and habitat. Meteorological data comes from Cyprus Meteorological Service website (2011) and were the mean values of the last 20 years. The habitats were defined as follow:

- moist sites (A): shaded and moist sites, stream and river banks, salt lakes and wet seashores;
- ruderal sites (B): fields, cultivations, ruderal and semi-ruderal places;
- rocky sites (C): rocks, rock faces, cliffs, rocky and sandy dry seashores;
- shrub-lands and forests (D): shrub-lands, garrigues and maquis, and forests.

Some species occurring over a wide ecological range were assigned to the zone where they are most frequent.

The biological factors taken into account were life form after Ellenberg and Mueller-Dombois (1967) classification, plant height of the sampled plant (cm),
and level of endemism to Cyprus. The level of endemism was categorized after Tsintides et al. (2007) as:

- species strictly endemic to Cyprus (A),
- close to endemic species (B),
- eastern Mediterranean species (C),
- Mediterranean species (D),
- more than Mediterranean species (E).

Taxonomical factors consider Lamiaceae family as categorical variable. Lamiaceae family is the larger family in our dataset, and it is known to be a wood anatomically homogenous family with small vessels, paratracheal parenchyma, heterogeneous rays, and with simple pitted fibers (Carlquist 1992a, Metcalfe & Clark 1950).

Data analysis was carried out at first describing the frequency distribution or the statistical variability of each anatomical variable and each attribute. After that we cross-related the anatomical variables to each other. Then we verified the presence of a relationship between each attribute to each anatomical feature. The continuous variables plant height, MAP, and MAT were categorized as short, dry, and cold if the species came from a site with plant height, MAP, and MAT less than or equal to the median for the all species pooled; otherwise, it was listed as tall, wet, and hot respectively. Wood density was classified following IAWA hardwood feature list (Wheeler et al. 1989). In this way all the variables in this study were categorical and the relationship was tested by chi-squared tests or exact Fisher tests to detect statistically significant relationships between the anatomical features and the other variables, and visualized significant relationships with association plots. Association plots (Choen 1980, Friendly 1991) indicate deviations from independence of rows and columns in a contingency table (Crawley 2009). Association plots visualize the table of Pearson residuals: each cell is represented by a rectangle that has (signed) height proportional to the corresponding Pearson residual, and width proportional to the square root of the expected counts (Meyer et al. 2003). Thus area of each box is made proportional to observed less expected frequencies. Cells with observed frequencies greater than expected frequencies rise above the independence dotted line (an are black filled), cells that contain less than the expected frequencies fall below the line (and are white shaded).
The software R (R Development Core Team, 2009) was applied to perform chi-squared tests and to draw graphs.

Results: ecological wood anatomy

Ecological wood and bark anatomy results will be presented in two distinct sections. Annex 2 shows the wood anatomical features analyzed. Ecological wood anatomy plant material consists of 179 species, which belong to 53 families and represent 118 genera. Labiatae is the family with the greater number of species (31, 17.6% of the total number of species), followed by Asteraceae (13, 7.4%), Papilionaceae and Rosaceae (11, 6.2%), Cistaceae (10, 5.7%), Chenopodiaceae (9, 5.1%), Brassicaceae (8, 4.5%), and Boraginaceae (6, 3.4%). These families all together represent half of the species studied. The other families are represented by less than 5 species each one.

Species distribution in life form categories show 65 (36.3%) woody chamaephyte, 91 (50.8%) nanophanerophyte, 14 (7.8%) phanerophytes, and 9 (5.0%) climbers. Plant height reflects the life form species frequencies distribution, in fact, even if the measured plant height range from 4 to 2200 cm, the mean value is 152.8 cm (s.d. 262.5 cm), and median 60 cm (Fig. 1a).

The levels of endemism show that almost 1/3 of the species are endemic (41 species, 22.9%) or close to endemic (14, 7.8%), almost 1/3 are typically eastern Mediterranean species (54, 30.2%), one more third designate species with an all over Mediterranean range distribution (59, 33.0%). Only 11 species (6.1%) has a range distribution outside the Mediterranean basin.

Mean annual precipitation ranges from 308.0 to 1109.0 mm, with a mean value of 592.3 mm (s.d. 245.0 mm; median 714.3 mm). The mean annual temperature shows a mean value of 17.4°C (s.d. 2.6°C, median 17.2 °C), and it ranges from 10.8 to 20.4°C. Mean annual precipitation and mean annual temperature are strictly negatively correlated ($r^2 = 0.89$, P<0.01) (Fig. 1b).

Sampled plants come predominantly from lower elevation of sampling (Fig. 1c). Habitats are predominantly represented by rocky soil sites both in mountain ranges (59 species, 33.0%) and on seashores or cliff (15, 8.4%). A total number of 50 species (27.9%) occurs in garrigues, maquis, and forests; 28 (15.6%) species occurs in fields, cultivations, and semi-ruderal places; and few in moist sites (19, 10.6%) or wet seashores and salt lakes (8, 4.5%).
Wood basic density range from 0.23 to 1.00 g/cm³. The mean value is 0.56 g/cm³ (s.d. 0.15 g/cm³, median 0.57 g/cm³) (Fig. 1d).

Most of the species of the Cyprus’ woody flora are diffuse porous (111, 62.0%), 30 species (16.8%) are clearly ring porous, and 38 (21.2%) are semi-ring porous (Fig. 2a). Vessel diameter classes frequency distribution for all species shows a predominance of small vessels: 53 species (29.6%) has earlywood vessel diameter less than 20 µm, 91 species (50.8%) showed earlywood vessels diameter greater than 20 µm but smaller than 50 µm (Fig. 2b).
Solitary vessels are typical anatomical feature for 74 species (41.3%), vessels in clusters for 75 species (41.9%), and vessel in radial multiples for 30 species (16.8%) (Fig. 2c). Helical thickenings were recorded in 56 species (31.3%) (Fig. 2d). Most of the sampled species showed thin walled fibers (105 species, 58.6%), 48 species (26.8%) thin to thick walled fibers, and 26 (14.5%) thick walled fibers (Fig. 3a). Tension wood was observed in 18 species (Fig. 3b). The number of ray per millimeter is greater in the class with more than 20 rays per millimeter (63 species, 35.2%), and smaller in the class with less than 4 rays per millimeter (20
species, 11.2%) (Fig. 3c). Raylessness was observed in 21 species (11.7%) (Fig 3c).

Axial parenchyma was paratracheal in most of the species (111 species, 62%), apotracheal in 37 (20.7%), and rare or difficult to observe in 31 (17.3%) species (Fig. 4a). Rays width distribution show a predominance of rays large 1 to 3 cells and uniseriate rays (Fig. 4b).

Fig. 3. a) Frequency distribution in fiber wall thickness classes, b) frequency distribution in relation to tension wood presence, c) frequency distribution in relation to rays per millimeter classes (114: less than 4 ray per mm, 115: 4-12 rays per mm, 116.1: 12-20 rays per mm, 116.2: greater than 20 rays per mm, A: rayless species) in the woody species from Cyprus.
The following table 1 shows statistical test results for anatomical feature relationships. The relationship between each anatomical feature to each one of the other were tested for they significance (with $\alpha = 0.05$). The table 1 show the results of these tests: a table cell contain an “X” when the relationship between the variables in the row and column are significantly related.

<table>
<thead>
<tr>
<th></th>
<th>Ring porosity</th>
<th>Vessel diameter</th>
<th>Vessel grouping</th>
<th>Helical thickenings</th>
<th>Fiber wall thickness</th>
<th>Tension wood</th>
<th>Rays per millimeter</th>
<th>Apotracheal parenchyma</th>
<th>Rays width</th>
<th>Raylessness</th>
<th>Rays of two sizes</th>
<th>Ray composition</th>
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</tbody>
</table>

Tab. 1. Relationships between anatomical features as categorical variables, “X” was noted only for statistically significant relationships after chi-squared of Fisher exact tests.
The following charts show the way in which the hydraulic anatomical features are related. 

Vessel diameters vs. ring porosity chart showed a clear trend in vessel diameter from diffuse, semi-ring porous species, to ring porous species.

Helical thickenings presence was related to semi-ring and ring porous woods and with vessels grouping in clusters.
Tension wood presence was related to ring porous species, to species with vessel diameter greater than 50 µm and to species with vessels in radial multiples (the latter association do not show in charts).

Vessel diameter vs. number of rays per millimeter showed a clear trend: greater the vessels diameter is, the lower the number of rays per millimeter. Thin walled fibers were associated with solitary vessels and radial grouping; species with vessels in clusters displayed a clear association with medium and thick walled fibers.
Axial parenchyma arrangements showed a clear association with ring porosity: apotracheal parenchyma was related to ring porous species, paratracheal parenchyma was related to diffuse porous species. Axial parenchyma was rarely observed in semi-ring porous species. The association plot showing the relationship between ring porosity and rays width displayed a distribution of uniseriate rays predominantly in semi-ring porous species, and rays commonly greater than 10 seriate to ring porous species.

All rayless species were diffuse porous. Presence of rays of two distinct sizes was associate to ring porous species.
The relationships between vessel diameters and ray widths showed a positive trend: greater is the vessels diameter, larger are the rays. Raylessness was associated to species with very small vessels (less than 20 µm).

Rays were homogeneous in species with small vessels. The association plot vessel grouping vs. rays width showed that uniseriate rays and rays greater than 10 seriate are associate to radial vessel grouping, intermediate large rays seem to be more associated with solitary vessels, and larger rays to cluster vessel grouping.

Rays of two distinct sizes were associated to radial vessel grouping. Heterogeneous rays were associated to radial vessels grouping, homogeneous rays to solitary vessels and vessels in clusters.
Tension wood tended to be lacking in species with few rays per millimeter and in species with greater than 20 rays per millimeter. The relationship between fiber wall thickness and axial parenchyma arrangement is not of clear interpretation.

Tension wood is associated to heterogeneous rays. Species with greater than 20 rays per millimeter showed a good association with apotracheal and rare axial parenchyma.
Rays width and rays per millimeter are inversely related: greater is the number of rays per millimeter, lower is rays width. Rays of two distinct sizes were observed in species with no more than 4-12 rays per millimeter.

Ray composition showed a relation to number of rays per millimeter: heterogeneity in rays is associated to less rays per millimeter.
The following table 3 shows the relationships between anatomical features and the biological, ecological and taxonomical attributes.

<table>
<thead>
<tr>
<th></th>
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<th>Storage</th>
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<td>Fiber wall thickness</td>
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<td>Rays width</td>
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<td>Rays composition</td>
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</tbody>
</table>

Life form: X
Plant height: X
Endemism level: X
MAP & MAT: X
Elevation: X
Habitat: X
Lamiaceae family: X
Wood density: X

Tab 4. Relationships between anatomical features and attributes as categorical variables, “X” was noted only for statistically significant relationships after chi-squared of Fisher exact tests.

The following charts describe the way in which these variables are associated. Diffuse porous structure was associated to woody chamaephytes, semi ring and rig porous anatomies were typically observed in nanophanerophytes and
phanerophytes. A trend in vessel diameter linked small vessels to woody chamaephyte and greater vessels to phanerophyte.

A lack of helical thickenings was associated to woody chamaephytes. The presence of tension wood to phanerophytes.

The number of rays per millimeter decreased from woody chamaephytes to phanerophytes. The axial parenchyma was rare in woody chamaephytes, apotracheal in nanophanerophytes and mainly paratracheal in phanerophytes.
Rays become larger moving from woody chamaephytes to phanerophytes. Raylessness was clearly associated to woody chamaephytes.

Homogeneous ray composition was associated to woody chamaephytes, heterogeneous ray composition was associated to nanophanerophytes and phanerophytes.
Taller plants showed a clear association to ring porous structure, and shorter species to diffuse porous woods. Short plants has very small vessels.

Helical thickenings and tension wood presence were associated to taller species (association plots not displayed).

Short plants showed an association with both few rays per millimeter and more than 20 rays per millimeter. Axial parenchyma was rare or difficult to observe in short plants, and apotracheal in tall species.
Short plants and uniseriate rays were strongly associated, 4 to 10 cells large rays were also associated to short plants. Tall plants displayed an association to 1-3 cells wide rays and to rays greater than 10 cells in width.

Homogenous ray were associated to short plants, heterogeneous rays to tall plants (charts not shown).
Species endemic to Cyprus and to Eastern Mediterranean region were associated to semi-ring and diffuse porous woods, in contrast Mediterranean species growing in Cyprus showed a strong association to diffuse porous structure. Tension wood tended to be lacking in endemic and close to endemic species, it was noted in Mediterranean species.
The absence of parenchyma was linked to species endemic to Cyprus, but close to endemic species showed an association to apotracheal parenchyma. Raylessness was not associated to Eastern Mediterranean species, but endemic and close to endemics species showed an association to raylessness.

Endemic and close to endemic species showed a strong association to homogenous rays. The other species from Eastern Mediterranean to over Mediterranean distribution range showed association to heterogeneous rays.
Precipitation and temperature were associated only to two anatomical features. We recorded a predominance of diffuse porous species in dry/hot site, and the presence of ring porous species in wet/cold sites. Ray composition varied from homogenous in dry/hot sites to heterogeneous in wet/cold sites. The same relation was observed in the elevation vs. ray composition association plot (chart do not showed).

Habitat relationships to ring porosity showed a clear association of ring porous woods to moist sites, and to ruderal sites too, but in the latter diffuse porous woods were also associated. Diffuse porous structures were associated to rocky and sandy sites, and semi-ring porous woods to forest and shrubland habitats.
Thick walled fiber species were associated to moist and ruderal habitats, thin walled fibers to forest and shrubland species.

The presence of tension wood was associated to ruderal and forests habitat. The relationships between number of rays per millimeter and habitat does not seem to be clear, but in moist habitats there was a clear association with 4-12 cells wide rays and in rocky and sandy habitats with larger rays.

At the same way the relationships of habitat vs. axial parenchyma arrangement is not clear. Apotracheal parenchyma was linked to moist and forest habitats, the lacking of parenchyma to rocky and sandy sites. Raylessness was associated to moist sites and to rocky sites.
A strong association was observed between ray homogeneity and rocky sites.

The only two statistically significant relationships between wood density and anatomical features showed an association between helical thickenings presence and medium dense woods. A clear trend was observed in fiber wall thickness vs. wood density: the greater the fiber wall thickness is, the greater is the wood density.
The analysis on Lamiaceae family compared to the all datasets showed an association between ring and semi-ring porosity to Lamiaceae. Vessels diameter of 20-50 µm was clearly associated to the analyzed family.

In Lamiaceae the presence of thin walled fibers and the absence of tension wood were common, rays were uniseriate and their proportion was greater than 12 per millimeter, and axial parenchyma was rare. Raylessness and rays of two sizes were not associated with Lamiaceae family, and rays composition showed an association with homogeneous rays (association plots do not shown).
Discussion: ecological wood anatomy

The goals of this study were to describe association patterns between wood anatomical features to ecological and biological factors. No specific hypotheses were tested.

We observed diffuse porous structure was associated to the shortest life form studied in this work, the woody chamaephytes. We detected semi-ring and ring porous xylems related to nanophanerophytes and phanerophytes. Taller plants show a clear association to ring porous structure, and shorter species to diffuse porous woods. At the same time a trend is vessel diameter show small vessels associated to woody chamaephyte and greater vessel diameters to phanerophyte. Our results comparing life form and plant height (short/tall) to hydraulic anatomical features are in line with those from another comparative study of 207 woody species in California, in which trees were found to have larger vessels (Carlquist & Hoekman, 1985). Results from many other investigations of height and vessel characteristics are not directly comparable to the present study because they were based on direct plant height measurements (e.g. Phillips et al. 2003, Preston et al. 2006, Koch et al. 2004), we in stead estimated plant height by life form classification. Nevertheless, those studies generally found that vessel lumen area increased as individuals grew taller, thereby counteracting some of the increased hydraulic resistance associated with height (Mencuccini et al. 2011).

A functional interpretation of the association between helical thickenings and tall plants (which also show greater vessels) confirm the possible role of helical thickenings in providing information on adaptive morphology of vessels elements (Baas 1973, Nair 1987, Schmid & Baas 1984).

To our knowledge the relationship between presence of tension wood associated to phanerophytes and to taller species was never showed. Rays features seem to be associate to space filling in wood, and the rays dimensional features seems to be constrained by vessels. In fact, rays became larger moving from woody chamaephytes to phanerophytes, and the numbers of rays per millimeter decrease moving from woody chamaephytes to phanerophytes allowing vessels to be greater in taller life forms. Raylessness is clearly associated to woody chamaephytes. Raylessness may cause the loss of radial conduction of assimilates and possibly water and hormones, and occurs only in stems that have relatively small diameters.
Raylessness can also be regarded as a means of achieving a rapid substitution of mechanical tissue for ray tissue (Carlquist 2001).

Rays composition vary from homogeneous in woody chamaephytes, to heterogeneous in nanophanerophytes and phanerophytes. At the same time homogenous rays are associated to short plants, heterogeneous ray to tall plants.

The axial parenchyma was rare in woody chamaephytes, apotracheal in nanophanerophytes and mainly paratracheal in phanerophytes. Axial parenchyma was rare or difficult to observe in short plants, and apotracheal is frequent in tall species. Axial parenchyma arrangements in relation to growth forms was discussed in Schweingruber & Poschlod (2005) and in Schweingruber et al. (2011) and other studies, but no functional or ecological interpretations were possible.

Level of endemism to Cyprus allow us to evaluate certain anatomical feature which evolved in the island and tell the difference to the other wider range distribution species.

Endemic and close to endemic species showed absence of axial parenchyma, raylessness, homogeneous rays, and did not show association to tension wood. This can be explained by endemic and close to endemic plants being short and mainly woody chamaephytes.

We recorded a predominance of diffuse porous species in dry/hot site, and the presence of ring porous species in wet/cold sites in line with most of the past studies (Carlquist & Hoekman 1985, Fahn et al. 1986, Martínez-Cabrera et al. 2011, Preston et al. 2006, Schweingruber & Bass 1987).

Habitat relationships to ring porosity showed a clear association of ring porous woods to moist sites, and to ruderal sites too, but in the latter diffuse porous woods were also associated. Diffuse porous structures were associated to rocky and sandy sites, and semi-ring porous woods to forest and shrublands habitats. This findings support the studies that suggest small vessels associated to arid sites.

Thick walled fibers species were associated to moist and ruderal habitats, thin walled fibers to forest and shrubland species. Climate variables were more intimately associated with fibers than with vessel traits in 61 shrub species from North and South America (Martínez-Cabrera et al. 2009). A clear trend
was observed in fiber wall thickness vs. wood density: greater in the fiber wall thickness, greater is the wood density.

The analysis on Lamiaceae family showed that the wood anatomy of the family can be describe by association with ring and semi-ring porosity, vessel diameter 20-50 µm, presence of thin walled fibers, absence of tension wood, rays proportion greater than 12 per millimeter, axial parenchyma rare, and uniseriate rays. Raylessness and rays of two sizes were not associated with Lamiaceae family. These results are in line with previous findings of Baas & Schweingruber (1987), Carlquist (1985a), Carlquist (1982), Carlquist & Hoekman (1985). A deeper taxonomic explanation was not possible because we don’t have enough material from other families than Lamiaceae.

**Results: ecological bark anatomy**

The annex 3 shows the dataset for ecological bark anatomy analysis. The following table 5 shows the statistically significant relationships between bark anatomical features to life forms, level of endemism, and habitat.

<table>
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Tab. 5. Statistically significant relationships between bark anatomical features to life form, level of endemism and habitat.
A number of relations involve life forms and bark anatomical features. Sieve tubes arrangement in tangential rows was associated to woody chamaephytes, the lack of sieve tubes in tangential rows was associated to the tallest life form, and to climbers. Sclerenchyma cells presence was associated to shorter life forms (woody chamaephytes and nanophanerophytes) and to climbers, and a lack of sclerenchyma cells was associated to phanerophytes.

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<tr>
<td>Absent</td>
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</table>

Fibers presence and fibers arrangement in tangential rows follows the same association described for sclerenchyma cells.

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<th>Fibers in tangential rows</th>
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<td>Present</td>
</tr>
<tr>
<td>Chamaeph.</td>
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</table>

A lack of sclereids was associated to phanerophytes. Prismatic crystals were associated to woody chamaephytes and nanophanerophytes; the absence of prismatic crystals was related to climbers and phanerophytes.
Phloem structure was homogenous for climbers and nanophanerophytes, and not homogeneous for woody chamaephytes and phanerophytes. The same association was observed for phellem disappearing in polarized light.

A layered structure for phellem was associated to climbers and nanophanerophytes. Layered phelloderm was associated to woody chamaephytes.
Endemic and close to endemic species showed a lack of rays dilated, eastern Mediterranean species were strongly associated to the presence of dilated rays. Sclerenchyma cells were absent in endemic and close to endemic species, but associated to eastern Mediterranean plants.

Fibers presence and fibers arrangement in tangential rows were not present in endemic and close to endemic species, but associated with all the species with a distribution range wider than the island of Cyprus.
An association lack was recorded for prismatic crystals in endemic to eastern Mediterranean species, the presence of prismatic crystals in bark was related to Mediterranean and over Mediterranean species.

Distinctness of phellem in polarized light was related to eastern Mediterranean and to over Mediterranean range distribution species. The presence of phelloderm with a distinct layered structure was associated to endemic and close to endemic species to Cyprus.
Relationships between habitat and bark features showed an association of dilated rays to moist and ruderal sites, and a lack of rays dilated in forest habitats. Sclerenchyma cells presence was associated with the all habitat considered, but not with rocky sites.

Sclereids presence followed the same association pattern described for sclerenchyma cells. The arrangement of sclereids in tangential rows was related to ruderal and forest sites.
Scattered sclereids were associated to all habitats beside rocky and sandy sites. Prismatic crystals presence was associate to ruderal species, a lack of prismatic crystals to rocky sites.

Crystals druses were related to moist sites and to forest habitat. Phellem homogeneous was associated to moist and ruderal sites.
Phellem not distinct in polarized light was associated to moist and ruderal sites. Layered phelloderm was associated to rocky and forest sites.

**Discussion: ecological bark anatomy**

A lack of sieve tubes in tangential rows, and of sclerenchyma cells were associated to the tallest life form, and to climbers. Prismatic crystals were associated to woody chamaephytes and nanophanerophytes. Sieve tube arrangement in tangential rows was associated to woody chamaephytes. Sclerenchyma cells and fibers presence was associated to shorter life forms (woody chamaephytes and nanophanerophytes) and to climbers. A lack of sclereids was associated to phanerophytes. Phloem structure was homogenous.
for climbers and nanophanerophytes, and not homogeneous for woody chamaephytes and phanerophytes. The same association was observed for the feature "phellem disappearing in polarized light".

Endemic and close to endemic species showed a lack of dilated rays, eastern Mediterranean species were strongly associated to the presence of dilated rays. Sclerenchyma cells were absent in endemic and close to endemic species, but associated to eastern Mediterranean plants. Fibers presence and fibers arrangement in tangential rows were not present in endemic and close to endemic species, but associated with all the species with a distribution range wider than the island of Cyprus. An association lack was recorded for prismatic crystals in endemic to eastern Mediterranean species, the presence of prismatic crystals in bark was related to Mediterranean and over Mediterranean species. Distinctness of phellem in polarized light was related to eastern Mediterranean and to over Mediterranean range distribution species. The presence of phelloderm with a distinct layered structure was associated to endemic and close to endemic species to Cyprus.

Relationships between habitat and bark features showed an association of dilated rays to moist and ruderal sites, and a lack of rays dilated in forest habitats. Sclerenchyma cells presence was associated with all the habitats considered, but not with rocky sites. Sclereids presence followed the same association pattern described for sclerenchyma cells. The arrangement of sclereids in tangential rows was related to ruderal and forest sites.

Scattered sclereids were associated to all habitats beside rocky and sandy sites. Prismatic crystals presence was associated to ruderal species, and a lack of prismatic crystals to rocky sites. Crystal druses were related to moist sites and to forest habitats. Phellem homogeneous was associated to moist and ruderal sites. Phellem not distinct in polarized light was associated to moist and ruderal sites. Layered phelloderm was associated to rocky and forest sites.

The association of sclerenchyma with lifeform suggests a biomechanical role, especially for young twigs. The level of endemism and the species' habitat were strongly linked to a number of bark features opening new fields of ecophyletic and ecophysiological investigation. The huge amount of results make it interesting in driving future studies on this field.
Conclusions

The ecological wood anatomy results showed in this research mostly confirm previous findings, but also addressed some new interesting research questions. As an example: how the presence of tension wood is related to plant height, to taxonomical groups, and to environmental conditions? How raylessness effect conductive and mechanical functions in plants? What are the ecological and functional interpretation of axial parenchyma presence and distribution in relation to life form, to plant height, to environment?

The statistical approach applied here is new in the field of ecological anatomy and it seemed to be easy to apply and to interpret. Since no hypothesis were tested it was not possible to underline a general or specific interpretation of the ecological relationships between the investigated anatomical features and ecological attributes. This is especially true for ecological bark anatomy which is an unexplored area in plant anatomy research. New questions need to be answered e.g.: how is the presence of crystals in wood related the presence of crystals in bark? What about the distribution of sclerenchyma tissues in bark, and how is it in relation to wood fibers? How is the sieve tubes distribution pattern related to phloem conductive functions and to ecological factors?
4. Wood anatomy relative to apparent mechanical and hydraulic needs of woody climbers vs. subshrubs on the island of Cyprus

The structure of secondary xylem in a given species is a reflection of both its evolved, adaptive features, and the constraints on that evolution that have canalized which features were most likely to evolve. Moreover, those evolved adaptive features may be intrinsically controlled (developmentally fixed) or they may be extrinsically controlled (plastic) (Day et al. 2002). By comparing the wood structure of taxa of differing growth forms and from different habitats, we can infer the environmental factors that were important in shaping the evolution of the growth forms and taxa. For example, if we observe a consistent difference in wood structure between taxa growing in dry vs. wet sites, we could infer that moisture is of strong importance in the evolution of these taxa’s wood structures.

This study looks at the mechanical, hydraulic, and ecological wood anatomy of 10 species of woody climber and 25 species of woody subshrubs growing on the island of Cyprus in the eastern Mediterranean Sea. The goals are to better understand the suites of anatomical characteristics in each of the growth forms, to learn which growth forms exhibit more variability with changing site characteristics, and to infer the environmental factors responsible, over an evolutionary time frame, for these relationships.

Climbing species have less need to provide their own support than do self-supporting species (e.g., Darwin 1865, Isnard & Silk 2009), and a number of studies have compared the wood anatomy of climbers to self-supporters. In this study, climbers were compared to subshrubs because in a larger study on the ecological wood anatomy of over 250 woody taxa of Cyprus (Crivellaro 2012), subshrubs as a group showed less variability (in plant height and stem diameter) than did the other self-supporting taxa, and so appeared to be a more cohesive growth form for this comparison. Climbers typically have relatively large-diameter vessels and a high proportion of the cross-section devoted to vessel lumen and parenchyma compared to self-supporters.
(Carlquist 1985). Among the self-supported plants, subshrubs in particular often have diffuse-porous wood, small diameter vessels, and high variability in axial parenchyma arrangements (Schweingruber & Poschlod 2005, Schweingruber et al. 2011). Because of the partial release from the need to provide mechanical support, climbers can have wood with lower strength and stiffness (e.g., Gartner 1991b). Wood density is a good index of mechanical support: the higher the density, the more mass a given unit of wood can support (Kollmann & Côte 1968, Niklas 1992). Fibers provide much of the mechanical support in woody stems. Therefore, we expect that subshrubs will have higher wood density and a higher proportion of fibers than climbers.

A second expectation is that climbers will have anatomy in which their vessel diameters and frequencies are closer to the ‘packing limit’ than will subshrubs. The packing limit is the maximum number of vessels that can fit in an area for a given mean vessel cross-sectional area: it is often represented by a line on a graph of area weighted vessel diameter vs. vessel frequency (in number per mm²) (McCulloh et al. 2010). The negative correlation between these two parameters means that species with wide vessels have very few of them in a given area relative to species with narrower vessels. Because fewer and wider vessels are theoretically more efficient at water conduction than more numerous, narrower ones (Gartner 1991a, Zanne et al. 2010; Tyree and Zimmermann 2002), more efficiently conductive species will approach the theoretical maximum packing limit (McCulloh et al. 2010). Again, because climbers have less need to provide their own mechanical support, one could expect their wood to be more optimized for water transport. The higher wood-area-specific hydraulic conductivity of climbers than self-supporters has been well documented in the wet and dry tropics (Bamber 1984, Ewers & Fisher 1989, Ewers et al. 1990, Gartner et al. 1990, Gallenmüllen et al. 2001, Gallenmüllen et al. 2004), and the temperate zone (Baas & Schweingruber 1987, Gartner 1991a, Chiu & Ewers 1992, Tibbetts & Ewers 2000). The packing function of climbers vs. self-supporting species has not been reported, to our knowledge.

A third expectation is that the wood anatomy of a species will be adaptive for the habitat in which it is growing, and this expectation forms the basis of extensive reviews (e.g., Baas 1982, 1986, Baas & Miller 1985, Carlquist 1988, Tyree & Zimmermann 2002). Given that climbers and self-supporters have
different relative hydraulic and mechanical constraints, one would not expect the same habitat/anatomy relationship across the growth forms. Ring-porosity, for example, is more common in climbers than in self-supporting taxa (Baas & Schweingruber 1987, Carlquist 1985, 1991).

The three hypotheses tested in this paper are the following: 1) climbers have less dense wood and a lower proportion of their cross-section devoted to fibers than subshrubs. 2) Vessel size and frequencies are closer to the packing limit in climbers than in subshrubs. 3) Wood anatomy (degree of ring- or diffuse-porosity, vessel diameter, vessel frequency) is related to site characteristics (temperature and water availability), and these relationships are different in climbers and subshrubs. These hypotheses are tested by comparing values from a census of species anatomies using data from one individual of each of the climbing species and most of the subshrub species on the island of Cyprus. The basic xylem traits compared here, such as wood-porosity, raylessness, and possession of successive cambia (successive layers of xylem and phloem, common in the subshrubs) are species traits and as such this census method is appropriate and allows a large sample size. Whereas the quantitative traits such as vessel and fiber diameter, vessel frequency, and tissues area will vary among individuals, the use of numerous species provides replication at the species level.

Materials and methods
The field sampling was carried out in the island of Cyprus (Fig. 1), which lies at the easternmost end of the Mediterranean basin (33° 2’’ E, 35° 12’’ N; 9251 km²; maximum elevation 1952 m).

The overall climate is Mediterranean, but it is strongly influenced locally by geographical position relative to relief and the Mediterranean Sea. Annual rainfall averages about 480 mm, with 60% falling between the months of December and February. It ranges from about 300 mm in the central plain to about 1100 mm in the central upper Troodos Mountain Range. The mean daily temperature in July and August range between 29 °C on the central plain and 22 °C at the higher altitudes in the Troodos, whereas the respective mean daily temperatures in January are 10 °C and 3 °C (Cyprus Meteorological Service, 2011).
In March and September 2009 we sampled all of the endemic and indigenous climbers (10 species) and most of the subshrubs (25 of approximately 40 species) belonging to the flora of Cyprus. We used the range descriptions in the standard references of Cyprus' woody flora (Meikle 1979, 1985; Tsintides et al. 2002) to choose a sampling area that was representative of the geographic distribution and habitat range for each species, and then at that site, sampled one individual. The individual chosen appeared normal and healthy, and was one of the tallest individuals of that species at the site. A portion of one stem was cut near the plant’s base (with the height dependent on the plant’s stature, Annex 4), and from this location we took a segment 5-8 cm tall including bark. The segment was stored in a sealed plastic bag to which we added several drops of 40% ethanol and kept it at 3-4°C until it was sectioned. During harvest, we recorded plant height, height of the midpoint from which the segment was taken, and diameter at that point (under bark) for each sample. Elevation and coordinates of the site (from a GPS unit) and site name

Fig. 1. Location of sampling sites for climbers and subshrubs on the island of Cyprus.
(from the nearest geographic feature) were recorded. We also described the site location relative to natural features such as bodies of water, position along the slope, and physical features of the surrounding landscape.

Stem samples were sawed to expose the wood at the segment’s mid-point for sectioning. We made transverse and longitudinal sections (15-25 µm) using a disposable blade and a sliding Reichert microtome in each of two wood anatomy laboratories: the Dept. Land, Environment, Agriculture and Forestry - University of Padova (TeSAF — UNIPD) in Italy, and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) in Birmensdorf — CH. The sections were stained with Astra blue and safranin, dehydrated with alcohol and xylene, and mounted in Canada balsam (Schweingruber 2008). The cell walls richer in cellulose stained blue, and cell walls richer in lignin stained red. With this double staining, parenchyma cells were usually blue and the remainders of the cells were usually red, facilitating the study the wood patterns in the cross-sections. General anatomy was described (Crivellaro 2012) including the IAWA characters (Wheeler et al. 1989). For this paper, we report presence of absence of successive cambia, presence or absence of rays, and the type of wood porosity (ring-porous, semi-ring-porous, or diffuse-porous).

Sections were imaged at Oregon State University in Corvallis, USA using a digital camera mounted on a Nikon Eclipse E400 compound microscope, and analyzed with the image-analysis program ImageJ v. 1.45d (National Institutes of Health, Bethesda, MD, USA; http://rsb.info.nih.gov/ij/). Under the microscope, we characterized a zone of the transverse section that included the outer complete growth ring between two rays and that was large enough to contain at least 80 vessels. For this zone, we estimated lumen area of all vessels, and then converted these areas to lumen diameters, assuming vessels were circular in cross-section. Next, we estimated the total area of the zone (excluding one of the two side rays). Then, knowing the number of vessels it contained, we calculated vessel frequency as number of vessels per mm² transverse area. The mean vessel hydraulic diameter was calculated as 

\[ d_h = (\Sigma d^4/n)^{1/4}, \]

where \( d \) is the diameter of each vessel and \( n \) is the number of conduits measured. The area-weighted mean vessel diameter (\( d_A \)) was calculated as 

\[ d_A = (\Sigma d^2/n)^{0.5} \]

(McCulloh et al. 2010) to allow us to examine the packing function, \( d_A \) vs. vessel frequency.
We estimated the proportion of this same zone that was occupied by vessel, fiber, and parenchyma (axial plus ray) (termed vessel area, fiber area, and parenchyma area) by using a line tool. We manually drew multiple polygons that enclosed each tissue type, and determined the area of that tissue using ImageJ. Knowing the total area we could then calculate proportion of transverse area occupied by each tissue. Lastly, we measured the tangential outer wall diameters of 15 earlywood fibers from this same zone.

Wood density was measured on stem sample portions after the bark and the pith were removed. Fresh wood volume was measured using Archimedes’ principal by immersing the segment in a beaker containing distilled water on a balance, recording the grams of water displaced, and converting that value to volume using the relationship of 1g water at room temperature is equal to 1 cm$^3$ volume. After fresh wood volume was measured, the sample was dried at 100 °C for 48 hours, and then weighed. Wood density was calculated on a dry mass/fresh volume basis (g/cm$^3$).

From the GPS information, we found the closest meteorological data (Cyprus Meteorological Service, 2011) for each of the 35 species sampling sites and calculated mean annual precipitation (MAP) and mean annual temperature (MAT). We developed three site characteristics for each species. Site water availability was listed as dry if the species came from a site with MAP less than or equal to the median MAP for the 35 species pooled (714 mm); otherwise, it was listed as wet. Site temperature was listed as cold if the species came from a site with MAT less than or equal to the median MAT for the 35 species pooled (17.2 °C); otherwise, it was listed as hot. Site water equability (the degree to which water would be available during the growing season) was determined by observing the very local plant growing conditions at the sampling site. Water equability was listed as low when it appeared water would be removed slowly enough to keep the soil moist for a significant part of growing season, and high when the soil is would be moist only for short periods following precipitation. For example, a sample growing on the edge of a pond or year-round creek would be listed as having high water equability but a sample growing on a slope, which would be presumed to have wet soil in the rainy season and dry soil in the dry season, would be listed as having low water equability. Lastly, we recorded leaf persistence during the adverse season (evergreen, deciduous).
from the standard references of the woody flora of Cyprus (Meikle 1979, 1985; Tsintides et al. 2002).

We plotted the relationships between pairs of anatomical and geometric variables for climbers and subshrubs separately, and then compared the curves between these growth forms statistically. These paired variables included outer fiber diameter vs. stem diameter, distance from the apex, and vessel lumen diameter; vessel lumen diameter vs. distance from apex; and vessel lumen diameter vs. both vessel frequency and the value -2, which is the slope of the theoretical packing limit. We also analyzed vessel area vs. fiber area. These variables could have different degrees of correlation in the two growth forms, even though there are constraints on the correlation because the sum of vessel area, fiber area and parenchyma area is 100%.

We used a Standardized Major Axis (SMA) line-fitting method to estimate the relationship between the two variables. We used the software SMATR (Warton et al. 2006, http://www.bio.mq.edu.au/ecology/SMATR/) to test for differences in slope between climbers and subshrubs.

Next, we compared the relationships of two anatomical factors (vessel lumen diameter, fiber diameter) with two stem characteristics (stem diameter and distance of sample from the stem apex) for climbers and subshrubs. Slopes were compared as above. Means were compared using student t-tests with the software R (R Development Core Team, 2009). Lastly, we categorized each taxon by four criteria: the three environmental factors (site water availability, site temperature, site water equability), and wood porosity. For each of the categories within each criterion, we plotted vessel diameter, vessel frequency, and fiber diameter of climbers and subshrubs. Means were compared as above using Student’s t-tests. We also inspected plots qualitatively to learn the extent to which climbers and subshrubs had the same pattern of wood variation with these environmental factors.

**Results**

Climbers were much taller than the subshrubs, and generally were sampled at much higher locations above ground (Annex 4). Sample diameters were similar in the two growth forms (Annex 4, Table 2).
None of the climbers had successive cambia or lacked rays but six of the
subshrubs had successive cambia, and five of the subshrubs were rayless. Most
of the climber species were ring-porous and most of the subshrub species were
diffuse-porous (Annex 4). The 10 climber species represented eight families,
whereas the 25 climber species represented only 8 families.

Compared to subshrubs (Table 2), climbers had significantly less dense wood.
The climber wood had lower fiber area but greater fiber diameters, greater
vessel area, greater vessel diameters, and lower vessel frequency (Table 2).

In climbers, vessel anatomy did not appear to be related to fiber anatomy:
vessel lumen diameter had no relationship with fiber diameter (Fig. 2a, $r^2 =
0.04$, $P = 0.57$), and vessel area (the percentage of the cross-section comprised
of vessels) had no relationship with fiber area (the percentage of the cross-
section comprised of fibers, Fig. 2b, $r^2 = 0.08$, $P = 0.44$). The three climbers
with the largest diameter vessels, all of which were ring-porous, drove the
relationship of vessel lumen diameter vs. fiber diameter, but not the
relationship of vessel area vs. fiber area (Fig. 2a, 2b).

In subshrubs, in contrast, vessel anatomy was strongly related to fiber anatomy
within a sample, showing that the subshrub cambium tends to make wider
fibers in species that have wider vessels. In subshrubs, vessel lumen diameter
was positively correlated with fiber diameter (Fig. 2a, $r^2 = 0.60$, $P < 0.01$), and
vessel area (%) was negatively correlated with mean fiber area (%) (Fig. 2b, $r^2 =
0.33$, $P < 0.01$).

<table>
<thead>
<tr>
<th></th>
<th>Climbers</th>
<th>Subshrubs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean ± s.d.</td>
<td>min</td>
</tr>
<tr>
<td>Stem diameter (mm)</td>
<td>8.4 ± 4.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Wood density (g/cm³)</td>
<td>0.44 ± 0.15</td>
<td>0.29</td>
</tr>
<tr>
<td>Fiber area (%)</td>
<td>29.4 ± 11.3</td>
<td>16.0</td>
</tr>
<tr>
<td>Vessel area (%)</td>
<td>44.5 ± 12.9</td>
<td>26.0</td>
</tr>
<tr>
<td>Parenchyma area (%)</td>
<td>25.9 ± 14.7</td>
<td>6.0</td>
</tr>
<tr>
<td>Fiber diameter (µm)</td>
<td>14.4 ± 2.60</td>
<td>11.86</td>
</tr>
<tr>
<td>Vessel diameter, $d_h$ (µm)</td>
<td>63.3 ± 46.3</td>
<td>23.3</td>
</tr>
<tr>
<td>Vessel frequency (no./mm²)</td>
<td>368 ± 367</td>
<td>28</td>
</tr>
</tbody>
</table>

Table 2. Sample characteristics of climbers (n = 10 species) vs. subshrubs (n = 25 species);
probabilities are from paired T-tests.
There was no significant relationship for either growth form between fiber diameter and stem diameter (Fig. 3a). However, vessel diameter and stem diameter were correlated and the relationship was significant for climbers \( (r^2 = 0.70, P < 0.01) \) but not for subshrubs \( (r^2 = 0.19, P = 0.03) \) (Fig. 3b). Climbers and subshrubs showed a common slope for vessel diameter vs. distance from the apex \( (P = 0.30, \text{Fig. 3c}) \), but had different y-intercepts \( (P < 0.01) \). Fiber diameter vs. distance to the stem apex also showed a common slope in climbers and subshrubs \( (P = 0.36, \text{Fig. 3d}) \), and had different y-intercepts \( (P = 0.02) \).
Vessel frequency was plotted against vessel lumen diameter ($d_{A}$) to examine the packing functions of the climbing vs. the subshrub species (Fig. 4). The slope of the relationship did not differ significantly between the two growth forms nor did either slope differ from the slope of the packing limit, which is -2 ($P = 0.46$). Climbers had a stronger correlation between vessel diameter and frequency than did subshrubs ($r^2 = 0.95$, $P < 0.01$, and 0.47, $P < 0.01$, respectively), suggesting more constraints on packing limit in climbers than subshrubs.

Fig. 3. a) Vessel lumen diameter vs. stem diameter, b) fiber diameter vs. stem diameter, c) vessel lumen diameter vs. distance from the stem apex, and d) fiber diameter vs. distance from the stem apex in climbers vs. subshrubs from the island of Cyprus. Each data point represents one species. The axes in c) and d) are shown on log-log plots.
Fig. 4. Vessel frequency vs. vessel diameter (dA) in climbers vs. subshrubs from the island of Cyprus. Each data point represents one species. Heavy solid line shows the packing function limit. The axes are shown on log-log plots.

Climbers differed markedly in vessel diameter or vessel frequency across environmental and anatomical categories (Fig. 5), showing the wide variation in climber anatomical structure. In climbers fiber diameter was not significantly different across these categories (Fig. 6). In contrast, subshrubs had remarkably constant values for vessel diameter, vessel frequency and fiber diameter across the categories (Figs. 5 and 6).
Climbers were significantly taller in wet relative to dry sites (mean plant height of 725 vs. 250 cm, respectively, $t = 2.73$, df = 7.14, $P = 0.03$) and in cold relative to hot sites (664 vs. 233 cm, respectively, $t = 2.38$, df = 7.47, $P = 0.04$). No statistically significant plant height differences were observed on the basis of water equability in climbers vs. subshrubs.
Discussion

The analysis of all the woody climbers and many of the woody subshrubs of the island of Cyprus supported all the hypotheses in this study and showed that climbers have less dense wood and a lower proportion of their cross-section devoted to fibers than subshrubs, that vessel size and frequencies are closer to the packing limit in climbers than in subshrubs, and that the ecological wood anatomy of climbers differs from that of subshrubs. Biomechanically, we expected that climbers would have wood structure that was less specialized for self-support than the subshrubs (Hypothesis 1). This expectation was supported by the climbers having lower wood density and lower fiber area than subshrubs (Table 2), and by climber anatomy exhibiting greater diversity, suggesting it has been less constrained evolutionarily in the structures and their combinations that were able to evolve. For example, climbers showed no correlation between the vessel and fiber area in a stem, because a wide variety of combinations of cell types were exhibited (Fig. 2b). In contrast, subshrubs had a strong negative correlation between these variables. Another example is the degree to which fiber and vessel diameter...
were correlated (Fig. 2a). In climbers, the two variables were not correlated but in subshrubs there was a strong positive correlation. The wide range of patterns in which climbers’ anatomical characteristics were combined was consistent with our understanding of their growth form. We think of climbers as having more slender stems, and thus more flexibility than self-supporting plants of the same height. Flexibility in climbers is often interpreted as a mechanical advantage for a growth form that may hang, swing, or be coiled while slipping or falling from host vegetation (Haberlandt 1914, Isnard & Silk 1996, Putz & Holbrook 1991). The stem stiffness is given by the products of material stiffness and a geometric factor (second moment area). Because the geometric factor is proportional to the fourth power of stem radius, narrower stems are much more flexible than wider stems of the same material. Climbing plants commonly have a much smaller rate of radial growth than do self-supporting species (Ewers et al. 1991, Putz 1990), and they are quite small in stem diameter relative to the amount of foliage they supply (Putz 1983). Apparently climbers compensate for their narrow stem diameters by producing wider vessels, and a greater number of vessels per area than closely related self-supporting species (Ewers 1985). Both wider vessel lumens and greater vessel density increase the theoretical conductivity making climbers much more hydraulically efficient.

However, what is the adaptive significance of the observed anatomical constraints on the subshrubs? One possibility is related to the path-length for water transport in different growth forms, with the assumption that subshrubs may have had little selective pressure to have wood with wide diameter vessels. Many woody plants produce wood that is more conductive near the base than the top of the plant, presumably mitigating the increased resistance on the water column due to path-length and height (Ryan & Yoder 1997, Enquist et al. 2000, McDowell et al. 2002, Barnard & Ryan 2003, McCulloh et al. 2010, Savage et al. 2010, Meizner et al. 2011). This interpretation is consistent with Fig. 3c, showing that vessel lumen diameter was positively correlated with the distance from the apex of the plant: wood near the base of the taller plants had much wider vessels than did wood at the base of short plants. If there was little selective pressure in subshrubs for wood with wide vessels and high selective pressure for wood that could support self-weight, then one may expect that
small-diameter vessels and large fiber areas may have evolved. An interesting observation is that in the subshrubs, with their apparent need for a large fiber area and their consequent constraint on vessel area, there could have been selective pressure to evolve larger-diameter vessels in to maintain high water flux: this pattern, however, was not observed.

Fiber diameter is related to distance from the apex in both climbers and subshrubs (Fig. 3d). This relationship may explain the higher wood density in subshrubs. In fact, previous findings show that wood density in shrubs can be driven by a reduction in fiber cell sizes (Jacobsen et al. 2005, 2007, Martínez-Cabrera et al. 2009).

Fiber diameters tended to be larger in ring-porous climbers than in the other types of climbers and all of the subshrubs types (Fig. 6). This unexpected result reflects the many roles that fibers can have. It is possible that the narrow diameter fibers, typically found in the subshrubs (Fig. 3b, 6) and diffuse-porous climbers (Fig. 6) function primarily in mechanical support but that the larger diameter fibers in the ring-porous climbers function in water storage and release (Carlquist 1958, 2001). This idea is supported by observed negative correlations between wood density and fiber diameter (Jacobsen et al. 2005, McCulloh et al. 2012), and the positive correlations found between wood density and water storage capacity and daily use of stored water (Meinzer et al. 2008, McCulloh et al. 2012).

As predicted by Hypothesis 2, climbers had vessel diameters and frequencies that were closer to the packing limit than did subshrubs. Climbers had a higher vessel frequency for a given vessel lumen diameter than did subshrubs (Fig. 4), reflected in climbers’ higher vessel area and lower fiber area (Table 2). As discussed above, this functional allocation of stem area is consistent with our understanding that climber xylem has less of a role in self-support than subshrub xylem. The fact that climbers tended to be shifted to the right on the packing-limit graph (Fig. 4) is consistent with the water transport efficiency that climbers often exhibit by having fewer wide vessels compared to subshrubs. As predicted by Hypothesis 3, there were differences between growth forms in the basic wood anatomy and in the distribution of anatomies with respect to climate and site factors. Regarding anatomy, only climbers had species that were ring-porous (Annex 4 and Fig. 5), and only subshrubs had species with...
successive cambia and/or that were rayless (Annex 4). One possible mechanism for the ring-porosity in climbers as well as the axial gradient in vessel diameter for all species pooled is the auxin hypothesis that predicts an increase in vessel diameter with distance from apical meristem (Aloni & Zimmermann 1983). The alteration of vascular increments with parenchyma provided by successive cambia may offer an ideal stem organization for storage and retrieval of photosynthate and water (Carlquist 2007). Raylessness may cause the loss of radial conduction of assimilates and possibly water and hormones, and occurs only in stems that have relatively small diameters. If rayless stems do experience the addition of secondary xylem to an appreciable extent, they tend to develop rays. Raylessness can also be regarded as a means of achieving a rapid substitution of mechanical tissue for ray tissue (Carlquist 2001). The rays may aid in giving climber stems flexibility, as was proposed for the role of axial parenchyma (summarized in Haberlandt 1914).

Regarding site factors, the climbing species showed differences in their mean vessel diameters and vessel frequencies by site water availability and site temperature. For the subshrubs species, in contrast, we detected no site-related variation in vessel anatomy (Fig. 5), and for fiber characteristics, neither growth form exhibited consistent site-related variation (Fig. 6). These results underscore the wider range of diversity of wood anatomies found within climbers than within subshrubs, and suggest that xylem adaptation options seem to be fewer in subshrubs. The lack of fiber diameter differences by site characteristic for either growth form may have resulted from ‘fiber’ actually representing more than one functional role, as discussed above.

Conclusions
This study showed that within the woody flora of the island of Cyprus, the structure of the secondary xylem of climbers appeared to be less specialized for mechanical support and more specialized for long-distance water transport than did the secondary xylem of subshrubs. The support for this statement included the greater vessel areas, vessel lumen diameters and higher incidence of ring-porosity in climbers than subshrubs, and the packing-limit functions that were closer to the maximum possible in climbers than subshrubs. Additionally, the anatomy of climbers varied systematically with site water availability and temperature, whereas the subshrub anatomy did not.
Our understanding of the plastic vs. genetic nature of these adaptations could be furthered by studies of the ecological wood anatomy of selected species over a range of environments. It would also be interesting to compare the habitats, ranges, plant architectures, and physiologies of ring-porous or diffuse-porous species of a variety of growth forms to learn if there are specific associations that would suggest constraints of the wood anatomy on the ecology of species.
5. Overall conclusions

In the past years, wood anatomy has gained new attention thanks to new studies showing the hidden ecological information richness in stems from trees, shrubs and herbs. These studies are a source for retrospective studies on many ecological and eco-physiological questions. In the era of global climate change such studies are of great relevance, especially in tropical and arid environments, where the knowledge in anatomical properties of plants is still largely unexplored, especially concerning shrubs and dwarf shrubs. Although the total area of Mediterranean forests are significantly smaller than the timber productive forest types, they have specific features which make them a unique world natural heritage. Moreover, it is expected that predicted climate and socio-economic changes will increase the already existing threats on Mediterranean forests on one hand and contribute to the expansion of Mediterranean conditions to new areas on the other. The Mediterranean region also houses an extraordinary natural heritage, which has resulted in it being identified among the 200 most important ecoregions in the world (Olson & Dinnerstein 1998), as well as considered as one of the 34 global “hotspots” for conservation priority (Mittermeier et al. 2004).

Wood of shrubs and dwarf shrubs, as well as wood of not widely technologically used trees, has been not investigated thoroughly and in detail before. Pith and bark anatomy were rarely presented systematically for a great number of species, and no comprehensive studies on the relation between bark and pith anatomical features were published to my knowledge. The present thesis investigated anatomically trees and shrubs species belonging to the flora of the island of Cyprus. More than 170 investigated species belonging to different woody plant life forms and many of them being endemic plants to the flora of Cyprus were described. These plants represent almost the entire woody flora of the island, excluding the exotics and introduced species. A great number of the presented plants have never been anatomically described before. Pith and juvenile bark anatomies were described by following new classification for anatomical features of those tissues specifically designed for this research.
Throughout examination of bark, wood and pith anatomy it will be much more easy to determine a plant fragment found of an archaeological site, or to pieces of wood that have been washed ashore. Identifying wood archeobotanical findings (carbonized wood, glacial deposits, etc.), historical objects, and remains belonging to the human cultural heritage (prehistoric stuffs, structural beams, etc.) is often difficult because wood anatomical features are only partially present. Therefore, having bark and pith anatomical descriptions address new possibilities in plant identification for wood anatomists who are interested on the wood structure of single species or the range of anatomical patterns within the Eastern Mediterranean region.

The methodology used in the current work will help to improve the standards of description of plants.

A large dataset that covers almost the entire woody flora of a well defined geographical region represented a great opportunity to describe patterns in distribution of wood anatomical features in relation to ecological, biological, taxonomical attributes. The results of this approach were described for tree and shrub species, results reveal new insights on the functional ecology of wood anatomy of certain plant ecological groups. This was a new approach providing new insight into wood formation of individual systematic plant taxa and under specific ecological site characteristics. The same procedure was carried out for bark analyses and it is the first comprehensive study on this aspect carried out on a so greet number of species.

The specific anatomy of 10 woody climbers and 25 subshrubs with different survival strategies, has been related to mechanical and hydraulic needs of the plants. The analyses showed that climbers have less dense wood and a lower proportion of their cross-section devoted to fibers than the subshrubs, that the vessel sizes and frequencies were closer to the packing limit in climbers than in subshrubs, and that the ecological wood anatomy of climbers generally differed from that of subshrubs. These findings will help the scientists to understand better the adaptations of anatomy to main functions of the plant tissues. The analyses will also help to understand better the secondary growth in relation to taxonomy, life forms, and ecology in general.
This thesis relates the described wood anatomical features to biogeographic, taxonomic, and environmental parameters and offers an approach towards an ecological interpretation of anatomical architecture and plant functioning. In providing such a dataset for a geographically distinct region like an island, the present study offers baseline data for ongoing research like e.g. the potential threats and benefits that plant species might experience from ongoing environmental change based on the hydraulic properties of their wood anatomical characteristics. Such study would provide a systematic basis on issues of biodiversity change or species extinction threats in terms of functional limitations of a species in terms of hydraulic plasticity.
Literature cited


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WEB sources


Annexes

Annex 1
Photomicrographs for each one of the species described. Wood, pith and bark transverse sections are presented. Each picture enlargements is indicated in the caption under the picture.

Annex 2
Biological and wood anatomical descriptive information on endemic and indigenous species studied.

Annex 3
Biological and bark anatomical descriptive information on endemic and indigenous species studied.

Annex 4
Descriptive information on climbers and subshrubs studied in chapter 4.
Plate no. 1

*Cupressus sempervirens* L.

![Image of *Cupressus sempervirens* L. at 100x magnification.]

![Image of *Cupressus sempervirens* L. at 100x magnification.]

![Image of *Cupressus sempervirens* L. at 100x magnification.]

*Juniperus excelsa* M.Bieb.

![Image of *Juniperus excelsa* M.Bieb. at 100x magnification.]

![Image of *Juniperus excelsa* M.Bieb. at 40x magnification.]

![Image of *Juniperus excelsa* M.Bieb. at 40x magnification.]

*Juniperus foetidissima* Willd.

![Image of *Juniperus foetidissima* Willd. at 100x magnification.]

![Image of *Juniperus foetidissima* Willd. at 100x magnification.]

![Image of *Juniperus foetidissima* Willd. at 40x magnification.]

Annex 1
Juniperus phoenicea L.

Juniperus oxycedrus L.

Cedrus brevifolia (Hook. F.) Henry

Plate no. 2

Annex 1
Plate no. 3

*Pinus brutia* Ten.

*Pinus nigra* J.F. Arnold subsp. *pallasiana* (Lamb.) Holmboe

*Pinus pinea* L.

Annex 1
Plate no. 4

Ephedra fragilis (J.C. Mayer) Asch. et Graebn.

Ephedra nebrodensis Guss.

Acer obtusifolium Sibth. & Sm.
Plate no. 5

*Acer pseudoplatanus* L.

*Bosea cypria* Boiss.

*Pistacia atlantica* Desf.

Annex 1
Plate no. 6

Pistacia lentiscus L.

![Images of Pistacia lentiscus L. at 40x, 40x, and 100x magnification.]

Rhus coriaria L.

![Images of Rhus coriaria L. at 40x, 40x, and 40x magnification.]

Schinus molle L.

![Images of Schinus molle L. at 100x, 40x, and 40x magnification.]

Annex 1
Plate no. 7

*Schinus terebinthifolius* Raddi

100x  
40x  
40x

*Nerium oleander* L.

40x  
20x  
40x

*Vinca major* L.

200x  
40x  
100x

Annex 1
Plate no. 8

_Hedera helix_ subsp. _poetarum_ L.

_Aristolochia sempervirens_ L.

_Cyprinia gracilis_ (Boiss.) Browicz

Annex 1
Plate no. 9

*Achillea cretica* L.

Ambrosia maritima L.

*Artemisia arbolescens* L.

Annex 1
Plate no. 10

*Centaurea akamantis* T. Georgiades et Hadjikyriakou

*Cichorium spinosum* L.

*Helichrysum italicum* (Roth) G. Don

Annex 1
Inula crithmoides L.

40x \hspace{0.5cm} 40x \hspace{0.5cm} 100x

Inula viscosa (L.) Aiton.

40x \hspace{0.5cm} 40x \hspace{0.5cm} 40x

Otanthus maritimus (L.) Hoffmanns. et Link

40x \hspace{0.5cm} 40x \hspace{0.5cm} 100x

Annex 1
Phagnalon rupestre (L.) DC.

Ptilostemon chamaepeuce (L.) Less. var. cyprius Greuter

Staehelina lobelii DC.

Annex 1
Plate no. 13

*Berberis cretica* L.

*Alnus orientalis* Decne.

*Echium angustifolium* Link ex Willk. & Lange

Annex 1
Plate no. 14

*Lithodora hispidula* (Sm.) Griseb. subsp. *versicolor* Meikle

*Onosma caespitosa* Kotschy

*Onosma fruticosa* Sm.

Annex 1
Plate no. 15

**Onosma mitis** Boiss. et Heldr.

[A microscope images of *Onosma mitis* Boiss. et Heldr. with magnifications of 100x, 100x, and 200x.]

**Alyssum akamasicum** B.L.Burtt

[A microscope images of *Alyssum akamasicum* B.L.Burtt with magnifications of 100x, 400x, and 100x.]

**Alyssum troodi** Boiss.

[A microscope images of *Alyssum troodi* Boiss. with magnifications of 200x, 40x, and 200x.]

Annex 1
Alyssum cypricum Nyar.

Arabis cypria Holmboe

Arabis purpurea Sibth. et Sm.

Annex 1
Plate no. 17

Brassica hilarionis Post

Erysimum kykkoticum Hadjikyriakou et Alziar

Ceratonia siliqua L.

Annex 1
Plate no. 18

*Capparis spinosa* L.

100x 40x 40x

*Lonicera etrusca* Santi

100x 40x 100x

*Lonicera japonica* Thumb.

100x 40x 200x

Annex 1
Plate no. 19

*Viburnum opulus* L.

*Viburnum tinus* L.

*Silene fruticosa* L.
Silene galataea Boiss.

Arthrocnemum macrostachyum (Moric.) Mois et Delponte

Arthrocnemum perenne (Mill.) Moss

Annex 1
Plate no. 21

*Atriplex halimus* L.

*Atriplex semibaccata* R.Br.

*Halimione portulacoides* (L.) Aellen

Annex 1
Plate no. 22

**Halocnemum strobilaceum** (Pall.) Bieb.

![Image of Halocnemum strobilaceum](image1)

![Image of Halocnemum strobilaceum](image2)

![Image of Halocnemum strobilaceum](image3)

**Noaea mucronata** (Forssk.) Asch. et Schwinf.

![Image of Noaea mucronata](image4)

![Image of Noaea mucronata](image5)

![Image of Noaea mucronata](image6)

**Suaeda aegyptiaca** (Hasselq.) Zohary

![Image of Suaeda aegyptiaca](image7)

![Image of Suaeda aegyptiaca](image8)

![Image of Suaeda aegyptiaca](image9)

Annex 1
Plate no. 24

*Cistus monspelliensis* L.

100x

*Cistus parvifolius* Lam.

100x

*Fumana arabica* (L.) Spach.

100x

100x

40x

100x

Annex 1
Plate no. 25

*Fumana thymifolia* (L.) Verlot

*Helianthemum obtusifolium* Dunal

*Helianthemum stipulatum* (Forssk.) C. Christens.

Annex 1
Helianthemum syriacum (Jacq.) Dum-Cours.

Convolvulus dorycnium L.

Convolvulus oleifolius var. desertii Desr. Pamp.
Plate no. 27

Convolvulus oleifolius var. pumilus Desr. Pamp.

Convolvulus oleifolius var. oleifolius Desr.

Pterocephalus multiflorus Poech subsp. multiflorus

Annex 1
Plate no. 28

*Pterocephalus multiflorus* Poech. subsp. *obtusifolius* Holmboe

100x

*Scabiosa cyprica* Post.

100x 40x 100x

*Elaeagnus angustifolia* L.

100x 100x 40x

Annex 1
Plate no. 29

**Arbutus andrachne** L.

![Arbutus andrachne L.](image)

100x 40x 100x

**Arbutus unedo** L.

![Arbutus unedo L.](image)

100x 40x 40x

**Erica sicula** Guss.

![Erica sicula Guss.](image)

200x 100x 200x

Annex 1
Plate no. 30

Euphorbia hierosolymitana Boiss.

Euphorbia thompsonii Holmboe

Ricinus communis L.

Annex 1
Plate no. 31

*Quercus coccifera* L. subsp. *calliprinos* (Webb) Holmboe

*Quercus infectoria* Oliv. subsp. *veneris* (A.Kern.) Holmboe

*Frankenia hirsuta* L.

Annex 1
Plate no. 32

Hypericum hircinum L.

Hypericum confertum (Choisy) G.Don

Juglans regia L.

Annex 1
Plate no. 33

**Ballota integrifolia** Benth.

![Image of Ballota integrifolia at 100x, 40x, and 100x magnification.]

**Calamintha incana** (Sibth. & Sm.) Boiss.

![Image of Calamintha incana at 100x, 40x, and 100x magnification.]

**Lavandula angustifolia** Mill.

![Image of Lavandula angustifolia at 100x, 40x, and 100x magnification.]

Annex 1
Plate no. 34

*Micromeria nervosa* (Desf.) Benth.

![Images of *Micromeria nervosa*](image1)

*Micromeria cypria* Kotschy

![Images of *Micromeria cypria*](image2)

*Micromeria chionistrae* Meikle

![Images of *Micromeria chionistrae*](image3)

Annex 1
Plate no. 35

*Micromeria myrtifolia* Boiss. et Hohen

200x

100x

200x

*Nepeta troodi* Holmboe

100x

40x

100x

*Origanum cordifolium* (Aucher et Montbret ex Benth.) Vogel

200x

40x

100x

Annex 1
Plate no. 37

*Phlomis cypria* Post. var. *cypria* Meikle

![Images of *Phlomis cypria*](image1)

100x | 40x | 200x

*Phlomis cypria* Post. var. *occidentalis* Meikle

![Images of *Phlomis cypria*](image2)

100x | 40x | 100x

*Phlomis lunariifolia* Sm.

![Images of *Phlomis lunariifolia*](image3)

100x | 40x | 100x

Annex 1
Plate no. 39

**Salvia lanigera** Poir.

- **200x**
- **40x**
- **100x**

**Salvia dominica** L.

- **100x**
- **40x**
- **100x**

**Satureja thymbra** L.

- **100x**
- **200x**
- **100x**

Annex 1
**Plate no. 40**

*Scutellaria sibthorpii* Boiss. et Reut. ex Boiss.

![Images of *Scutellaria sibthorpii*](image1.png)

100x  
40x  
100x

*Sideritis cypria* Post

![Images of *Sideritis cypria*](image2.png)

100x  
40x  
40x

*Teucrium micropodioides* Rouy

![Images of *Teucrium micropodioides*](image3.png)

100x  
40x  
40x

Annex 1
Plate no. 41

*Teucrium creticum* L.

*Teucrium cyprium* Boiss. *cyprium*

*Teucrium cyprium* Boiss. subsp. *kyreniae* Boiss. P.H. Davis

Annex 1
Plate no. 42

*Teucrium divaricatum* subsp. *canescens* Heldr. (Celak.) Holmboe

*Teucrium kotschyanum* Poech.

*Thymus capitatus* (L.) Hoffmanns
Plate no. 43

*Thymus intiger* Griseb.

*Laurus nobilis* L.

*Lavatera bryoniifolia* Mill.

Annex 1
Plate no. 45

*Ficus sycomorus* L.

*Morus alba* L.

*Callistemon lanceolatus* DC.

Annex 1
Plate no. 46

*Eucalyptus camaldulensis* Dehnh.

![Image of Eucalyptus camaldulensis](image1)

*Eucalyptus gomphocephala* DC.

![Image of Eucalyptus gomphocephala](image2)

*Eucalyptus salubris* F.Muell.

![Image of Eucalyptus salubris](image3)

Annex 1
Plate no. 47

**Eucalyptus torquata** Luehm.

![Images of Eucalyptus torquata](image1)

**Melaleuca almillaris** (Sol. ex Gartn.) Sm.

![Images of Melaleuca almillaris](image2)

**Myrtus communis** L.

![Images of Myrtus communis](image3)

Annex 1
Plate no. 48

Olea europaea L.

![Image of Olea europaea L.]

Phillyrea latifolia L.

![Image of Phillyrea latifolia L.]

Syringa vulgaris L.

![Image of Syringa vulgaris L.]

Annex 1
Plate no. 50

Argyrolobium uniflorum (Dec.) Jaub. & Spach

Astragalus echinus subsp. echinus DC.

Calycotome villosa (Poir.) Link

Annex 1
Plate no. 51

Coronilla emerus L. subsp. emeroides (Boiss. et Spruner.) Holmboe

Genista sphacelata Decne

Glycyrrhiza glabra L.

Annex 1
Plate no. 52

*Hedysarum cyprium* Boiss.

100x 40x 40x

*Ononis spinosa* L. (Boiss.) subsp. *leiosperma* Sirjaev

100x 40x 100x

*Spartium junceum* L.

100x 40x 100x

Annex 1
Plate no. 53

**Phytolacca pruinosa** Fenzi

100x

100X

100x

**Platanus orientalis** L.

40x

100X

100x

**Plumbago auriculata** Lam.

100x

40x

100x

Annex 1
Plate no. 54

Plumbago europaea L.

Punica granatum L.

Clematis cirrhosa L.

Annex 1
Plate no. 55

*Clematis vitalba* L.

*Rhamnus alaternus* L.

*Rhamnus oleoides* L.

Annex 1
Plate no. 56

Zizyphus lotus (L.) Lam.

Zizyphus spina-christi (L.) Willd.

Zizyphus zizyphus (L.) Meikle

Annex 1
Plate no. 57

*Cotoneaster racemiflorus* (Desf.) C.Koch var. *nummularius* (Fisch. et Meyer) Dippel

Crataegus azarolus L.

Crataegus monogina Jacq.
Plate no. 59

*Prunus dulcis* (Mill.) D.A.Webb

40x 40x 40x

*Pyracantha coccinea* M.Roem.

100x 40x 100x

*Pyrus malus* L.

100x 40x 100x

Annex 1
Plate no. 60

_Pyrus syriaca_ Boiss.

_Rosa canina_ L.

_Rosa chionistrae_ H. Lindb.
Plate no. 61

Rosa damascena Mill.

Rubus discolor Weihe et Nees

Rubus sanctus Schreb

Annex 1
Plate no. 62

*Sarcopoterium spinosum* (L.) Spach

![Images of *Sarcopoterium spinosum*](image1)

40x 100x 200x

*Sorbus aria* (L.) Crantz subsp. *cretica* (Lindl.) Holmboe

![Images of *Sorbus aria* subsp. *cretica*](image2)

40x 40x 100x

*Asperula cypria* Ehrend.

![Images of *Asperula cypria*](image3)

100x 40x 100x
Plate no. 63

*Putoria calabrica* (L.f.) DC.

100x

40x

100x

*Rubia laurae* (Holmboe) Airy Shaw

200x

40x

100x

*Rubia tenuifolia* d’Urv.

100x

40x

100x

Annex 1
Plate no. 64

*Citrus aurantium* L.

![Image of Citrus aurantium L.](image)

*Citrus aurantium* L.

![Image of Citrus limon (L.) Burm.f.](image)

*Citrus limon* (L.) Burm.f.

![Image of Citrus sinensis (L.) Osbeck](image)

*Citrus sinensis* (L.) Osbeck

Annex 1
Plate no. 66

**Antirrhinum majus** L.

- 100x
- 40x
- 100x

**Odontites cypria** Boiss.

- 200x
- 40x
- 100x

**Lycium ferocissimum** Miers

- 100x
- 40x
- 100x

Annex 1
Plate no. 67

*Nicotiana glauca* Graham

*Withania somnifera* (L.) Dunal

*Styrax officinalis* L.

Annex 1
Plate no. 68

*Tamarix ahpylla* (L.) H. Karst

*Tamarix dalmatica* Baum

*Tamarix smyrnensis* Bunge

Annex 1
Plate no. 69

*Tamarix tetragyna* Ehrenb.

*Tamarix tetrandra* Pall. ex Bieb.

*Thymelaea hirsuta* (L.) Endl.

Annex 1
Plate no. 70

*Celtis australis* L.

*Celtis tournefortii* Lam.

*Ulmus canescens* Melville

Annex 1
Plate no. 72

_Fagonia cretica_ L.

![Image of Fagonia cretica](image1)

100x  40x  100x

_Zygophyllum album_ L.

![Image of Zygophyllum album](image2)

100x  40x  100x

Annex 1
Annex 2. Wood anatomical descriptive information on endemic and indigenous species studied: family and scientific name, lifeform (W, woody chamaephyte; N, nanophanerophyte; P, phanerophyte; Cl, climbers), plant height (Short, species with plant height less than or equal to the median plant height; Tall, species with plant height greater than the median plant height), level of endemism (A, species strictly endemic to Cyprus; B, species close to endemic; C, eastern Mediterranean species; D, Mediterranean species), MAP (Mean Annual Precipitation) (Dry, if the species came from a site with MAP less than or equal to the median MAP; Wet, if the species came from a site with MAP greater than the median MAP), MAT (Mean annual temperature) (Cold, if the species came from a site with MAT less than or equal to the median MAT; Hot, if the species came from a site with MAT greater than the median MAT), elevation (Low, if the species came from a site with elevation less than or equal to the median elevation; High, if the species came from a site with elevation greater than or equal to the median elevation). Habitat (A, shaded and moist sites, stream and river banks, salt lakes and wet seashores; B, fields, cultivations, ruderal and semi-ruderal places; C, rocks, rock faces, cliffs, rocky and sandy dry seashores; D, shrub-lands, garriques and maquis, and forests.), wood density (Low, less than 0.40 g/cm³; Med, 0.40-0.75 g/cm³; High, greater than 0.75 g/cm³), wood porosity (R, ring-porous; S, semi ring-porous; D, diffuse porous), vessel diameter (40.1, less than 20 µm; 40.2, 20-50 µm; 41, 50-100 µm; 42, 100-200 µm; 43, greater than 200 µm), vessel grouping (S, solitary; C, clusters; R, radial), helical thickenings (A, absent; P, present), fiber wall thickness (Thin; Med, medium; Thick), tension wood (A, absent; P, present), rays per millimeter (number of rays classes) bark sclerenchyma (A, absent; F, fibers; S, sclereids; F, S, fibers and sclereids), axial parenchyma (Apo, apotracheal; Para, paratracheal; Rare), ray width (A, raylessness; 96, uniseriate; 97, 1-3 cells wide; 98, 4-10 cells wide; 99, greater than 10 cells; 103, rays of two distinct size), raylessness (A, absent; P, present), rays composition (He, heterocellular rays; Ho, homocellular rays; He, Ho, both heterocellular and homocellular rays present), crystals in wood (A, absent; P, present), crystals in bark (A, absent; P, present), tyloses and deposits (T, tyloses; D, deposits; T, D, tyloses and deposits. Species are ordered alphabetically by family name and than by scientific name within each family.

<table>
<thead>
<tr>
<th>#</th>
<th>Family</th>
<th>Scientific name</th>
<th>Lifeform</th>
<th>Plant height</th>
<th>Endemism</th>
<th>MAP</th>
<th>MAT</th>
<th>Elevation</th>
<th>Habitat</th>
<th>Wood density</th>
<th>Ring porosity</th>
<th>Vessel diameter</th>
<th>Vessel grouping</th>
<th>Helical thickenings</th>
<th>Fiber wall thickness</th>
<th>Tension wood</th>
<th>Rays per millimeter</th>
<th>Bark sclerenchyma</th>
<th>Axial parenchyma</th>
<th>Ray width</th>
<th>Raylesness</th>
<th>Rays composition</th>
<th>Crystals in wood</th>
<th>Crystals in bark</th>
<th>Tyloses and deposits</th>
<th>Deposit type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aceraceae</td>
<td>Acer obtusifolium Sibth. et Sm.</td>
<td>N</td>
<td>Tall</td>
<td>C</td>
<td>Wet</td>
<td>Cold</td>
<td>High</td>
<td>C</td>
<td>D</td>
<td>40.2</td>
<td>R</td>
<td>P</td>
<td>Thin</td>
<td>P</td>
<td>12-20</td>
<td>F,S</td>
<td>Para</td>
<td>97</td>
<td>A</td>
<td>He</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Amaranthaceae</td>
<td>Bosea cypros Boiss.</td>
<td>N</td>
<td>Tall</td>
<td>A</td>
<td>Dry</td>
<td>Hot</td>
<td>Low</td>
<td>C</td>
<td>Med</td>
<td>40.2</td>
<td>S</td>
<td>A</td>
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<td>R</td>
<td>42</td>
<td>C</td>
<td>P</td>
<td>Thin</td>
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<td>F</td>
<td>S</td>
<td>Para</td>
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<td>B</td>
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<td>R</td>
<td>41</td>
<td>C</td>
<td>P</td>
<td>Thin</td>
<td>P</td>
<td>4-12</td>
<td>S</td>
<td>Para</td>
<td>103</td>
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<td>He</td>
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<td>Lifeform</td>
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<td>MAT</td>
<td>Elevation</td>
<td>Habitat</td>
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<td>Vessel grouping</td>
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<td>Rays per millimeter</td>
<td>Bark s/correnchyma</td>
<td>Axial parenchyma</td>
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<td>Rayessness</td>
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<td>42</td>
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<td>P</td>
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<td>A</td>
<td>Para</td>
<td>A</td>
<td>98</td>
<td>A</td>
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<td>B</td>
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<td>43</td>
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<td>F</td>
<td>Para</td>
<td>103</td>
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<td>D</td>
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<td>Low</td>
<td>C</td>
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<td>F</td>
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<td>He, Ho</td>
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<p>| #  | Family         | Scientific name                  | Uniform | Endoderm | Sieve tube inclusions | Sieve tube in tang rows | Sieve tube in rad rows | Some rayed | Scalariform/ellipsoidal | Fibers | Fibers in rad rows | Fibers in tang rows | Fiber bordered | Fibers bordered | Scalaried | Scalaried in rad rows | Scalaried in tang rows | Scalaried bordered | Prismatic crystals | Ascending crystals | Druzy crystals | Crystals | Parenchyma uniform | Laticifer structure | Laticifer tubes | Collar content | Phellem not distinct | Phellem homogeneous | Phellem distinct rad | Phellem distinct tang | Phellem lignified | Phellem layered | Phellem parenchyma layered |
|----|----------------|----------------------------------|---------|----------|-----------------------|-------------------------|------------------------|------------|------------------------|--------|---------------------|---------------------|---------------|------------------|----------|---------------------|---------------------|------------------|-------------------|------------------|-----------------|----------------|------------------|----------------|----------------|------------------|
| 1  | Aceraceae      | Acer obutusifolium Sibth. et Sm.| N       | C        | C                     | A                       | A                      | A          | A                      | P      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | P                 | P               | A                 | A                 | A                |
| 2  | Amaranthaceae  | Bosea cypria Boiss.              | N       | A        | C                     | P                       | A                       | A          | A                      | A      | A                   | P                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | P               | A                 | A                 | A                |
| 3  | Anacardiaceae  | Pistacia atlantica Desf.        | P       | E        | B                     | P                       | A                       | A          | P                      | P      | A                   | A                   | A             | A                | A                   | A               | A                 | P                | A              | A                 | A                 | A               | A                 | A                 | A                |
| 4  | Anacardiaceae  | Pistacia lentiscus L.           | N       | D        | C                     | P                       | A                       | P          | A                      | A      | P                   | A                   | A             | A                | A                   | A               | P                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 5  | Anacardiaceae  | Pistacia terebinthus L.         | N       | C        | D                     | P                       | A                       | A          | A                      | P      | A                   | P                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 6  | Anacardiaceae  | Pistacia terebinthus x lentiscus| N       | C        | D                     | P                       | A                       | A          | P                      | P      | A                   | A                   | A             | A                | A                   | A               | P                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 7  | Anacardiaceae  | Rhus coriaria L.                | N       | C        | D                     | P                       | A                       | A          | P                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 8  | Apocynaceae    | Nerium oleander L.              | N       | D        | A                     | P                       | A                       | A          | A                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 9  | Araliaceae     | Hedera helixpoetanum L.         | L       | B        | A                     | P                       | A                       | A          | A                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 10 | Aristolochiaceae| Aristolochia sempervirens L.   | L       | D        | D                     | P                       | A                       | A          | P                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | P                 | P               | A                 | A                 | A                |
| 11 | Asteraceae     | Achillea retica L.              | N       | C        | C                     | P                       | A                       | A          | A                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 12 | Asteraceae     | Ambrosia maritima L.            | N       | D        | C                     | P                       | A                       | A          | P                      | A      | A                   | A                   | A             | A                | A                   | A               | P                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 13 | Asteraceae     | Centaurea akamantis             | Z       | A        | C                     | P                       | A                       | A          | P                      | A      | A                   | A                   | A             | A                | A                   | A               | P                 | A                | A              | A                 | A                 | A               | A                 | A                 | A                |
| 14 | Asteraceae     | Chichorium spinosum L.          | Z       | C        | C                     | P                       | A                       | A          | A                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 15 | Asteraceae     | Helichrysum corymbosum (Viv.)  | Z       | D        | B                     | A                       | A                      | A          | A                      | P      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | A                 | A                 | A               | A                 | A                 | A                |
| 16 | Asteraceae     | Helichrysum italicum (Roth)    | Z       | D        | C                     | P                       | A                       | A          | P                      | P      | A                   | P                   | A             | A                | A                   | A               | A                 | A                | A              | A                 | A                 | A               | A                 | A                 | A                |
| 17 | Asteraceae     | Inula crotchoides L.            | Z       | D        | A                     | P                       | A                       | A          | P                      | A      | A                   | A                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| 18 | Asteraceae     | Inula viscosa (L.) Alton        | Z       | D        | B                     | P                       | A                       | A          | P                      | P      | A                   | P                   | A             | A                | A                   | A               | A                 | A                | A              | P                 | A                 | A               | A                 | A                 | A                |
| #  | Family              | Scientific name                             | Lifeform | Endemism | Habitat | Sieve tube in clusters | Sieve tube in tang. rows | Sieve tube in radial rows | Sieve tube collapsed | Sparse chlorenchyma cells | Fibers | Fiber in radial rows | Fiber in tangential rows | Fiber scattered | Fiber grouped | Sieve cells | Sieve cells in radial rows | Sieve cells in tangential rows | Sieve cells scattered | Sieve cells scattered | Prismatic crystals | Axial crystals | Druce crystals | Crystalized | Phellem uniform | Laticiferous system | Laticiferous vessels | Cell content | Phenolic compounds | Phellogen homogeneous | Phellogen heterogeneous | Phellogen pseudoparenchymatous | Phellogen layered | Phenolic layered |
|----|--------------------|---------------------------------------------|----------|----------|---------|------------------------|--------------------------|---------------------------|--------------------------|--------------------------|--------|----------------------|-------------------------|----------------|----------------|----------------|-----------------------------|-----------------------------|---------------------|------------------|----------------|-------------|----------------|-------------|----------------|----------------|----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| #  | Family       | Scientific name                                 | Lifeform | Endoderm | Habitat | Slime tubes in clusters | Slime tubes tang rows | Slime tubes rad rows | Slime tube collapsed | Some cupulated | Sclerenchyma cells | Fibers | Fiber in rad rows | Fiber in tang rows | Fiber scattered | Fibers scattered | Scleres in rad rows | Scleres in tang rows | Scleres scattered | Scleres scattered | Prismatic crystals | Acicular crystals | Trichomes | Crystal | Lamellae structure | Lamellae index | Cell content | Phellem type | Phellem index | Phellem homogeneous | Phellem disorganized | Phellem discoloration | Phellem discoloration | Phellem lignified | Phellem layered |
|----|--------------|-------------------------------------------------|----------|----------|---------|------------------------|----------------------|--------------------|---------------------|---------------|-------------------|--------|----------------|------------------|---------------|----------------|-------------------|------------------|----------------|------------------|----------------|----------------|------------------|----------------|------------------|----------------|----------------|----------------|----------------|---------|
| 38 | Capparaceae  | Capparis spinosa canescens L.                  | N        | D        | B       | P        | A        | A        | P        | P        | A        | A        | P        | A        | A        | P        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 39 | Caprifoliaceae| Lonicera etrusca Santi                          | L        | D        | C       | A       | A       | A       | A       | P        | P        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 40 | Caprifoliaceae| Sambucus nigra L.                              | P        | D        | D       | P       | A       | P       | P        | P        | A        | A        | A        | A        | A        | A        | A        | A        | A        | P        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 41 | Caryophyllaceae| Dianthus caryophyllus L.                      | Z        | A        | C       | P       | A       | A       | A       | A       | A       | P        | A        | P        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 42 | Caryophyllaceae| Silene fruticosa L.                            | Z        | D        | C       | P       | A       | A       | P        | A        | A        | A       | A       | A       | A       | A       | A       | A       | A       | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 43 | Caryophyllaceae| Silene galactea Boiss.                        | N        | A        | C       | P       | P        | A       | P        | A        | A       | A       | A       | A       | A       | A       | A       | A       | A       | P        | A        | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 44 | Chenopodiaceae| Arthrocnemum macrostachyum (Moric.) Moss et Del Ponte | Z        | D        | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 45 | Chenopodiaceae| Arthrocnemum perenne (Mill.) Moss             | Z        | D        | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | P        | A        | A       | A       | A        | A        | A        | A        | A        | A        | A        | A        |
| 46 | Chenopodiaceae| Atriplex halimus L.                            | N        | D        | C       | P       | A       | A       | A       | A       | P        | A        | P        | A        | A       | A       | A       | A       | A       | P        | A        | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 47 | Chenopodiaceae| Noaea mucronata (Forsk.) Asch; et Schwef.      | N        | C        | C       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 48 | Chenopodiaceae| Salsola fruticosa (L.) L.                     | Z        | D        | A       | P       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 49 | Chenopodiaceae| Suaeda aegyptica (Hasselt.) Zohary             | Z        | C        | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | P        | P        | A       | A       | A       | A       | A       | A       | A        | A        | A        |
| 50 | Chenopodiaceae| Suaeda vera Forsk. ex J.F.Gmel                | N        | D        | C       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A       | A        | A        | A       | A       | A       | A        | A        | A        | A        | A        | A        |
| 51 | Cistaceae    | Citrus creticus creticus L.                   | N        | D        | D       | P       | A       | A       | A       | A       | P        | P        | A        | A       | A       | A       | A       | A       | A       | P        | A        | A       | A       | A       | A        | A        | A        | A        | A        | A        | A        |
| 52 | Cistaceae    | Citrus monspeliensis L.                      | N        | D        | D       | A       | A       | A       | A       | A       | P        | P        | A        | A       | A       | A       | P        | P        | A        | A       | A       | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 53 | Cistaceae    | Citrus parviflorus Lam.                      | N        | D        | D       | A       | P       | A       | A       | A       | P        | A        | P        | A       | A       | A       | A       | A       | A       | A       | A        | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| 54 | Cistaceae    | Citrus parviflorus x monspeliensis           | N        | D        | D       | P       | A       | A       | P        | A       | P        | A        | P        | A       | A       | A       | A       | A       | A       | A       | A        | A       | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| #  | Family                | Scientific name                      | Life-form | Endemism | Habitat | Sieve tube in clusters | Sieve tube in long rows | Sieve tube in radial rows | Sieve tube in collateral | Same-rayed | Sclerenchyma cells | Fibers | Fiber in radial rows | Fiber in long rows | Fiber scattered | Fibers in groups | Sclerenchyma in radial rows | Sclerenchyma in long rows | Sclerenchyma in collateral | Prismatic crystals | Asteriscus crystals | Druce crystals | Crystalloid | Ratio uniform | Ratio heterogeneous | Ratio of cell size | Cell content | Phleom weinhardi | Phleom heterogenous | Phleom distinct cell type | Phleom distinct cell type | Phleom distinct cell type | Phleom distinct cell type | Phleom distinct cell type |
|----|----------------------|--------------------------------------|-----------|----------|---------|------------------------|-------------------------|---------------------------|--------------------------|-------------|-------------------|--------|-------------------|-------------------|----------------|-----------------|-------------------------|--------------------------|--------------------------|-------------------|---------------------|-----------------|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------|------------------|------------------|-----------------|------------------|
| #   | Family               | Scientific name                     | Lifeform | Endemism | Habitat | Sieve tubes in clusters | Sieve tubes in tang. rows | Sieve tubes in radial rows | Sieve tubes collapsed | Some cooled | Sclerenchyma cells | Fibers | Fiber in radial rows | Fiber in tangential rows | Fiber scurfed | Fiber grouped | Sclereids | Sclereids in radial rows | Sclereids in tangential rows | Sclereids scurfed | Prismatic crystals | Adaxial crystals | Druce crystals | Crystals | Rhizome uniform | Laticifer structure | Laticifer ducts | Cell content | Phellem radial | Phellem heterogenous | Phellem distinct parabiotic | Lignified cells in phellem | Phellem layered | Phellem layered |
|-----|----------------------|-------------------------------------|----------|----------|---------|--------------------------|---------------------------|---------------------------|-----------------------|-------------|------------------|--------|-------------------|-------------------------|---------------|--------------|----------|--------------------------|---------------------------|-------------------|-----------------|-----------------|-----------------|-----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 73  | Euphorbiaceae        | Euphorbia thompsonii Holmboe        | Z        | B        | D       | P             | A             | A             | A          | A            | A    | A     | P             | A           | P             | A          | A            | A             | A           | A            | P           | A             | A           | A           | A            | A           | A           | A            | A           |
| 74  | Fagaceae             | Quercus coccifera calliphrus (Webb) Holmboe | P        | C        | D       | P             | A             | A             | P            | A            | P    | P     | P             | P           | P             | P          | A            | A             | A           | A            | P       | P             | A           | A           | A            | A           | A           | A            | A           |
| 75  | Fagaceae             | Quercus infectoria verneris (A.Kern.) Holmboe | P        | C        | D       | P             | A             | P             | P            | P            | P    | A     | P             | A           | P             | A          | A            | A             | A           | A            | P       | P             | A           | A           | A            | A           | A           | A            | A           |
| 76  | Frankeniaceae        | Frankenia hirsuta L.                | Z        | B        | A       | P             | A             | A             | A            | A            | A    | A     | A             | P           | P             | P          | A            | A             | A           | A            | P       | P             | A           | A           | A            | A           | A           | A            | A           |
| 77  | Gutierrezaceae       | Hypericum confertum stenobotrys (Choisy) G.Don | Z        | C        | D       | P             | A             | A             | P            | P            | A    | A     | P             | P           | P             | A          | A            | A             | A           | A            | A       | P             | A           | A           | A            | A           | A           | A            | A           |
| 78  | Gutierrezaceae       | Hypericum hircinum abimontanum L.  | N        | D        | A       | P             | A             | A             | A            | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 79  | Labiateae            | Ballota integrifolia Bentham       | N        | A        | C       | P             | A             | A             | A            | A            | A    | P     | A             | P           | P             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 80  | Labiateae            | Lavandula stoechas L.              | N        | C        | C       | A             | A             | A             | A            | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 81  | Labiateae            | Microseria chionista Melleae       | Z        | A        | C       | P             | A             | A             | A            | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 82  | Labiateae            | Microseria cypria Kotschyi         | Z        | A        | C       | A             | A             | A             | A            | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 83  | Labiateae            | Microseria myrsinitis Boiss. &amp; Hohen | Z        | A        | C       | D             | P             | A             | A             | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 84  | Labiateae            | Microseria nervosa (Desf.) Bentham | Z        | D        | D       | P             | A             | A             | A             | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 85  | Labiateae            | Nepeta troodi Holmboe              | Z        | A        | C       | P             | A             | A             | A            | A            | A    | A     | A             | A           | P             | A          | P            | P             | P           | A             | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 86  | Labiateae            | Origano carthulii (Auchar et Montbret ex Bentham) Vogel | Z        | A        | A       | P             | A             | A             | A             | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 87  | Labiateae            | Origano dubium Boiss.             | N        | B        | D       | A             | A             | A             | A            | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | P             | A           | A           | A            | A           | A           | A            | A           |
| 88  | Labiateae            | Origano majorana tenuifolium L. Weston | N        | A        | D       | P             | A             | A             | A             | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 89  | Labiateae            | Phlomis brevifraeacea Tunr                   | N        | A        | D       | P             | A             | A             | A             | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |
| 90  | Labiateae            | Phlomis cypria cypria Post               | N        | A        | D       | A             | A             | A             | A             | A            | A    | A     | A             | A           | A             | A          | A            | A             | A           | A            | A       | A             | A           | A           | A            | A           | A           | A            | A           |</p>
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Annex 4. Descriptive information on climbers and subshrubs studied: scientific name and family, total plant height (cm), sampling height from soil level (cm), wood diameter where sampled (mm), presence of successive cambia (N, not present; Y, present), presence of rays (N, not present; Y, present), wood porosity (3, ring-porous; 4, semi ring-porous; 5, diffuse porous), mean annual temperature (°C), mean annual precipitation (mm), water equability, water availability, elevation of sampling (m), leaf persistence during the adverse season (E, evergreen; D Deciduous, ?, unknown but presumed to be evergreen), and habitat from which plant was sampled. Species are ordered by vessel diameter within each growth form.

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