



INTERNATIONAL OAKS

The Journal of the International Oak Society

Issue No. 13
Summer 2002

INTERNATIONAL OAKS

The Journal of the International Oak Society

Issue No. 13
Summer 2002



Contact the International Oak Society

Business Office:

Ron Lance, President
Chimney Rock Park
P.O. Box 39
Chimney Rock, NC 28720
USA
e-mail:
ronl@chimneyrockpark.com

Editorial Office:

Doug McCreary
Integrated Hardwood
Range Mgt. Program
University of California
8279 Scott Forbes Road
Browns Valley, CA
95918
USA
e-mail:
ddmccreary@ucdavis.edu

Membership Office:

International Oak Society
c/o Richard Jensen
Department of Biology
Saint Mary's College
Notre Dame, Indiana 46556
USA
e-mail:
rjensen@saintmarys.edu

Anyone interested in joining the International Oak Society or ordering information should contact the membership office. Membership dues are U.S. \$15 per year, and benefits include *International Oaks* and *Oak News and Notes* publications, conference discounts, and exchanges of seeds and information among members from approx. 30 nations on six continents.

International Oak Society Website:

<http://www.saintmarys.edu/~rjensen/ios.html>

Cover Photo:

An aged *Quercus rotundifolia* stands among companions on the *Dehesa* of southern Spain. See the article on the *Spanish Dehesa* by Enrique Balbuena-Gutierrez in this issue.

International Oaks Number 13
is designed by Clark Communications,
Asheville, North Carolina, USA
2002

Table of Contents

Letter from the President	4
Ron Lance	
Origin and Management of the "Dehesa"	5
Enrique Balbuena-Gutierrez	
<i>Quercus ilex</i> L. and <i>Quercus rotundifolia</i> Lam.: Two Different Species	9
Francisco M. Vázquez Pardo, Soledad Ramos Maqueda, Esperanza Doncel Pérez	
Remarkable Oak Forests in Europe	15
Dr. Ing. Stelian Radu, Corina Coandă	
An Update on <i>Phytophthora ramorum</i> , Causal Agent of Sudden Oak Death	38
Steve Swain	
<i>Armillaria</i> , a Pathogen of Trees and Natural Component of Oak Woodlands	46
K.A. Jacobs	
Aiken, South Carolina - Oak City, USA!	56
Bob McCartney	
Spaces Between the Footsteps, The Pemberton Oak	61
Mike Dahl	
Northbrook's Champion Bebb Oak (<i>Quercus xbebbiana</i>)	68
Terry Cichoki	
Live Oak Society	73
Coleen Perilloux Landry	
Errata Table	78
Emile Gardiner	

Letter from the President

Ron Lance

Chimney Rock Park
Chimney Rock, North Carolina, USA

No doubt some of you were wondering where your journal had journeyed this year. Now that you have it in hand, let me pass along my apologies for its lateness, and gratitude for your patience. Like the oaks we all admire, patience and endurance are indeed virtues to take pride in.

This issue has survived arduous hours of editing, revisions, formatting, and other various maneuvers in the publishing process, finally delivered amid some mid-stream changes in our publishing and printing firms. The current issue reflects a renewed commitment to the publication of *International Oaks*, using a new publisher and printer that is expected to streamline future issues and reach all members in a more predictable schedule.

Within this issue you will find some worthwhile reading, even if your interest in oaks is casual. Of course, that description doesn't apply to most of us, but if you do happen to know someone who is 'casually interested', loan them this issue and see what they think about this oak booklet. They may be interested to learn of the close association of oaks and livestock to a large part of the Spanish countryside, or of the significance of *Armillaria* fungi to all forests, or of the rapidly developing knowledge of a new pathogen that affects several plant species (not just oaks) in California. Or, they might enjoy a military history story that involves an incidental oak in its telling, or a valuable, detailed account of some of Europe's most significant forests. These and other articles are presented in this issue with the hope that everyone who picks up this publication will find some enlightening reading.

Members of the International Oak Society are reminded that we have two international events in the near future. The Oak Open Days is set to happen in Turkey in October 2002, and our next Triennial Conference is approaching, in 2003, in the United Kingdom. Keep your membership viable and check the website regularly for developing details. If you can find the finances and time to make either of these trips, you will not regret it! Look for information about these events in the newsletter, via your regular mail if you are a member, or on the website. And, concerning the Fourth Conference in 2003, as members we have some important items to address at our membership meeting there, regarding membership categories and board officer terms. Your vote, whether by attendance or proxy, is important. Details are forthcoming.

All members, please consider how you can contribute to each other's knowledge about oaks. Do you have a potential article to submit, or know just who to ask about submitting one? Contact Doug McCreary of the Editorial Office to make it happen. And, just as I sit here looking out my office window at an oak forest adorning a mountainside, I realize that each of our accustomed, everyday images of oaks and our oak-related activities are of high interest to other members, if we take the time to share them in print.

Ron Lance
President
International Oak Society

Origin and Management of the *DEHESA* (Evergreen Oak) (*Quercus rotundifolia* Lam.) Woodlands of the Southwestern Iberian Peninsula

Enrique Balbuena-Gutierrez
Forestry Production
Investigation Agraria Services
P.O. Box 22, Badahoz 06080, Spain

What is the "DEHESA"?

The *Dehesa* is a good example of a manmade ecosystem with a high level of sustainability and stability in terms of ecological products. *Dehesa* ("Montado" in Portuguese) is the Spanish word used to describe the open forests and woodlands of *Quercus* species that can be found in the Southwestern Iberian Peninsula, a savannah-like landscape. These lands are also good grazing lands and are usually divided into plots enclosed by stone walls or wire fences to permit the management of the livestock.

The main characteristics of the *Dehesa* are the following:

- It has many uses and needs good management because it has multiple products including those derived from the trees and those derived from the pasture.
- One of the principal products - the livestock - is also a tool that is used to improve and transform the ecosystem. By making good use of the livestock, the perpetuation of the *Dehesa* system can be promoted.

There are different layers of vegetation in the *Dehesa*:

- The tree canopy layer is mainly formed by *Quercus rotundifolia* Lam., with high presence of *Quercus suber* L. in the more sandy soils, *Quercus pyrenaica* Willd. (mountain areas), *Quercus coccifera* L. (as shrubs), *Quercus lusitanica* Lam. (as shrubs,) and occasionally, *Quercus faginea* Lam.
- The grassland layer is formed by species of the genus of the family *Leguminosae*; *Trifolium*, *Medicago*, *Lotus*, *Anhyllis*, *Vicia*, *Lathyrus*, *Onobrychis*, *Hipopocrepis*, *Astragalus*, *Scorpiurus*, etc., and genera of the family *Poaceae* such as *Lolium*, *Dactylis*, *Poa*, *Festuca*, *Agrostis*, *Bromus* etc. Trees are generally widely spaced with a density of 40 - 60 per ha. Since trees live for hundreds of years, replacement is infrequent.
- The grassland has a very high turnover rate because the pasture is formed mainly by annual grasses that live and grow during the autumn-winter-spring period and die at the end of spring during the hot and dry summers (that last around four months); these plants survive as seeds to start growing again the next autumn.

Why does the *Dehesa* exist?

The word "*dehesa*" comes from the Latin word "*deffesa*"; it was the name given to an area enclosed and protected from being grazed by wild animals and was reserved for livestock to rest and feed. These lands have been inhabited by human and human societies for thousands of years.

Early societies had to provide their food and clothing needs with the resources that the poor acid soils of these Mediterranean climates supplied. These zones have a typical Mediterranean climate with long hot-dry summers and cold winters, with a very irregular distribution of rain, and frequent drought periods. Because of the poor soils and the Mediterranean climate, resources were always scarce, diverse, and variable from season-to-season and year-to-year. Little land in these areas was suitable for agriculture, so most land was used for stockbreeding. A special feature was that some oaks (40-60 trees/per ha.) were left in these pastures.



Fig. 1. Edie Sternberg in *Quercus rotundifolia* Dehesa.

Copyright, Guy and Edie Sternberg

Why were the evergreen oaks and some other oaks left in this good grazing land?

Since olden times, people living on these lands noticed that *Quercus rotundifolia* Lam. trees, "encinas" in Spanish or "azinheiras" in Portuguese, produced sweet acorns. These acorns were highly valued as food - both for humans and for livestock. Men sometimes ate them directly, or dried and crushed them into acorn flour. Acorns were also fed directly to domestic livestock, including sheep, goats and the native Iberian black pigs. Feeding acorns to the pigs resulted in very high quality pork, which is very expensive today.

So for hundreds of years the inhabitants of these lands selected the best trees — the ones with sweetest acorns, the best branch structure, and those that occupied the most favourable sites. These trees were mainly evergreen and cork oaks and were left scattered in the pastures. Although leaving some trees meant that livestock had less area for grazing, there were many advantages, including a more natural ecosystem.

The ancestors of the current Spanish and Portuguese landowners also appreciated other advantages by leaving the oak trees in these areas, including:



Fig. 2. *Quercus rotundifolia* foliage and acorns.

Copyright, Guy and Edie Sternberg

- There was a microclimate under the crowns of the trees, resulting in warmer temperatures in winter and cooler, fresher conditions during the summer.
- The trees helped protect the undeveloped soils from erosion.
- The trees provided shade to livestock during the hot summers.
- The trees slowed down the winds and helped prevent the pastures and soils from drying rapidly after rains.
- By leaving the trees, a greater variety of products could be produced from these areas, such as firewood for heating and cooking, good quality charcoal, and cork (where cork-oaks (*Quercus suber* L.) grew).
- Leafy branches could be used to feed livestock in very dry years; special products such as edible mushrooms that grow under the trees could be harvested; and the habitat for wild animals that lived in the *Dehesa* (deer, wild boars, rabbits, hares, etc.) could be enhanced.

How was the *Dehesa* created?

To create a *Dehesa* the forest first has to be cleared and the pastureland must be stabilised. To clear the forest, fire was used extensively in ancient times to remove shrubs and keep them from growing back. Today the undergrowth is cleared using caterpillar tractors with plows that eliminate the shrubs. Since the pastures in these zones are not permanent vegetation communities (they aren't climax vegetation), shrubs (mostly *Cistaceae*) quickly invade them if they are abandoned. The pastures must be stabilised by continuous grazing and by plowing and cultivating from time to time, each four or five to fifteen years, until the shrubs are controlled.

Below is the traditional cycle used for stabilisation;

ORIGINAL FOREST > CLEARING THE FOREST > FALLOW LAND > PLOWING > SOW CEREAL & LEGUMES > GRAZE LIVESTOCK ON STUBBLE FIELDS > GRAZE LIVESTOCK ON UNSTABLE PASTURE LAND FOR 3 TO 15 YEARS > STABILISED PASTURELAND

This cycle lasts from five to fifteen years and has to be repeated many times until there is good, stable grasslands with species of grasses of good quality for feeding livestock. Once stabilized, however, there is no need for further plowing and sowing because shrubs can be controlled through grazing. If the *Dehesa* is abandoned, shrubs will invade and weeds will replace the high quality forage previously selected by the animals.

How do we manage a *Dehesa*?

As we have already said, livestock are both the main product of the *Dehesa* and the primary tool for creating the *Dehesa* and controlling the invasion of shrubs. Therefore it is necessary to always have livestock grazing the *Dehesa* at the appropriate density.

Today there are enough livestock in the *Dehesa* during the whole year to maintain it as pasture. But there are some problems with this. In first place, during the drought period in the summer, there is almost no forage in the *Dehesa*, so the animals have to be fed supplements. In the second place, with so many animals grazing throughout the year, there are problems with the natural regeneration of oaks, because the soils have become compacted and saplings are eaten because there is no other food in summer.

In the past this problem didn't exist because there were not as many livestock in the *Dehesa*; there were no cows and generally only Iberian black pigs and sheep were bred up. The sheep were moved to summer pastures in the mountains during the summer ("*trashumancia*" is the Spanish name for this traditional custom) and the pigs could survive well in the summer, even when little food was available. The season and duration of grazing depended on the management approach of the landowner and usually the livestock rotated from one plot to another to use all the pastures most efficiently.

Today, however, sheep (mainly "*merina*" breed; 1-3 sheep/ha.) are kept in the pastures all year long, and are bred for meat (lambs), and produce milk for cheese, and wool. Spanish bulls and cows of high rusticity ("*avileña*", "*retinta*" breeds; 0.25 cows/ha.) are also bred for meat. They all have to be fed supplements during the summers.



Fig. 3. An ancient *Quercus rotundifolia* frames a horse in a Spanish *Dehesa*.

Copyright, Guy and Edie Sternberg

During the time of acorns (from October to February), Iberian black pigs are fattened (0.5-1 pigs/ha.) on the acorns throughout the *Dehesa*. This is the period known as "*montanera*," during which time the pigs double their weight in only a few months by eating acorns, grasses, mushrooms, etc. They grow from around 80 kg. at one year of age at the start of *montanera*, to around 160 kg. Four months later, they are slaughtered. Until they are one year old to start the *montanera*, the little pigs are raised in intensive farming, in special plots and pigsties where they are looked after and fed with mixed feed.

The *Dehesas* are also the feeding zones of many wild animals, some of which have high economic value because they are valuable game species. These include deer, wild boars, hares, rabbits, etc., which people pay considerable sums to hunt.

In the *Dehesas* where cork oaks grow, the bark of these trees is removed every nine or ten years during the summer (July-August) and sold at high prices (actually around \$50 per tree).

Grazing appears to be the most important factor contributing to stabilizing the *Dehesa* when done in a correct, sustainable manner. But it can also contribute to poor oak regeneration when too many animals are kept on the land. In some cases, artificial tree regeneration may be necessary. These new trees should be protected from livestock with tree shelters, or the plots where they are planted should be removed from grazing for several years. Conservation of the *Dehesa* ecosystem may require management techniques that reduce animal numbers and call for careful timing of the season, rotation and duration of grazing in each different pasture.

Quercus ilex L. and *Quercus rotundifolia* Lam.: Two Different Species

Francisco M. Vázquez Pardo
Soledad Ramos Maqueda
Esperanza Doncel Pérez
Forestry Production
Investigation Agraria Services
P.O. Box 22
Badajoz 06080, Spain

Abstract

Two evergreen oaks from Southern Europe have a confusing taxonomic history: *Q. ilex* and *Q. rotundifolia* (= *Q. ballota* Desf.) In this article we will discuss the salient differences between the two taxa, provide a key for the two species, and include a taxonomy review.

Key words: *Quercus ilex*, *rotundifolia*, Mediterranean, differences, acorns, taxonomy, nomenclature, leaf, distribution.

Introduction

The presence of two closely related sclerophyllous *Quercus* species in the Mediterranean area has been a continuous source of taxonomic confusion. The first publication on this subject was by Linnaeus (1753), who described *Quercus ilex* ("*QUERCUS foliis ovato-oblongis indivisis serratisque, cortice integro Variant foliis integerrimis & serratis, saepius etja in eadem arbore; difficile fine cortice distingitur a Subere*") with material from France or Italy.

In 1785 Lamarck described a new sclerophyllous species from the Mediterranean area, very close to *Quercus ilex*, but clearly different: "*Quercus foliis ovato-subrotundis, dentato-spinosis, supra è cinereo & viridi glaucis, subtus incanis. N. An ilex foliis rotundioribus & spinosis, è luco gramuntio*". The material used for this description was grown in a garden of Mister M. Cels, and the acorns came from a tree from Northern Africa or Southern Spain.

The differences between the two types are clear. The Linnean *Quercus ilex* has lanceolate leaves, without spines, and petioles are more than 0.8 mm long; Lamarck's *Quercus rotundifolia* has oblong-to-circular, spiny leaves, pubescent on both sides, with small petioles up to 0.9 mm, having spines.

At the time these type descriptions were made, communication between botanists was poor and access to published descriptions of new species was limited. This resulted in many errors of synonymy in botanical nomenclature, such as the names *Quercus ballota* Desf., *Quercus avellaniformis* Colmeiro & Boutelou, *Quercus gracilis* Lange or *Quercus alsina* Pall., and was the source of misinterpretations of *Quercus ilex* L. and *Quercus rotundifolia* Lam.

Geographical differences

There are important differences between these two taxa of the genus *Quercus*. First, these species have distinct and mostly separate geographical distributions. *Q. ilex* L. grows along the northern Mediterranean sea coast, from Greece to Northern Spain and probably to northern of Morocco; *Q. rotundifolia* Lam., on the other hand, grows in the western Mediterranean basin from northern Spain to the Western Sahara.

Q. ilex L. grows wild in Albania, Bosnia, Bulgaria, Croatia, Greece, France, Hungary, Italy, Montenegro, Spain, Switzerland and Turkey.

Q. rotundifolia Lam. grows wild in Algeria, France, Morocco, Spain, Tunisia and Western Sahara (see Figure 1).

Q. ilex L. occurs from sea level to 1200-1400 meters elevation, in mixed or homogeneous forests (with *Q. cerruoides* Willd., *Q. pubescens* Willd. or *Q. pyrenaica* Willd., and sometimes with *Q. robur* L.), frequently on basic soils having typical scrub and climber vegetation formed by sub-sclerophyllous to mesophyllous species such as *Viburnum tinus* L., *Buxus sempervirens* L., *Erica* spp., *Myrtus communis* L., *Cistus laurifolius* L., *Rosa sempervirens* L., and *Lonicera periclymenum* L.

Q. rotundifolia occurs from sea level to 1800-2100 meters elevation, on a variety of soils, alone or with other species of *Quercus*, such as *Q. suber* L., *Q. pyrenaica* Willd., *Q. faginea* Lam., or *Q. coccifera* L., and sometimes with *Q. canariensis* Willd. The scrub and climber vegetation of this forest consists of sclerophyllous species, such as *Cistus* spp., *Lavandula* spp., *Abutilo unedo* L., and *Smilax aspera* L.

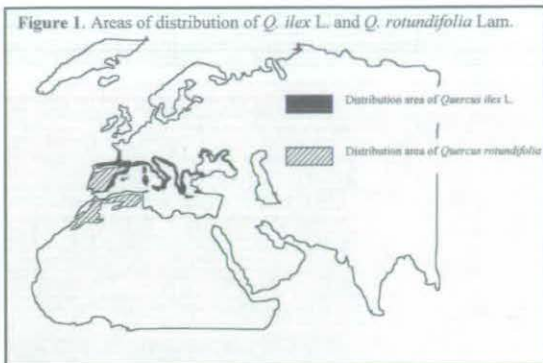


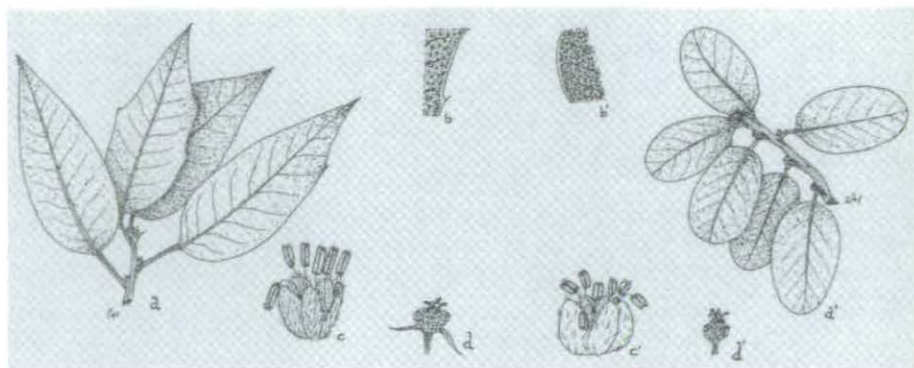
Figure 1. Areas of distribution of *Q. ilex* L. and *Q. rotundifolia*

Leaf differences

For many authors (Camus, 1936-1954; Schwarz, 1964; Amaral, 1990) the best characteristic distinguishing the two taxa is leaf morphology.

Q. ilex L. has lanceolate to oblong leaves, with 7-10 pairs of secondary veins, the margins entire to serrate, glabrous and with a clear hyaline edge. Young trees sometimes have leaves with spiny margins. On the lower leaf surface, pubescence is slight to dense; the upper surface is subglabrous or has star-shaped hairs, occasionally glabrous. The petiole is 4-15 mm long. The upper surface of the leaf is dark green.

Figure 2. Leaf and flower differences of *Q. ilex* (a,b,c,d) and *Q. rotundifolia* (a',b',c',d'). a: leaf, buds and branch; b: margin of leaf; c: male flower; d: female flower. Scale 1:1.5 cm in a; 1:0.4 cm in b, c and d.



Q. rotundifolia has oblong to rotund leaves, with 4-8 pairs of veins, the margins entire or with spines, pubescent or glabrous, but with a thin hyaline edge; leaves of young trees always have spiny margins. The upper surface is pubescent; the lower slightly pubescent. The petiole is 3-12 mm long. Leaf colour above is greenish blue, and is ash-coloured below (see figure 2).

Flower differences

Petals of the male flower of *Q. ilex* are pubescent or glabrescent, with an acute apex; stamen number varies from 4 to 7; stamen filament length is greater than that of the petals.

Male flower petals of *Q. rotundifolia* are glabrous or glabrescent, with an obtuse apex; stamen number varies from 5 to 12; filament length is less than, equal to, or greater than the petals. Female flowers in *Q. rotundifolia* and *Q. ilex* are very similar, but those of *Q. ilex* sometimes have flower bracts in the lower portion of the future cupule (see figure 2).

Fruit differences

Fruits of these two *Quercus* species vary greatly in morphology and in the external characteristics of the acorn and cupule. Acorns of *Q. ilex* have a more acute apex and are small; acorns of *Q. rotundifolia* are larger, with an apex round to acute (Vázquez et al., 2000).

The big difference between *Q. ilex* and *Q. rotundifolia* acorns is the taste. Acorns of *Q. rotundifolia* are sweet, while those of *Q. ilex* are bitter. Chemical analysis of the acorns shows clear differences between them. Rafii et al. (1992) found that *Q. rotundifolia* acorns had more lipid concentration (6.3-11.3%) than *Q. ilex* acorns (3.1-4.3%), as well as greater protein concentration (0.73-0.97% vs. 0.5-0.6%).

Earlier, Rafii et al., (1991) had found differences between the two species in the concentration of unsaturated fatty acids. Acorns of *Q. ilex* had lower levels of unsaturated fatty acids (78.9 (1.40) than those of *Q. rotundifolia* (81.6 (1.48)). Also the distribution of the fatty acids was different for the two species; *Q. ilex* had higher concentrations of the linoleic, linolenic, and palmitic fatty acids than *Q. rotundifolia*, as well as higher concentrations of oleic and stearic fatty acids.

Genetic differences

Molecular studies of populations of *Q. ilex* and *Q. rotundifolia* have found clear differences between distant populations, but much smaller molecular differences between populations growing close together (Rafii, 1988).

Other authors such as Michaud et al. (1995), found differences within the same species and similarities between the two species when they were growing near each other in southern France and northern Spain. Separate populations of *Q. rotundifolia* from Rif (Morocco) and Algeciras (South Spain) were genetically similar to a population of *Q. ilex* from Cyprus. These



Francisco Vazquez examines a group of *Quercus rotundifolia* in northern Spain in an area where this species is sympatric with the closely related *Quercus ilex*.

Photo copyright Guy and Edie Sternberg.

results suggest hybridisation between the two species in areas where they are growing together. Also, these results indicate phylogenetic proximity of the two species, although they are still differentiating.

Differentiation and hybridization between the two species.

With the above information, it is clear that differentiating between the two species is easier in individuals from distant areas, but very difficult in areas where the two are found living together.

Hybridization and introgression take place because of self-breeding and crossing with other species, or with other individuals of the same species, as confirmed by Yacine et al., (1997) in the case of the *Q. ilex* L.

Various authors have noted the presence of small populations or individuals of *Q. ilex* in typical areas of *Q. rotundifolia*. Maire (1961) documents the existence of *Q. ilex* in the Rif next to *Q. rotundifolia*; Vicioso (1950) found *Q. ilex* individuals in the north part of Huelva province (Spain), in typical areas of *Q. rotundifolia*. The opposite situation has not been widely reported, but in southern France in typical areas of *Q. ilex*, it is possible to find populations of *Q. rotundifolia* (Barbero et al., 1980).

In contact areas in southern France and northern Spain, where both species grow together in the same habitat, there are many trees with intermediate characters between the two species. In areas with a single species only, but where both species grew together previously, it is today possible to find individuals with intermediate characteristics between the two species.

The most confusing characters are leaf and acorn morphology and flavour of the acorns. Trees in hybrid populations have characteristics intermediate for these characters. The more stable characters are male and female flower morphology, but are of limited use since they are inconspicuous and of short duration.

Study of the hybridisation between the two species found individuals with intermediate characters in northern Spain. These have been known as *Q. ilex* x *Q. rotundifolia*. We propose naming these populations as *Q. xautumnalis* nothospec. nov. forest hybrids.

Quercus xautumnalis F. M. Vázquez, S. Ramos & E. Doncel nothospec. nov.
= *Quercus ilex* L. x *Q. rotundifolia* Lam.

Diagnosis:

Arbor cum ramuli tomentosi. Gemmae ovato-globulosae, squamis pubescentibus. Folia supra subtomentosa, subtus tomentosa; marginis integer, lanceolata vel oblonga cum apicem obtusis et basi rotunda. Lamina cum 5-9 nervis lateralis; 2-5(-6) cm longa, 0,8-1,2(-1,9) cm lata. Petiolus pubescentibus, 8-16(22) mm longus. Fructus 14-27(35) mm longus, amarus.

Description:

Tree with tomentose branches. Bud ovate globular, with pubescent scales. Leaf subtomentose above and tomentose below lower with entire margin, from lanceolate to oblong with obtuse apex and rounded base. Leaf 5-9 lateral veins; 2-5(6) cm long and 0.8-1.2(-1,9) wide. Petiole pubescent, 8-16(22) mm long. Fruit 14-27(35) mm long, bitter.

Holotype:

Spain: Huesca, near San Juan de la Peña, 22, 10, 2001, E. Doncel, G. Sternberg, R. Lance, M. Conggesshall, E. Balbuena, SS. Ramos et F.M. Vázquez. HSIA

Nomenclature and taxonomy

Because of the above information, we think that the two taxa can be considered separate species based on clear differentiating taxonomic characters, their clear and separate distributions, and the chemical and genetic studies that confirm their separation into two groups.

Key:

- Plants with petals in male flowers pubescent to glabrescent; leaves lanceolate, with more than seven pairs of secondary veins and glabrous margins; acorns bitter and apex normally acute *Q. ilex* L.

- Plants with petals in male flowers glabrous to glabrescent; leaves round, oblong to lanceolate, with three to seven (sometimes eight) pairs of secondary veins and pubescent to glabrescent margins; acorns sweet and apex normally obtuse (acute some of the time) *Q. rotundifolia* Lam.

Nomenclature:

Q. ilex L., Sp. Pl. 995 (1753).

Q. smilax L. Sp. Pl. 994 (1753).

Q. gramuntia Sauvage ex L. Sp. Pl. 995 (1753).

Q. sempervirens Mill., Gard. Dict. ed. 8:3 (1768).

Q. integrifolia Steud., Nomencl. Bot. 1: 673 (1821).

Q. alpina Endl. Gen. Pl., Suppl. 4(2): 25 (1848).

For more information see Govaerts & Frodin., 1998.

Ind. loc.: *Habitat in Europa australis*.

Lectotype: LINN 1128-4 see in Microfiche.

Q. rotundifolia Lam., Encycl. 1: 723 (1785).

Q. ballota Desf., Observ. Phys. 38: 375 (1791).

Q. alzina Lapeyr., Hist. Arb. Pyr., 584 (1813).

Q. avellaniformis Colmeiro & Boutelou, Examen de las Encinas, 9 (1854).

Q. ilex var. *ballota* (Desf.)DC., Prodr. XVI(2): 39 (1864).

Q. ilex subsp. *ballota* (Desf.)Samp. Bol. Soc. Brot. 24: 102 (1908-1909).

Q. ilex subsp. *rotundifolia* (Lam.)O. Schwarz ex Tab. Mor., Bol. Soc. Brot. ser. 2, 14: 122 (1940).

Q. ilex subsp. *smilax* C. Vicioso, Rev. Gen. Quercus España, 166 (1950).

For more information see Govaerts & Frodin., 1998.

Ind. loc.: *Ce Chêne croît naturellement en Espagne*.

Lectotype: P-LAMARCK see in Microfiche.

References

- Amaral, J. 1990. *Quercus* L. In: S. Castroviejo, M. Lainz, G. López & al., *Flora Ibérica*. 2: 15-36. Madrid.
- Barbero, M. R. Loisel & P. Quezel, 1980. Le Chêne vert en Région Méditerranéenne. *Revist. Forest. Franc.* 6: 531-543.
- Camus, A. 1936-1954. *Les Chênes*. Paris
- Govaerts, R. & D. G. Frodin, 1998. *World Checklist and bibliography of Fagales*. Kew.
- Lamarck, J.B., 1785. *Encyclopédie Methodique Botanique*. vol. 1, Paris
- Linné, C., 1753. *Species Plantarum*. Upsala.
- Maire, R. 1961. *Quercus* L. In: R. Maire, *Flore de l'Africa du Nord*, 7: 90-134. Paris

- Michaud, H., L. Toumi, R. Lumaret, T.X. Li, F. Romane & F. di Giusto 1995. Effect of geographical discontinuity on genetic variation in *Quercus ilex* L. (holm oak). Evidence from enzyme polymorphism. *Heredity*, 74: 590-606
- Rafii, A. Z. 1988. Caractéristiques taxonomiques, morphologiques et isoenzymatiques du complexe chêne vert. *Bull. Soc. Bot. France*, 135: 343-352.
- Rafii, A. Z., R. S. Dodd & Y. Pelleau 1992. Mediterranean evergreen oak diversity: morphological and chemical variation of acorns. *Canad. Journ. Bot.* 70: 1459-1466.
- Rafii, A.Z., E. Zavarin & Y. Pelleau 1991. Chemosystematic differentiation of *Quercus ilex* and *Quercus rotundifolia* based on acorn fatty acids. *Biochem. Syst. Ecol.*, 19: 163-166.
- Schwarz, O. 1964. *Quercus* L. In: T.G. Tutin, V. H. Heywood, N.A. Burges, D. H. Valentine, S.M. Walters & D. A. Webb. *Flora Europaea*. 1: 72-76. Cambridge.
- Vázquez, F.M., Esparrago, F., Lopez J.A., Jaraquemada F. & Perez M.C. 2000. *Quercus rotundifolia* Lam. and its forms in Extremadura, Spain. *International Oaks*, 11: 39-52.
- Vicioso, c. 1950. Revisión del género *Quercus* L. en España. *Monog. Inst. Nac. Inv. y Exp. Forestales*. Madrid.
- Yacine, A. & F. Bouras, 1997. Self-and cross pollination effects on pollen tube growth and seed set in holm oak *Quercus ilex* L. (Fagaceae). *Ann. Scie. For. Franc.*, 54: 447-462.

Remarkable Oak Forests in Europe

By Dr. Ing. Stelian Radu and For. Eng. Corina Coandă
Arboretum Simeria, Deva, Romania

Introduction

The primeval oak forest, which in prehistorical times grew in rich soils and covered tremendous areas, has been drastically reduced during the centuries by different human activities. It has been replaced by agriculture, grasslands or human settlements. Even where the forests have not been converted, the utilization of the trees for various wood products has resulted in a progressive fragmentation and structural degradation of these ecosystems. Today there has been a worldwide decline of oaks and a reduction in their biodiversity. Oaks have been used for a variety of purposes including buildings, tools, fortifications, ships, charcoal for metallurgy, and for many other more or less noble uses, including food and game.

Oak forests in earlier times served many purposes. They were temples for primitive peoples, impenetrable domains for outlaws, sanctuaries for recluse believers, a paradise for wildlife, and later, the sites for royal and aristocratic sport hunting. Today these forests survive only in a quasi-natural state as protected remnants in National Parks, Biosphere Reserves or Forest Reserves.

Using available information that is, no doubt, incomplete, we have tried to compile a list of some of the more remarkable natural European oak forests, specifying their location, composition, history and some special features. These forests are critical resources and provide a variety of functions including growing timber products, providing rich biological diversity, protecting watershed function, serving as reservoirs of genetic variability, and providing a historical record of the past oak management practices

Famous and Interesting Oak Forests in Europe

Compiled by Dr. Stelian RADU and For. Eng. Corina COANDĂ

Nr. crt.	Country Forest or reserve name Location, Area (ha)	Oak species	Remarks : specific features, history, performances, sources
1.	ALBANIA DAJTI-NATIONAL PARK TIRANA AREA 2,400	<i>Q. ilex</i> <i>Q. robur</i> <i>Q. coccifera</i> (probably)	Situated 10 km from Tirana, the NP covers a large area (2400 ha), between 200 and 1216 m a.s.l. and contains mainly <i>Fagus sylvatica</i> , <i>Pinus leucodermis</i> and <i>Abies alba</i> forests. The lower sites are predominantly composed of oaks and typical species of Mediterranean macchia (<i>Erica</i> , <i>Arbutus</i> , <i>Q. ilex</i>). Göbel, Keller, Steinbach, 1996; Ionescu & Condur-teanu-Fesci, 1985
2.	ARMENIA DILIJAN NATURAL RESERVE - 21,822 (forest)	<i>Q. iberica</i> <i>Q. macranthera</i>	Situated on the northern slopes of Small Caucasus, it covers a very fragmented relief. The interior forest layer is composed by oak and beech stands. Main species are <i>Q. iberica</i> , <i>Q. macranthera</i> , and <i>Fagus orientalis</i> in

- | | | |
|----|--|---|
| | <i>Q. iberica</i>
<i>Q. macranthera</i>
(continued) | mixture with <i>Acer</i> sp., <i>Ulmus</i> sp., <i>Tilia</i> sp.,
<i>Fraxinus</i> and many other tree and shrub
species.
Forest encyclopedia, I, 1985 |
| 3. | ARMENIA
HOSROV NATURAL RESERVE
-
9,446 (forest) | <i>Q. macranthera</i>
<i>Q. iberica</i>
Situated on southern ramification of
Hebamsk Mts. on typical high mountain
relief (between 1600-4300 m altitude)
fragmented by numerous narrow paths.
Predominant stands of <i>Q. macranthera</i> ,
<i>Q. iberica</i> , <i>Fraxinus</i> sp., <i>Acer</i> sp. and
<i>Ulmus</i> sp. in the interior mountain layer.
Forest encyclopedia, II, 1986 |
| 4. | AUSTRIA
MARCHEGG -
MARCHAUEN
NIEDERÖSTERREICH
~200 (in the frame of
1100 ha protected area) | <i>Q. robur</i>
Predominant pannonic forest associations
(<i>Leucojo-Fraxinetum angustifoliae</i> and
<i>Quercus-Ulmetum</i>) unique for Austria.
International importance area (WWF
Reserve, 1973), with strong negative
game and tourist influence. Decline of
oak and <i>Ulmus</i> .
Zukrigl, 1990 |
| 5. | AUSTRIA
STAMSER
EICHENWALD
TIROL, INN RIVER
VALLEY
~5 | <i>Q. petraea</i>
Very old sessile oak-lime and grey alder
stand at 700m altitude on alluvial soils.
Unique broadleaf forest reserve in Inn
River Valley. Damaged by island position
and visitors.
Zukrigl, 1990 |
| 6. | AUSTRIA
KALKSBURG,
HIMMELSWIESE
WIEN
12 | <i>Q. pubescens</i>
<i>Q. robur</i>
Stands of <i>Q. pubescens</i> , <i>Q. robur</i> ,
<i>Carpinus betulus</i> and <i>Pinus nigra</i> at
270-340 m altitude, on Dolomit and
Jurrasic limerocks, at different exposures.
Interesting floristic complex of marginal
Wien lime forests.
Zukrigl, 1990 |
| 7. | AUSTRIA
JOHANNSER
KOGEL OAK
FOREST RESERVE
LAINZER
TIERGARTEN,
WIENERWALD
1,935 (forest area)
of 2,450 protected
area | <i>Q. petraea</i>
<i>Q. cerris</i>
Different subassociation of European oak-
hornbeam species. Advanced stand
development stage with typical terminal and
disintegration phases. The 200-400 years
old oak trees in overstory are overmature,
with reduced vitality and increasing
mortality. Young growth of hornbeam
begins to reach the middle and upper story
in most of the area, illustrating the natural
conversion of the oak climax forest into a
hornbeam association. Due to the high
game population there is no natural
regeneration of <i>Q. petraea</i> and only a little
of <i>Q. cerris</i> . 200 years ago, at the time
when the old oaks grew up, the Lainzer
Tiergarten was not fenced and game
populations were lower, where as today, |

Q. petraea natural regeneration of oak stands is impossible without fencing. Similar
Q. cerris problems of stand structure and natural regeneration of oak stands occur in
continued the oak reserves Spessart (Germany) and Bialowieza (Poland).
 Mayer & Tichy, 1979

8. BELARUS and POLAND
 BELOVEJSKAIA PUSCIA
 PUSZCZA BIELOWIESKA
 BIAVLOWIEZA N.P.
 77,100 (Belarus)
 58,000 (Poland)
- Q. robur* + *Q. petraea*
 (6-10% both)
- Large complex of boreo-nemoral; less disturbed primary old forest with uninterrupted tree cover since prehistoric time, belonging to both countries. Mosaic of soils and stands composed by pine, spruce, oak and other broadleaves (26 tree species).
 Great diversity : 900 plant species, 59 mammals sp. (red deer, wild boar, roe buck, European bisons, wolfs, lynx, foxes, beavers), 230 bird species (storks, kites, mountain cooks, black grouse). Very valuable and rich genetic center. National Park and Biosphere Reserve. Center for aurochs reintroduction. Veritable natural sanctuary. Home of some of the tallest and oldest individual trees in Europe (oak : 43 m; 400-500 yr old; spruce : 55 m; 300 yr old; Scots pine : 40 m; 350 yr old; ash : 42 m; lime : 40 m; maple : 35 m)
 Forest encyclopedia, vol. I, 1985

9. BOSNIA and HERZEGOVINA
 VIRGIN FOREST
 PERU_JCA
 N.P. SUTJESKA
 1,434
- Q. petraea*
- The N.P. include areas with altitudes ranging from 500 m to 2370 m. Due to its great variance of bedrocks and soil conditions, different forest associations developed here (more than twenty), ranging from *Carpinetum orientalis* to *Pinetum mughi*.
 Pintari_, 1999

10. BOSNIA and HERZEGOVINA
 -
 N.P. KOZARA
 3,375
- Q. petraea*
- Natural stands of sessile oak (*Querceto-Carpinetum*) and beech (*Fagetum*). Oak forest of Bosnia and Herzegovina are composed by *Q. petraea*, *Q. cerris*, *Q. robur*, *Q. frainetto*, *Q. pubescens* and *Q. trojana*.
 Pintari_, 1999

10. BOSNIA and HERZEGOVINA
 -
 N.P. KOZARA
 3,375
- Q. petraea*
- Natural stands of sessile oak (*Querceto-Carpinetum*) and beech (*Fagetum*). Oak forest of Bosnia and Herzegovina are composed by *Q. petraea*, *Q. cerris*, *Q. robur*, *Q. frainetto*, *Q. pubescens* and *Q. trojana*.
 Pintari_, 1999

- | | | |
|--|------------------------|---|
| 11. BULGARIA
USUN BODJARK
(LOPU_NA) NATU-
RAL RESERVE
-
2,836 | <i>Q. hartwissiana</i> | Located in Strandja at 100-150 m altitude this reserve includes dominant old oak forest in mixture with <i>Fagus sylvatica</i> , <i>Q. hartwissiana</i> , <i>Rhododendron ponticum</i> , <i>Daphne pontica</i> , <i>Ilex aquifolium</i> . Note : common oak species in Bulgaria are <i>Q. petraea</i> , <i>Q. frainetto</i> , <i>Q. cerris</i> and <i>Q. robur</i> . Other species: <i>Q. coccifera</i> , <i>Q. macedonica</i> , <i>Q. eagilops</i> and <i>Q. trojana</i> .
Ionescu & Condur_eanu-Fesci, 1985 |
| 12. CROATIA
PRA_NIK OAK
RESERVE
OKU_ANI
58.0 | <i>Q. robur</i> | Virgin forest of pedunculate oak and common hornbeam and a Slavonian forest of <i>Q. robur</i> ssp. <i>slavonica</i> . Oak trees are between 250 and 350 years old, their dbh ranges from 70 to 200 cm, and 36 m tall. According to the latest inventory there are 993, the volume of some individuals old oaks trees exceeds 50 m ³ .
Klepac, 1981 |
| 13. CROATIA
MU_KI BUNAR
OAK RESERVE
PSUNJ
58.67 | <i>Q. petraea</i> | Remnant of 300 years-old virgin forest of beech and beech with sessile oak. Note : Both these small forest reserves are remnants of famous large previous Slavonian oak forest located between Sava and Drava rivers, particularly in the Sava River Valley (Pasavina). A trunk with 260 cm dbh and 65 m ³ were presented at the International Exhibition in 1990 in Paris. Fragmentation, lowering of ground waters, Dutch elm disease, absence of fructification, defoliators and diseases make today these ecosystems fragile, like other oak stands in Europe. As concerning their management, Klepac confirmed the finding of local people that "oak grows (vigorously) in the first 100 years, matures in the following 100 years, and dies during the other 100 years". For this reason, valuable oak timber can be obtained only at the end of a 300 year management cycle.
Klepac, 1981, Matic, 1999 |

Others special reserves (virgin forests) for oak species in CROATIA :

- | | | |
|--|-----------------|-------------|
| 14. Stupni_ki lug-_ret;
Motovunska (Istria);
Lo_e (Otok); Radi_evo
(Vrbanja); _esma and
Varo_ki lug- all
together ~ 553 ha; | <i>Q. robur</i> | Matic, 1999 |
|--|-----------------|-------------|

15. Tusti vrh-Kremenjak *Q. petraea*
(on Medvednica);
Babji zub-Ponikve and
Duga_ko brdo-all
together ~ 179 ha;
16. Lokrum - *Q. ilex*
Dubrovnik; Dundo
(Island Rab); Velika
dolina (NP Mljet)
and Glavotok (Island
Krk) - all ~ 195 ha
17. Gracek - Lukovica - *Q. pubescens*
Rebar (on
Medvednica) and
Kontija (Istria) - all ~
62 ha.
18. CYPRUS *Q. alnifolia* Small area of semi-natural mixed forest
TRIPYLOS of pine (*Pinus brutia*), golden oak (*Q.*
- *alnifolia*) and cedar (*Cedrus brevifolia*).
320 Ibero, 1994
19. CZECH *Q. robur* Located at the confluence of Morava
REPUBLIC and Dyje (Theiss) Rivers, at the border
LAN_HOT State with Slovak Republic, this flood plain
Natural Reserve old virgin forest is composed by
DOLNO- mixture of ash, oak, maple, hornbeam,
MORAVSK_ elm and lime species. It contain two
UVAL sectors : Cahnov and Ran_purk, at the
38.63 altitude 150-160 m. Oak trees reach 164
and 183 cm dbh, 37 m tall and 43.1 m³,
and ash 134 cm, 37 m and 27.01 m³.
Korpel, 1995
20. ESTONIA *Q. robur* Mixed Scots pine - Oak forest with
VIIDUMJAESK dominant oak second layer and
Reserve understory of hazel, *Viburnum* sp. and
honeysuckle.
ISLAND SAAREMAA Numerous endemic, relict and rare
967 (forest) plants.
Forest encyclopedia, 1985
21. FRANCE *Q. petraea*
BELLÈME and *Q. robur*
RÉNO-VALDIEU
ORNE One of the most prestigious oak forests of
4,000 France. Located on the Perche plateau (200
m alt.) in a mild and humid climate, on
deep grey brown soils, the oak and beech
stands find here optimal conditions. Trees
reach currently 35-40 m and excel by their
rectitude. An oak from Réno-Valdieu
represented the French forests at the
Brussels International Exhibition (1958).
This forest massif is well known and

managed since the 16th century, producing successive historical forest products (acorns, fuel wood, marine/naval timber, charcoal, sabots clogs, cognac staves) and finally high quality timber for modern uses.
Office National des Forêts, 1991

- | | | | |
|----|--|--------------------------------------|--|
| 22 | FRANCE
BERCÉ
SARTHE
5,391 | <i>Q. petraea</i>
<i>Q. robur</i> | <p>Famous highly productive old oak forest, an authentic green jewel, remnant of immense Carnuta Sylva (forest of Carnutes) existing at the time of Gaul conquest by Romans. Saved from mediaeval clear-cutting due to its high topography and poor soils, the forest belonged successively to Anjou family, to Royalty (1337) and to the State (since 1791). Producing marine timber for French Navy, Bercé forest - like other oak massives, has, from Colbert time (1669) until 1921, a strategic role and was permanently well managed. The regular high forest treatment has been practiced here for 500 years, with a 240 year rotation, having as a result the production of valuable timber, in tall, dense, and straight stands. The famous "Futaie des Clos" preserved on 8 ha 440 trees of <i>Q. petraea</i> 365 years old (the Emery's Oak reach 44 m tall other oaks 45 m). Like other forest massives in France, Bercé was partially damaged by the disastrous hurricane of 26 December 1999. Timber Museum in Jupilles. O.N.F., 1991; Arborescences, 83/2000</p> |
| 23 | FRANCE
FONTAINBLEAU
SEINE et MARNE
near PARIS
17,000 | <i>Q. robur</i>
<i>Q. petraea</i> | <p>Large and famous oak, beech and coniferous (Scots pine) forest founded in 11th century by Robert II as royal hunting domain. Royal castles of Francois 1st (1528) and Henry 2nd. Napoleon signed here his abdication (1814). Famous artistic school of painters (Barbizon). As royal hunting forest domain Fontainbleau was appreciated, enlarged and improved by almost all French sovereigns. Climatic and geologic diversity determine an exceptional richness of flora and fauna : 5685 vegetal species (1350 flower plants, 460 mosses, 2700 mushrooms, 675 lichens and 500 alga) and 6600 animal species (57 mammals, 195 birds, 5600 insects). The landscape variety is also unusual. The prolonged conservation of forest as an artistic reserve between 1850 and 1970 determined a systematic aged structure of stands. The monumental Jupiter's Oak (<i>Q. robur</i>) with its > 600 years, 190 cm dbh and 35 m tall, died in 1994 after drying, but is still conserved at its base with rooted cuttings. Fontainbleau receives 10 millions visitors annually.
ONF, 1991</p> |

- 24 FRANCE
TRONÇAIS
ALLIER
10,812
- Q. petraea*
Q. robur
- Known from ancient times, the forest was during the Middle Age owned by 14 parishes, and latter belonged successively to the Bourbon family, from 1327 to 1528 when was it was confiscated by the King. Located on acid, sandy, partly hydromorphic soils, Tronçais was subjected to multiple fires and uses, pastured and renewed as a result of Colbert's orders (1670) through cutting-back and intensive reforestation, in order to turn it into a high forest producing wood for the navy, with a 200 years rotation. Starting from 1788, two thirds of the forest was managed as coppice with standards producing charcoal for iron furnaces, located in the forest. The decline of this technology brought about the renunciation of this system in 1835 and the return to a high system. In order to obtain bigger size trunks, the initial rotation of 100 years was successively increased to 180-225 and even to 250 years.
- Almost on its whole area, the forest shows favorable site conditions for *Q. petraea* managed as regular high forest. The silvicultural practice aim to obtain straight thick trunks (with dbh larger than 50 cm to 1 m and more), with regular growth and light wood, free of deficiency logs, for plywood, carpentry, and staves. Two important principles characterize this classic oak silviculture: the natural regeneration (from seeds) of mature stands by the shelterwood system (conserving the genetic fund), and the permanent tending of stands during their whole life (releases, cleanings and thinnings), in order to promote the best trees. The forest contains many three-century-old trees (for instance : The Oak of Resistance - 40 m; the Twins - 370-420 years) and has tourist facilities (marked paths, fishing, swimming, boating in marshes). Paradise of birds (6 sp. of woodpeckers), diversity of predatory fauna. In 1976 the pedunculate oak was affected by decline, particularly at sites on very acid soils and with a high temporary water table. ONF, 1996; Arborecences No 73/1998
- 25 FYROM (former Yugoslavic Republic Macedonia)
GALLICA N.P.
-
22,700
- Q. trojana*
Q. macedonica
and others
- This N.P. includes lime mountains area (700 - 2000 m alt.) with the Ohrid Lake (659 m alt.), Prespa lake (853 m) and the pic Magaro (2254 m). Contains 150 tree species, among others *Juniperus communis*, *Celtis australis*, *Quercus trojana*, *Q. macedonica*, *Q. cerris*, *Q. frainetto*, *Q. petraea*, *Q. pubescens* on steep slopes of inferior vegetative layer. Göbel, Keller, Steinbach, 1996; Ionescu & Condur_eanu-Fesci, 1985

- | | | | |
|----|---|--|--|
| 26 | GEORGIA
ADJAMETSK
RESERVE
COLCHIDA
DEPRESSION
4,700 (forest) | <i>Q. imeretina</i>
<i>Q. hartwissiana</i>
<i>Q. iberica</i> | Located in the valley of Rioni River, the reserve houses unique massives of Caucasian oaks (<i>Q. imeretina</i> , <i>Q. hartwissiana</i> and <i>Q. iberica</i>) in mixture with hornbeam, maple, ash and <i>Pyrus salicifolia</i> . The understory is composed of <i>Crataegus</i> sp., <i>Carpinus orientalis</i> , <i>Zizyphus jujuba</i> , <i>Ilex aquifolium</i> , <i>Azalea pontica</i> and <i>Rosa</i> sp. On 11.5 ha is preserved a relict stand of <i>Zelkova carpinifolia</i> .
<i>Forest encyclopedia, 1985</i> |
| 27 | GERMANY
NATURPARK
BAYERISCHER
SPESSART
BAYERN
130,000 | <i>Q. petraea</i> | The Natural Park includes a large area of Beech-Oak forests. Spessart ('Spechtshart' or 'Woodpecker Forest') is an upland region of deciduous forest at altitude of some 500 m.
<i>Dittrich, 1990 (?)</i> |
| 28 | GERMANY
NATURPARK
HESSISCHER
SPESSART
HESSEN
71,000 | <i>Q. petraea</i> | The Natural Park includes remarkable mixtures of deciduous species including oak.
<i>Göbel, Keller, Steinbach, 1996</i> |
| 29 | GERMANY
NATURPARK
HOHE MARK
NORDRHEIN
WESTFALEN
104,000 | <i>Q. robur</i>
<i>Q. petraea</i> | Remnants of former large and grand oak forests surrounded by a well conserved natural landscape.
<i>Göbel, Keller, Steinbach, 1996</i> |
| 30 | GERMANY
NATURPARK
PFALZER WALD
RHEINLAND-
PHALZ
179,300 | <i>Q. petraea</i> | Mixed Scots Pine - Beech - Oak forest covers two thirds of the natural park area.
<i>Göbel, Keller, Steinbach, 1996</i> |
| 31 | GERMANY
NECKARTAL -
ODENWALD
BADEN -
WÜRTENBERG
and HESSE
130,000 | <i>Q. robur</i>
<i>Q. petraea</i> | The Vorderer Odenwald is a region of rounded hills build up of crystalline rock, covered by deciduous forest (including oaks) pitted by valleys.
<i>Göbel, Keller, Steinbach, 1996</i> |

GERMANY

Numerous small natural oak forest reserves (Bannwälder) (pure oak stands or mixture with oaks) as follows:

32 Bechtaler Wald in
Upper Rhine basin
Oak - Hornbeam
forest - 13 ha

33 Sautrieb in Odenwald
Beech - Oak forest -
12 ha

34 Schnapsried in
Odenwald
Beech - Oak forest
with Scots pine - 16 ha

35 Stammberg in
Neckarland
Beech - Oak and Oak
forest - 23 ha

36 Lindach in
Neckarland
Beech - Oak forest -
16 ha

37 Schlierbach in
Neckarland
Beech - Oak forest -
27 ha

38 Greifenberg in
Neckarland
Beech - Oak forest -
13 ha

39 Sommerberg in
Neckarland
Beech - Oak forest -
12 ha

40 Eisenbachhein in
Neckarland
Beech - Oak forest -
8 ha

-in other different Regions

41 Shubertswald in
Spessart - Odenwald
(Oak) - Beech forest -
33.4 ha

42 Wolfsee in Fränkische
Platte
Oak - Hornbeam -
Beech forest - 183.9
ha

43 Dianensruhe in
Fränkische Platte
Oak - Hornbeam forest
- 22.2 ha

44 Heilige Hallen in
Fränkischer Keuper
and Albvorland
Oak - Hornbeam and
Beech forest - 20.9 ha

45 Fasanerie in
Schwabish -
Bayerische
Schotterplatten
Oak - Ash - Hornbeam
forest - 40.8 ha

46 GREECE *Q. coccifera*
AENOS N.P. *Q. ilex*
ISLAND
KEFALONIA
2,800
In the frame of this small N.P. declared
for the protection of natural pure stands
of *Abies cephalonica*, at the inferior
altitude are growing *Q. coccifera*,
Cornus alba, *Pyrus* sp., *Rosa* sp. On the
Mt. Roudi : *Tilia cordata*, *Q. ilex*, *Rhus*
sp., *Lonicera* sp., *Hedera helix* and
other shrubs.
Göbel, Keller, Steinbach, 1996

47 GREECE *Q. petraea*
OETI N.P. *Q. coccifera*
Near LAMIA (central
Greece)
7,200
Large stands of *Q. petraea* up to the
altitude of 800 m and in the northern
part, dense bushes of *Q. coccifera*,
Arbutus sp., *Rhus* sp., *Juniperus* sp.
Göbel, Keller, Steinbach, 1996

48 GREECE *Q. pubescens*
OLYMOPOS N.P. *Q. coccifera*
-
3,998
The "House of Gods". Above the
Mediterranean machia (composed by
Vaccinium, *Juniperus*, *Q. coccifera*,
Rhus, *Tilia cordata* and different
Ericaceae) on slopes, small stands of *Q.*
pubescens, beech, maple, elm and
conifers like *Pinus nigra* and hybrids of
Abies cephalonica.
Göbel, Keller, Steinbach, 1996

49 GREECE *Q. pubescens*
PRESPA N.P. *Q. coccifera*
-
19,470
Natural forest of *Q. pubescens*, *Q.*
cerris, maple, alder, *Ostrya carpinifolia*
and aspen in the inferior part of the N.P.
Göbel, Keller, Steinbach, 1996

- | | | | |
|----|---|--|--|
| 50 | HUNGARY
AGETELEK N.P.
and B.R.
-
19,947 | <i>Q. petraea</i>
<i>Q. cerris</i> | Predominant Hornbeam - Sessile Oak association covers the downy surfaces of the hills, between 400-600 m above sea level. On lower altitudes (250-400 m) appears the Turkey-Sessile Oak association.
Volo__uk, Duska, Varga, 1999 |
| 51 | HUNGARY
BÜKK N.P.
-
43,200 | <i>Q. cerris</i>
<i>Q. petraea</i>
<i>Q. pubescens</i>
<i>Q. virgiliana</i> | Different associations can be found in this large area, according to climatic and soil conditions, as follows :
- The Turkey oak - sessile oak forest association, in the wet, cool Central Bükk, up to 500 m;
- The Hornbeam sessile oak zone (<i>Quercus petraeae-Carpinetum</i>) on southern hillsides, between 400 and 600 m;
- The termofil oaks (<i>Corno-Quercetum petraeae-pubescentes</i>), on dry, warmer south slopes on chalky forest soils;
- The calciphobic oak association (<i>Genisto tinctoriae - Quercetum</i> and <i>Genisto pilosae - Quercetum</i>) on warm, dry habitats with acidic soil or quartz stone bases
- The calciphobic Sour cherry-downy oak (<i>Ceraso-Quercetum pubescentis</i>), the relict hare's tail grass-downy Oak association (<i>Seslerio - Quercetum pubescentis et virgiliane</i>) and the <i>Poa pannonici - Quercetum</i> - on volcanic stone and dolomite; the submediterranean-like karst <i>Quercetum</i> - on volcanic stone and dolomite, and the submediterranean like karst forest with smoke tree (<i>Cotino-Quercetum pubescentis</i>) - on the warmest, barren soiled slopes.
Volo__uk, Duska, Varga, 1999 |
| 52 | IRELAND
KILLARNEY N.P.
-
10,263 | <i>Q. petraea</i> | Natural stands of sessile oak and mixtures with birch, European mountain -ash, yew and rarely ash. Under the green cover of oaks, dense holly, mosses, lichens and ferns cover the soil.
Göbel, Keller, Steinbach, 1996 |
| 53 | ITALY
ABRUZZO N.P.
-
44,000 | <i>Q. cerris</i>
<i>Q. petraea</i> | Beech and conifers are the dominant tree species, according to the altitude, but in warm valleys can be found <i>Q. cerris</i> , <i>Q. petraea</i> , maple, holly, chestnut and a local form of black pine.
Göbel, Keller, Steinbach, 1996 |
| 54 | ITALY
CIRCEO N.P. | <i>Q. ilex</i>
<i>Q. cerris</i> | This N.P. includes seacost dunes, peat bogs, Mediterranean maquis and |

- South of
ROME
7,445
- remnant of natural forests. The dendroflora are represented by *Q. ilex*, *Q. suber*, ash, *Juniperus phoenicea*, *Arbutus unedo*, *Pistacia terebinthus*, *P. lentiscus*, *Myrtus*, *Olea oleaster*, *Erica arborea*, *Rosmarinus* and many endemic herbs.
Ionescu & Condur_eanu-Fesci, 1985
- 55 LATVIA *Q. robur*
AUK_TAITIJA N.P.
-
30,209
- In addition to birch forests and small remnants of original oak stands in N.P. there are Norway Spruce old stands, with trees more than 200 year old and partially with the appearance of the untouched virgin forests.
Göbel, Keller, Steinbach, 1996
- 56 LITHUANIA *Q. robur*
GAUJA N.P.
-
92,048
- Among Scots pine, Norway spruce and birch predominant stands, there are few old oaks and ash trees. Big trees are considered from the period before Christian time as holy places. Even after their Christianization, the Baltic people showed a real attachment to nature and a special protection of giant trees in the N.P. In the place Ort Turaida there is an oak with more than 7-m circumference, a Scots pine with 4.4 m, a birch with 3.1 m, a willow with 5.4 m and an alder with 1-m circumference.
Göbel, Keller, Steinbach, 1996
- 57 MOLDOVA *Q. petrea*
CODRI NATURAL *Q. robur*
RESERVE
LOZOVA-
CAPRIANA
5,174
- Compact forest massif composed by oak, hornbeam, and beech stands in which predominant species are *Q. petraea*, *Q. robur* and *Fagus sylvatica*. Companion species: *Carpinus betulus*, *Fraxinus excelsior*, *Tilia tomentosa*, *Acer platanoides*, *A. campestre*, *Prunus avium*. Predominant are vegetatively reproduced stands. Undergrowth is composed by *Cornus mas*, *Euonymus verrucosa*, *Viburnum kantana*.
There are 900 species of plants (34 rare species) and rich fauna (mammals, birds a.o.).
Research projects on dynamics and productivity of forest ecosystems.
Forest encyclopedia, 1985
- 58 THE NETHERLANDS *Q. robur*
-
-
- Oak species can be found in some Dutch forest reserves, forming different floristic associations as follow :
For. Res. Starnumansbos - Gaasterland - 53 ha - association *Betulo - Quercetum*;
For. Res. Galgenberg - Amerongen - 48 ha - association *Fago-Quercetum*;

- For. Res. Pijpebrandje - Speulderbos - 36 ha - association *Fago - Quercetum*;
 For. Res. Drieduin 3 - Schoorl - 28 ha - association *Betula - Quercetum*;
 For. Res. Roodaam - *Castricum* - 35 ha - association *Convallario - Quercetum* and other 12 forest reserves
Brockmeyer, Szabo, 1993
- 59 POLAND
 PUSZCZA
 BIALOVIESKA N.P. See No 8
- 60 POLAND *Q. robur*
 DRAWIENSKI N.P. *Q. petraea* Oak and beech natural mixed primeval forest.
 - *Göbel, Keller, Steinbach, 1996*
 8700
- 61 POLAND *Q. robur*
 WIELKOPOLSKI N.P. *Q. petraea* Primeval oak, pine and mixed forests with interesting flora and fauna. Among different species *Cerambyx cerdo* - one of the largest Europe's beetles reaches a length 25-50 mm.
 - *Göbel, Keller, Steinbach, 1996*
 5,200
- 62 POLAND *Q. robur*
 OJKOWSKI N.P. Oak-hornbeam forests on 40% of the N.P. area.
 Near KRAKOW *Göbel, Keller, Steinbach, 1996*
 1,592
- 63 POLAND *Q. petraea*
 ROZTOCZANSKI N.P. Large area covered by beech, fir (50 m tall), oak and Scots pine woods, located not far from the Renaissance town Zamosk.
 - *Göbel, Keller, Steinbach, 1996*
 6,800
- 64 PORTUGAL *Q. petraea*
 PENEDA-GERÊS *Q. pyrenaica* The former large oak natural forest was in 1930 replaced by massive man-made plantations of *Eucalyptus* sp. and *Acacia dealbata*. Few old, knotty, covered by lichens and mosses specimens of *Q. petraea* and *Q. pyrenaica* can be found on difficult sites. They are accompanied by *Arbutus* sp., *Ilex aquifolium*, *Pyrus* sp., *Salix* sp. and *Tilia cordata*. The soil is covered by sp.
 Note : Brockmeyer & Vos, 1993 mentioned the occurrence of some fragments of virgin oak forests with laurel-leaved shrubs in northern Portugal.
Göbel, Keller, Steinbach, 1996
 72,000
- 65 ROMANIA *Q. robur*
 LETEA NATURAL *Q. pedunculiflora* Located on latest Romania's relief, make up in holocen from alluvia transported by Danube and marine sands carried by Black sea streams, the
 FOREST
 RESERVE

primary forest covers the numerous depressions among sand dunes.

According to the microaltitude and the site conditions, the forest biocenosis are composed of oaks (*Q. robur*, *Q. pedunculiflora*), *Fraxinus angustifolia*, *F. pallisae*, *Populus alba*, *P. tremula*, *P. canescens*, *Alnus glutinosa*, accompanied by numerous shrubs (*Sambucus nigra*, *Telicrania sanguinea*, *Crataegus monogyna*, *Ligustrum vulgare*, *Berberis vulgaris*, *Viburnum opulus*, *Rhamnus cathartica* a.o.) and liana (*Periploca graeca*, *Hedera helix*, *Humulus lupulus*, *Clematis vitalba*, *Vitis sylvestris*).

The strip of gallery forests are ordered in a fan and the permanent humid depressions are partially covered by willows (*Salix alba*, *S. fragilis*, bushes of *Salix cinerea*), reed, *Carex* sp. and aquatic herbs.

By their composition, structure and landscape diversity the Letea forest and the Caraorman forest - situated also in Danube Delta - are unique in Romania and Europe.

Doni_, Băndiu, Biri_, 1999

- | | | | |
|----|---|--|---|
| 66 | ROMANIA
BOLINTIN
NATURAL
FOREST RESERVE
TELEORMAN'S
PLAIN (NEAR
BUCHAREST)
1,263 | <i>Q. robur</i> | Remnant of previous primary large oak forests of Romania's Plain, these extended formerly up to Danube. The tree layer stands are composed by <i>Q. robur</i> and rare <i>Fraxinus angustifolia</i> (1st layer), <i>Tilia tomentosa</i> (2nd layer) and <i>Carpinus betulus</i> (3rd layer). Oaks exceed the age of 100 years and reach 35 m tall and 92 cm dbh. The herb layer is composed by <i>Allium ursinum</i> , mull flora or grasses.
Stoiculescu, 1999 |
| 67 | ROMANIA
BEJAN NATURAL
FOREST RESERVE
DEVA
235 | <i>Q. robur</i>
<i>Q. cerris</i>
<i>Q. petraea</i>
<i>Q. dalechampii</i>
<i>Q. polycarpa</i>
<i>Q. frainetto</i>
<i>Q. pubescens</i>
<i>Q. virgiliana</i>
and numerous
natural hybrids of
most of them | Famous for the occurrence of eight native oak species and hybrids, most of them in a remarkable forest area of less then one square mile.
The previous literature cites the following oak hybrids in the Bejan Forest :
<i>Q. x tabajdiana</i> Simonk., <i>Q. x tufae</i> Simk., <i>Q. x dacica</i> Borb., <i>Q. x haynaldiana</i> Simonk., <i>Q. x kernerii</i> Simonk., <i>Q. x budensis</i> Borb. and some varieties of them. The newly identified taxa (1988-1990) are : <i>Q. x rosacea</i> Beschst. with 3 varieties, <i>Q. x pseudodalechampii</i> Crtz., <i>Q. x csatoi</i> Borb., <i>Q. diversifrons</i> Borb., <i>Q. x cazenensis</i> Pascovschi, <i>Q. petraea x Q. dalechampii</i> , <i>Q. petraea x Q. polycarpa</i> and <i>Q. dalechampii x Q. polycarpa</i> .
Stanciu, 2000 |

- 68 ROMANIA
RUNCU-GRO_I
NATURAL
FOREST RESERVE
MT. ZARAND
(BĂRZAVA)
262.2
- Q. polycarpa*
Q. dalechampii
- Old quasi-virgin sessile oak forest and mixture of *Q. polycarpa* with *Fagus sylvatica* ssp. *moesiaca*. Sessile oaks are between 120 and 200 years old and reach a height of 42.5 m and 72 cm and more in diameter.
Doni_, Biri_, 1999
- 69 ROMANIA
COZIA N.P.
VÎLCEA
6,747
- Q. petraea*
Q. robur
- Natural and quasi-virgin forests of beech, sessile oak, spruce and fir. Occurrence of *Q. robur* at high altitudes (1800 m).
Radu, 1999
- 70 ROMANIA
POR_ILE DE FIER
(IRON GATES)
NATURAL PARK
MEHEDIN_I
423
- 5 *Quercus* species
- Semi-natural stands on limestone along the Danube with beech (*Fagus sylvatica*, *Fagus taurica*, *Fagus orientalis*) and Oak species (*Q. cerris*, *Q. pubescens*, *Q. virgiliana*, *Q. polycarpa* and *Q. dalechampii*).
Radu, 1999
- 71 ROMANIA
FOREST MOCJAR
-
48.8
- Q. robur*
- Small reserve (since 1932) with 371 very old (> 500-650-720 years) oak trees growing on heavy, moist soils, with conical shaped trunks (3-4 dbh and 18 m tall) and dried tops. Till now was not possible to reproduce this original ecotype and area was restocked by planting *Fraxinus excelsior*, *Q. robur*, *Q. borealis*, *Q. petraea*, *Prunus avium* and *Pinus sylvestris*. The understory is composed by *Crataegus monogyna*, *Rhamnus frangula*, *Corylus avellana* a.o.
Radu, 1999
- 72 ROMANIA
DOMOGLED
FOREST RESERVE
B_ILE HERCULANE
2,500
- Q. frainetto*
Q. cerris
Q. pubescens
- Natural stands with *Q. pubescens*, *Q. cerris*, *Q. frainetto* and other submediterranean trees and shrubs species (*Carpinus orientalis*, *Sorbus torminalis*, *S. cretica*, *S. borbasii*, *Fraxinus ornus*, *Rosa spinosissima*, *Corylus colurna*, *Syringa vulgaris* a.o.). Occurrence on *Pinus nigra* ssp. *banatica* and of many endemic plants.
Radu, 1999
- 73 ROMANIA
HÎRBOANCA-
BROHO_OAIA
FOREST RESERVE
VASLUI
70
- Q. pedunculiflora*
Q. pubescens
Q. dalechampii
Q. virgiliana
- Natural oak forest of these four oak species in sylvic-steppe, with occurrence of their natural hybrid populations.
Radu, 1999

74	ROMANIA COMANA FOREST RESERVE GIURGIU 439	5 <i>Quercus</i> species	Complex of natural <i>Q. robur</i> , <i>Q. pedunculiflora</i> , <i>Q. pubescens</i> , <i>Q. frainetto</i> , <i>Q. cerris</i> forests, which include reserves of rare and threatened species (<i>Convallaria majalis</i> , <i>Paeonia peregrina</i> , <i>Ruscus aculeatus</i>). Radu, 1999
75	ROMANIA SEACA-OPT_ANI FOREST RESERVE OLT 434	<i>Q. frainetto</i>	Old remnant of ancient 2000-ha pure massif of <i>Q. frainetto</i> . Radu, 1999
76	ROMANIA TISMANA- POCRUIA FOREST RESERVE GORJ 220	3 <i>Quercus</i> species	Remnant groups of natural <i>Castanea sativa</i> , dispersed in natural oak (<i>Q. petraea</i> , <i>Q. cerris</i> , <i>Q. frainetto</i>) or beech stands. Radu, 1999
77	ROMANIA FOREST DRINOVA- LUGOJ TIMI_ -	<i>Q. petraea</i>	Old growth mixture of sessile oak with beech, lime, hornbeam and maple remarkable by the performances of the high productive and quality <i>Q. petraea</i> . Radu, 1999
78	ROMANIA FOREST CHEVERE_- LUNCA TIMI_ULUI TIMI_ -	<i>Q. robur</i>	Old growth <i>Q. robur</i> monumental stand, proposed as "monument of nature". <i>Bândiu, Smejkal, Vi_oiu-Smejkal, 1995</i>
79	RUSSIAN FEDERA- TION SHIPOV FOREST VORONEJ REGION 35,600	<i>Q. robur</i>	Located on the right bank of Oseredi river (tributary of Don river) at the border between steppe and forest steppe on chernozem soils. The average forest composition is oak (92%) with rare ash, aspen, maples, elm and lime. These are remnants of ancient large forests, which exert great hydrological and climatological protection function. By the order of Peter 1st, in 1709, this forest was included in the category of shipbuilding forest. Periodical management plans since 1770 until present days. Here is working a forest genetics laboratory. The Moskow Historical Museum exhibit an 8 m long boat made from one oak trunk, discovered in 1954 by an archeological expedition in the Don River. Conserved in the earth approximately 4000 years, the boat preserved well, not only the shape, but also the orifices in which were fixed the 8 pairs

of oars. Impregnated with special resins this boat will survive still thousand of years. As a rule other wood things rarely can be conserved under earth more than 1000 years. Fighting for a rational utilization of valuable timber, Peter 1st forbid the fitting out of graves with oak or pine wood, indicating the use of spruce, birch and alder for these purposes.

Forest encyclopedia, 1986; Vasiliev, 1966

- | | | | |
|----|--|---------------------------|---|
| 80 | RUSSIAN
FEDERATION
FOREST MASSIF
BORISOGLEBSK
include :
TELLERMAN
FOREST,
HOPERSK
RESERVE,
TELLERMAN
EXPERIM.
DISTRICT
VORONEJ
REGION
60,000 | <i>Q. robur</i> | Located North of the town Borisoglebsk, along the river Vorona at Hoper, at the border of the steppe and forest steppe, on both river's banks, in different site conditions of high plateau (right bank) and flooded plain + terrace (left banks). Famous old and productive oak forest (with some aspen and elm) designated by Peter 1st as forest reserve for shipbuilding timber. Contain many giant oaks 180-280 years old (the champion : 35 m tall, 2 m dbh at 350 years). Extensive oak plantations in the frame of massif. Valuable seed source. Experimental forest district established in 1948 by academician V.N. Sukaciov. Here worked forester Kornakovski. Forest encyclopedia, 1985 |
| 81 | RUSSIAN
FEDERATION
TULSKIE ZASEKI
TULA REGION
74,300 | <i>Q. robur</i> | Located at the steppe and forest steppe border as belts 2-5 km wide. In the frame of the forest common oak alternated with ash and lime stands plus second growth of birch and aspen and oak plantations. Forest of strategic importance. Their belt structure was established in 13th century at the southern border of Russian as obstacles against Tatarian invasion, using felled trees, ditches, and fortress. Many methods of oak planting and tending were elaborated here. At the beginning of 18th century were assigned to the Tula weapon factory. First forest in Russia where a territorial organization and forest escort was established. Forest encyclopedia, 1986 |
| 82 | SERBIA
DJERDAP N.P.
(IRON GATES)
-
63,500 | 10 <i>Quercus</i> species | Located on the north-eastern mountain part of Serbia as far as the Danube - the border with Romania - the N.P. was organized in 1974 as an large "protected landscape area". In this area is situated the famous Serbo-Romanian hydropower |

plant Djerdap - Portile de Fier (Iron Gates) - one of the biggest in Europe. A lot of cultural and archeological monuments and many natural reserves with rare and endemic plants are in the N.P., including also semi-natural and natural forests. According to J. Movcan, 10 oak species are growing in this area (*Q. robur*, *Q. petraea*, *Q. pubescens*, *Q. frainetto*, *Q. cerris*, *Q. pedunculiflora*, *Q. virgiliana*, *Q. dalechampii*, *Q. polycarpa* and probably *Q. trojana*). A similar natural Park "Portile de Fier" is situated on the Romanian bank on 2700 ha, along 134 km of Danube, with many natural reserves.
Göbel, Keller, Steinbach, 1996

- | | | |
|---|---|---|
| <p>83 SLOVAK REPUBLIC
NATURAL STATE
RESERVE
KOVA_OVSKÉ-
KOPCE-SOUTH
CONFLUENCE OF
RIVERS HRON
AND IPEL
364.14</p> | <p><i>Q. pubescens</i>
<i>Q. cerris</i>
<i>Q. petraea</i></p> | <p>Forest were destroyed since ancient time in this area situated at the limit of forest and forest steppe zones at 120-180 m altitude, but this remnant, protected since 1888, was saved by its poor accessibility and low economic value. Rare tree layer is composed by <i>Quercus pubescens</i>, <i>Q. cerris</i>, <i>Fraxinus ornus</i>, <i>Acer campestre</i>, <i>A. tataricum</i>, and the oldest specimens are 220-240 years old. Second layer is formed by <i>Cornus sanguinea</i>, <i>C. alba</i>, <i>Rhamnus cathartica</i>, <i>Ligustrum</i> sp., <i>Euonymus</i> sp., <i>Rosa</i> sp., and <i>Prunus spinosa</i>.
Korpel, 1995</p> |
| <p>84 SLOVAK REPUBLIC
NATURAL STATE
RESERVE BOKY
MT. KREMnitz
176.5</p> | <p><i>Q. cerris</i>
<i>Q. petraea</i>
<i>Q. robur</i></p> | <p>Mixed oak forest with remnants of virgin stands of <i>Q. robur</i>, <i>Q. cerris</i>, <i>Q. petraea</i> with <i>Carpinus betulus</i>, <i>Fagus sylvatica</i> and <i>Sorbus torminalis</i> in different developmental phases (growing up, optimal, decadent).
Korpel, 1995</p> |
| <p>85 SLOVAK REPUBLIC
NATURAL STATE
RESERVES
KA_IVAROVA and
LESNÁ
MT. _TIAVNICÁ
20.44 + 3.93</p> | <p><i>Q. petraea</i></p> | <p>High quality and productive of <i>Q. petraea</i> in mixture with beech, fir, lime, hornbeam and <i>Prunus avium</i> in different developmental phases.
Korpel, 1995</p> |
| <p>86 SLOVAK REPUBLIC
NATURAL STATE
RESERVES
BUJANOV
MT. CIERNA HORA
88.2</p> | <p><i>Q. petraea</i></p> | <p>High quality and very productive mixed virgin oak-beech forest in different developmental phases.
Korpel, 1995</p> |

- | | | | |
|----|---|--|---|
| 87 | SLOVAK
REPUBLIC
NATURAL STATE
RESERVE SITNO
MT. SCHEMNITZ
(1010 m alt.)
92.68 | <i>Q. petraea</i>
<i>Q. cerris</i> | Mixed virgin forest composed mainly by beech, sessile oak and sycamore. <i>Q. cerris</i> , maple, hornbeam, ash and fir participate also in a reduced proportion. Different stand developmental phases (growing up, optimal and decadent) can be found in this reserve.
Korpel, 1995 |
| 88 | SLOVAK REPUBLIC
POLONINY
NATIONAL PARK
EASTERN
SLOVAKIA (AT THE
BONDARY WITH
POLAND AND
UKRAINE)
1,778 (prot. forest) | <i>Q. robur</i>
<i>Q. petraea</i> | Dominant pure beech forests with some oak-beech stands on the lowest and warmest sites. In addition to the dominant species (<i>Q. robur</i> , <i>Q. petraea</i> , <i>Carpinus betulus</i>), these forests also include maples (<i>Acer platanoides</i> , <i>A. campestre</i>) and lime (<i>Tilia platyphylla</i> , <i>T. cordata</i>).
Volo_cuk, 1999 |
| 89 | SLOVAK REPUBLIC
SLOVAK KARST
BIOSPHERE
RESERVE
SOUTHEAST
SLOVAKIA
36,170 | <i>Q. robur</i>
<i>Q. petraea</i> and others
oak species | The most frequent forests in this B.R. are Carpathian oak-hornbeam forests and xero-thermophilous oak forest on alkaline bedrocks. An oak virgin forest is mentioned in Jasovske dubiny.
Volo_uk, 1999 |
| 90 | SLOVAK
REPUBLIC
POL'ANA
BIOSPHAERE
RESERVE
CENTRE OF
SLOVAKIA
20,080 | <i>Q. cerris</i>
<i>Q. petraea</i>
<i>Q. robur</i> | Beech and fir-beech forests are the most frequent forest communities, but remnants of beech-oak and oak-beech remain only in the southwestern foothills. Beside the oaks and beech, these forests also include hornbeam and limes.
Volo_uk, 1999 |
| 91 | SLOVAK REPUBLIC
SLOVAK PARADISE
NATIONAL PARK
SLOVAK ORE
MOUNTAINS
(SOUTH-WEST)
32,763 | <i>Q. pubescens</i>
<i>Q. petraea</i> | Predominant are the beech and beech-coniferous forests, but in the warmest region of the northern part of the Hornad Ravine there are frequent communities of the alliance <i>Quercion pubescentis-petraeae</i> , where in some association there are numbers of thermophile, even xerothermic species of plants.
Volo_uk, 1999 |
| 92 | SPAIN
CAVADONGA
NATIONAL PARK
CANTABRIA MTS.
65,000 | <i>Q. petraea</i> | In a vast high mountain and karst area of North of Spain, in the middle mountain layer fragmented forests composed by beech with other species (<i>Ilex aquifolium</i> , <i>Taxus</i> , <i>Q. petraea</i> , <i>Fraxinus</i> , sycamore and <i>Tilia</i> can be find). Under this layer, stands of <i>Q. petraea</i> in mixture with <i>Pistacia</i> , <i>Arbutus</i> and other thermophile |

shrubs occur. Large areas are occupied by natural *Castanea sativa* and young plantation of pine and *Eucalyptus* sp.
Göbel, Keller, Steinbach, 1996

- | | | | |
|----|--|--|---|
| 93 | SPAIN
DOÑANA NATIONAL PARK
SOUTH OF SPAIN
73,000 | <i>Q. suber</i> | <p>Small areas of forest composed by light species, groups of shrubs and meadows in an variegated vegetal mosaic are typical for this sunlit area. Dispersed old cork oaks (<i>Q. suber</i>) dominate the landscape, with Imperial Eagle and Great Egrets nesting in their crowns, in alternation with pine forests and Mediterranean maquis shrubs, and sand dunes.</p> <p>Göbel, Keller, Steinbach, 1996</p> <p>Notes :</p> <p>1) Broekmeyer and Vos, 1993 mentioned the occurrence of some fragment of virgin forest belonging to the types: Holm-oak; Cork-oak and oak on a very moist and warm Mediterranean climate.</p> <p>2) In Spain and Portugal, multi-purpose ecosystems called <i>dehesas</i> and <i>montados</i> were traditionally used and formed a valuable, typical landscape of pasture mixed with open woodland: the open tree stratum dominated by oak species (<i>Q. suber</i>, <i>Q. ilex</i>, <i>Q. pyrenaica</i> and <i>Q. rotundifolia</i>) was grown for cork, timber, fuel and charcoal, but also tannin and acorns, together with shifting cultivation of cereals, and grazing of pigs, sheep, goats and fallow land. The <i>dehesas/montado</i> is the typical candidate for a Red Book of threatened landscapes.</p> <p>Europe's Environment, 1995</p> |
| | | <i>Q. suber</i>
<i>Q. ilex</i>
<i>Q. pyrenaica</i>
<i>Q. rotundifolia</i> | |
| 94 | SPAIN
ORDESA NATIONAL PARK
PYRENEES MTS.
15,700 | <i>Q. petraea</i> | <p>Isolated groups of rare <i>Q. petraea</i> dispersed in field, garden and meadows and also in fir beech forests.</p> <p>Göbel, Keller, Steinbach, 1996</p> |
| 95 | TURKEY
KARATÉPE
ASLANTA_ NATIONAL PARK
ADANA
7,715 | Probably 6
<i>Quercus</i> species | <p>Located in the river's Ceyhan valley, the park includes a hill area covered by oaks and pine forest. In this area are probably growing <i>Q. robur</i>, <i>Q. petraea</i>, <i>Q. cerris</i>, <i>Q. infectoria</i>, <i>Q. coccifera</i> and <i>Q. itaburensis</i> ssp. <i>macrolepis</i>. An interesting wild fauna and many archeological vestiges occur in the park.</p> <p>Ionescu & Condurceanu, 1985</p> |

Note : Eighteen oak species are known to be native to Turkey and they occupy 25% of country's forest area, but many of them are heavily degraded (grazed, cut for fuel). According to climatic conditions and to their ecological demands, these species are located in four climatic and geographical zones : 1) the pontic, temperate zone; 2) the Mediterranean zone; 3) Central Antolia with continental arid subdesertic climate in interior and 4) eastern Antolia with mountain climate. In addition to the above species can be mentioned : *Q. hartwissiana*, *Q. pontica*, *Q. frainetto*, *Q. pubescens*, *Q. trojana*, *Q. ilex*, *Q. aucheri*, *Q. libani*, *Q. virgiliana*, *Q. vulcanica* and *Q. brantii*
 Ertas, 1995; Hedge & Yaltirik, 1994

- | | | | |
|----|---|--------------------------------------|--|
| 96 | UKRAINE
FOREST MASSIF
TROSTIANETSK
SUMSK REGION
19,241 | <i>Q. robur</i> | Located in the forest-steppe, in the valley of Vorskla River and on the watershed between Vorskla and Psel rivers, on different soil types. In addition to the common oak in this area, Scots pine, birch and alder are growing. More than 100 years these forests were successively studied by famous Russian forest scientists (Orlow, Visotzki, Pogrebniak, Jukow, Piatnitzki, Gurski and other). Regular periodical management plans were practiced here since 1878. In Krasno-Trostianetz an experimental forest station is working.
Forest encyclopedia, 1986 |
| 97 | UKRAINE
KUZYSKYI
FOREST MASSIF
TRANSCARPATIAN
REGION
737,5 | <i>Q. robur</i>
<i>Q. petraea</i> | Located in the southern slopes of the Svidovecky massif, in the Kuzyi river basin, on Jurassic limestone bedrocks. The climate is influenced by warm flow from the Marmaroskyi Valley. Original mixed oak-beech communities with hornbeam occur at the altitude of 1090 m, representing the highest location of these oak species in Ukraine.
Volo__uk, 1999 |
| 98 | UNITED KINGDOM
LAKE DISTRICT
NATIONAL PARK
NORTH-WEST OF
GREAT BRITAIN
229,200 | <i>Q. robur</i> | In the varied landscape of this famous N.P. natural mixed forests composed by common oak, birch, yew, ash, mountain elm and lime can be find.
Göbel, Keller, Steinbach, 1996 |

- 99 UNITED KINGDOM *Q. petraea*
SNOWDONIA
NATIONAL PARK
WEST OF GREAT
BRITAIN
214,200
- In this "land of eagles" in the narrow valley of Afon Hachno river, fragments of natural forests composed by *Q. petraea* in mixture with ash, black alder, birch and mountain ash (*Sorbus aucuparia*) are well preserved. Göbel, Keller, Steinbach, 1996
- 100 UNITED KINGDOM *Q. petraea*
DARTMOOR
NATIONAL PARK
SOUTHWEST OF
GREAT BRITAIN
95,400
- Only small remnants of the formerly large forest, composed by sessile oaks with a dense understory of *Ilex*, ferns, mosses and lichens, in the river's valleys. Göbel, Keller, Steinbach, 1996
- 101 UNITED KINGDOM *Q. petraea*
PEAK DISTRICT
NATIONAL PARK
MANCHESTER
ZONE
143,800
- Old deciduous forest with *Fraxinus excesa*, *Ulmus glabra*, *Acer pseudoplatanus*, *Q. petraea* and *Tilia platyphyllos*. Göbel, Keller, Steinbach, 1996

REFERENCES

- ALBRECHT, L., 1990 : Grundlagen, Ziele und Metodik der wald-ökologischen Forschung. München.
- BROEKMEYER, M.E.A., VOS, W & KOOP, H. (eds.), 1993 : European Forest Reserves. Pudoc, Wageningen.
- BÜCKING, W., 1986 : Study of vegetation changes in natural forest reserves in South-West Germany. In : Forest dynamics research in western and central Europe. (Fanta, ed.). Pudoc, Wageningen.
- DITTRICH, B : Deutschlands Nationalparks - Naturpark und Naturservate. Vehling-Verlag, Werl i. W.-Basel-Graz.
- ERTAS, A., 1995 : Oaks of Turkey and the Mideast. Journal of International Oak Society, No. 6.
- GÖBEL, P., KELLER, C., STEINBACH, G., 1966 : Paradiese-National Parks in Europa. V.S. Verlaghaus Stuttgart GmbH.
- HEDGE, I.C. & YALTIRIK, F., 1994 : The Oaks of Turkey. Journal of International Oak Society, No 5.
- IBERO, C., 1994 : The Status of Old Growth and Semi-Natural Forests in Western Europe. WWF Report, Gland, Switzerland.
- IONESCU, M., CONDUR_EANU-FESCI, S., 1985 : Parcuri_i rezerva_ii naturale pe glob. Ed. Albatros, Bucure_ti.
- KLEPAC, D., 1981 : Les forêts de Chêne en Slavonie. Revue Forestière Française, no spécial, 87-104.

- KORPEL, U., 1995 : Die Urwälder der Westkarpaten. Gustav Fischer Verlag, Stuttgart, Jena, New York.
- MATIC, S., 1999 : The forests of Croatia-Country report. In : Virgin forests and forest reserves in Central and East European countries. Ljubljana.
- MAYER, H., TICHY, K., 1979 : Das Eichen-Naturschutzgebiet Johannser Kogel im Lainzer Tiergarten, Wienerwald. Centralblatt f.d.ges. Forstw. 96/1.
- PAULENKA, J., PAULE, L. (eds), 1994 : Conservation of Forests in Central Europe. Arbora Publishers, Zvolen.
- PINTARU, K., 1999 : Forestry and forest reserves in Bosnia and Herzegovina. In : Virgin forests and forest reserves in central and east European countries. Ljubljana.
- RADU, S., 1993 : Forest reserves in Romania. In : European Forest Reserves. Pudoc, Wageningen.
- RADU, S., 1995 : Oaks of Europe and Asia. Occurrence, Ecology and Amenity Values. Journal of International Oak Society, No 6.
- RADU, S., 1999 : Conservation and Ecological Reconstruction of Oak Forests in Romania. International Oaks, No 9.
- SMEJKAL, G.M., BÎNDIU, C., VI_OIU-SMEJKAL, D., 1995 : Banater Urwälder. Mirton Verlag, Temeswar-Rumänien.
- VOLOUK, I. (ed), 1999 : National Parks and Biosphaere Reserves in Carpathians - The Last Nature Paradises. ACANAP, Tatranská Lomnica, Slovak Rep.
- ZUKRIGL, K. a.o., 1990 : Naturwaldreservate in Österreich. Wien.
- *** ARBORESCENCES No : 72/1998; 73/1998; 78/1999; 83/2000. Office National des Forêts, Paris.
- *** Forest Encyclopedia (in russian), I, II, 1985, 1986, Moskow, Sovijetskaia Entziklopedija.
- *** 1979 : Guide de la nature en France. Bordas, Paris.
- *** ONF, 1991 : Les Chênes de Bellême et Réno-Valdieu.
- *** 1999 : P_durile virgine_i cvasivirgine din România (Virgin and quasivirgin forest in Romania). Mss. ICAS, Bucure_tii.

An Update on *Phytophthora ramorum*, Causal Agent of Sudden Oak Death

Steve Swain

Sudden Oak Death Project Coordinator for the University of California
Cooperative Extension Office in Sonoma County

When the pathogen *Phytophthora ramorum* was first described in northern Europe in 1993 (Werres et al., 2001), it did not receive widespread attention, as it only produced leaf spots on a few nursery stock species. Since then, it has garnered a bit more attention under the name "Sudden Oak Death" by killing thousands of trees across the coastal regions of central California. However, the name "sudden oak death" is a misnomer; the disease has a broad host range including plants from several different families, doesn't always kill oaks when it infects them, and when it does kill them, it doesn't always happen suddenly. So, then, what is "sudden oak death"? The term generally has come to be used synonymously with infection of a plant or a community of plants by *Phytophthora ramorum*. This article is intended to briefly summarize the current state of knowledge of this pathogen, its effects and distribution, and what is being done about it.

The Pathogen

The name "*Phytophthora*" literally means "plant destroyer." These are fungus-like organisms that are more commonly known as "water molds," and they typically thrive under moist conditions. Most species within the genus are aggressive plant pathogens that infect and often kill their hosts; these microbes can also survive on infected plant parts and in the soil. Worldwide, they represent root and leaf pathogens, but most temperate species on oaks are root pathogens.

Like all others in the genus, *P. ramorum* produces several different reproductive structures, including chlamydospores, zoospores, and sporangia. Each of these is somewhat specialized to a specific mode of dispersal. The chlamydospores produced by *P. ramorum* are survival structures; they act in a manner somewhat analogous to that of seeds, able to handle comparatively long periods of time in harsh environmental conditions. Zoospores of *P. ramorum* swim through water actively seeking hosts. These comparatively tiny spores are relatively short lived when exposed to dry air, but can survive up to 30 days in water (Davidson et al., 2002). Sporangia (Figure 1) are larger structures that can produce and release zoospores, or can infect plant tissues directly. Morphological similarities of the spo-



Figure 1: Sporangia (larger oblong structures) as viewed under a microscope

Photo courtesy of Matteo Garbelotto, UC Berkley

rangia produced by *P. ramorum* to the two known aerially dispersed *Phytophthora* species suggest that *P. ramorum* may be among the few known *Phytophthora* species that can be aerially dispersed. (Rizzo, pers. comm.). This hypothesis is supported by a distribution pattern across the landscape that suggests wind as a dispersal mechanism. Although there is currently no evidence that *P. ramorum* can be moved by wind in the absence of rain, it is almost certain that *P. ramorum* can be dispersed in wind-driven rain. The wide variety of spore types produced by *Phytophthora* species allow them several different methods of dispersal across the landscape, including transport by water, the movement of soil on tires, animal feet, or shoes, and possibly even wind. Once in place, certain spore types can subsist for long periods of time waiting for optimal conditions to infect a new host.

Phytophthora ramorum has a broad host range: at least fourteen different hosts species in several different families are susceptible (Davidson et al. 2002; Rizzo et al. 2002a; Rizzo et al. 2002b). The symptoms vary depending upon the host species infected, and also vary depending upon whether they cause trunk cankers or necrotic leaf spots. In most species, this is an either/or situation: *P. ramorum* either causes a trunk canker or it causes necrotic leaf spots. Infection is frequently lethal to species that develop trunk cankers, which include coast live oak (*Quercus agrifolia*), black oak (*Quercus kelloggii*), Shreve's oak, (*Quercus parvula* var. *shrevei*), and tanoak (*Lithocarpus densiflorus*). All of the *Quercus* species listed above are in the section *Lobatae* (red or black oaks), and it appears that all of the members of this section may be susceptible to infection by *P. ramorum* to one degree or another. Other sections of *Quercus*, such as the white oaks (section *Quercus*), are not known to be susceptible (Rizzo et al. 2002a). The infection of tanoak is noteworthy in that *P. ramorum* is able to cause both trunk, branch, and leaf infections. It was the first species in California known to be symptomatic of this disease (Svihra, 1999), and appears to be among the most susceptible species discovered. In this case, the term "sudden oak death" is descriptive of the infection process, even though tanoak isn't a true oak. The remaining ten or so host species develop leaf infections, and commonly also develop cankers in their branches - hence the specific name "ramorum", meaning "to branch." However, these "foliar hosts" generally do not develop large cankers in their trunk tissues.

Table 1. A list of host species by scientific and common names, and whether or not they are foliar or trunk canker hosts.

Latin Name	Common Name	Foliar Host	Trunk Canker	Branch Canker
<i>Acer macrophyllum</i>	Big-leaf maple	x		
<i>Aesculus californica</i>	California buckeye	x		
<i>Arbutus menziesii</i>	Madrone	x		x
<i>Arctostaphylos manzanita</i>	Manzanita	x		x
<i>Heteromeles arbutifolia</i>	Toyon	x		x
<i>Lithocarpus densiflorus</i>	Tanoak	x	x	x
<i>Lonicera hispidula</i>	California honeysuckle	x		
<i>Quercus</i> (section <i>Lobatae</i>)	"Black" or "red" oaks			
<i>agrifolia</i>	Coast live oak		x	
<i>kelloggii</i>	California black oak		x	
<i>parvula</i> var. <i>shrevei</i>	Shreve's oak		x	
<i>Rhamnus californica</i>	California coffeeberry	x		
<i>Rhododendron</i> spp.*	Rhododendron varieties	x		
<i>macrophyllum</i>	California Rose-Bay	x		
<i>Umbellularia californica</i>	Bay Laurel	x		
<i>Vaccinium ovatum</i>	California huckleberry	x		x
<i>Viburnum</i> spp.*	Arrow-wood	x		x

* "spp." listings: species in these genera are sold in the horticultural trade, and some represent a significant risk of contagion. They are often not native to California.

New hosts for *P. ramorum* are being discovered every year, and therefore the above species host list is expected to grow. The potential size of the completed host list is large, potentially numbering into the hundreds of species; as an example, the host list for *P. cinnamomi* is in the vicinity of 2000 species.

Symptoms

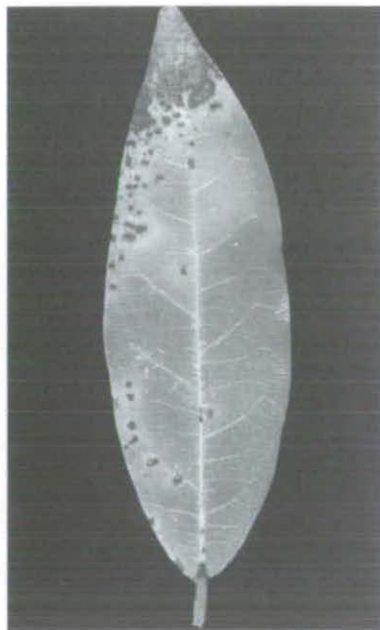
Although the best known form of the disease involves the formation of trunk cankers leading to the disease commonly termed "sudden oak death", it appears that the more common form of the disease results in necrotic leaf spots on a foliar host. *Phytophthora ramorum* seems to be quite contagious, especially among certain foliar hosts such as Rhododendron species, tanoak, and bay laurel (*Umbellularia californica*).

To date, susceptible *Quercus* species have only been seen to develop trunk cankers; *P. ramorum* hasn't been found to cause infections of oak foliage. These cankers inhibit the conduction of key nutrients through the vascular tissues of the host tree, leading to the disease commonly termed "sudden oak death". External symptoms typically appear as sticky, viscous, bur-



Figure 2: Bleeding from the bark of coast live oak

Photo courtesy of Matteo Garbelotto, UC Berkeley



gundy or molasses colored droplets that appear on clear bark (Figure 2) and they are usually not associated with a wound. Canker symptoms on tanoaks are similar, but are typically runnier and preceded by a general browning of the entire canopy.

Among the foliar hosts, symptoms of infection are variable with plant species. Most symptoms manifest themselves as leaf spots (figure 3), which are not always obvious to the casual observer. They are often easily confused with many other maladies that the host plants may contract. *Phytophthora ramorum* produces few visible signs of its presence, as all of its structures are microscopic, or nearly so (Garbelotto et al., 2002). To view typical symptoms on various hosts, please visit www.suddenoakdeath.org.

Figure 3: Spots caused by *P. ramorum* on a bay laurel leaf

Photo courtesy of Matteo Garbelotto, UC Berkeley

Secondary organisms may accelerate the decline of infected oak and tanoak trees. Typical among these are oak bark beetles (*Pseudopityophthorus pubipennis*) and ambrosia beetles (*Monarthrum* spp.). These beetles leave pin sized holes in the bark, surrounded by a fine sawdust like material, commonly termed "frass". Anecdotal evidence suggests that attacks by beetles are typically what cause oak trees to die "suddenly" more so than the comparatively slow moving infections caused by *P. ramorum*.

Dead and dying trunk tissues are typically colonized by decay fungi. Common among this group of organisms is *Hypoxylon thoursianum*, a fungus that produces fruiting bodies that resemble small, rounded chunks of charcoal that grow on the bark of infected trees. The presence of *Hypoxylon*, beetles, or both, does not necessarily indicate that the tree is infected with *P. ramorum*, but they are part of the general disease process that oaks and tanoaks have evolved with in western North America. The oaks colonized by these secondary organisms may have been initially stressed for any of a multitude of reasons, as has been the case for centuries.

Distribution

Generally speaking, at least two things are required for an effective quarantine: an idea of the distribution of the infection over space and time, and some sort of restriction on its movement from infected regions. As such, disease delineation is critical to any proposed containment approach. As of April 15, 2002, the North American distribution of *P. ramorum* extends over more than 300 km of the central California coastline, and in one small isolated area of Curry County, Oregon, just north of California.

Phytophthora ramorum requires water in order to reproduce, and prefers temperatures in the vicinity of 20 ° C. Moist, comparatively cool climatic zones are frequently found in the coastal regions, and it is perhaps because of this that most of the confirmed distribution of *P. ramorum* occurs within 30 km of the coastline. In the San Francisco Bay Area it has been found farther inland, but at the time of this writing has only been confirmed at locations corresponding to cool, Bay Area weather.

This does not mean that *P. ramorum* is necessarily limited to these climates. Dr. Matteo Garbelotto's heat treatment experiments clearly show that in certain host materials, such as bay laurel leaves, *P. ramorum* is capable of surviving temperatures of 35 ° C for extended periods of time (Garbelotto, unpublished data). This suggests that although the pathogen may not be able to reproduce under the comparatively hot, dry climate associated with California's interior valley summers, it may be able to survive them. It is plausible that *P. ramorum* could be introduced to regions such as this during comparatively cool, moist weather frequently associated with springtime, and then reproduce whenever favorable conditions recur. Exactly how fast the disease would spread, how the symptoms would manifest themselves, and which hosts it would be capable of infecting under these conditions are all unknown at this time.

Hot, dry summers and cool moist spring weather typify many climates beyond California's central valley. If *P. ramorum* is not limited to the west coast environment, this begs the question of how infectious it might be on host species found elsewhere on the continent, or indeed the world. Many of the oaks of eastern North America, for example red oak (*Quercus rubra*) and pin oak (*Quercus palustris*), are in the same section (*Lobatae*) as susceptible western oaks. The two eastern oak species tested were at least as susceptible to *P. ramorum* as were western oaks (Rizzo, *Pers. Comm.*). Although *P. ramorum* was first discovered in northern Europe and has been identified in England, no infected European oaks are known (DEFRA, 2002).

Up until recently, monitoring the distribution of the disease has been based upon reports of suspected infestations coming in from the public. For the most part, the public seems to have keyed in on oak death as the defining characteristic that they are reporting, and this may be a direct result of the disease's common name. It may also be that many people simply aren't concerned about leaf spots on their laurel trees, or other foliar hosts. Whatever the reason, it now seems to take at least a few months for tanoak trees to show symptoms, and it may take years for coast live oak to show symptoms. The result is that we have been monitoring a phenomenon that is perhaps up to several years behind the arrival of the disease at a

particular given site, and therefore the actual extent of this disease may be significantly wider than what is represented in Figure 4. Researchers have suggested that perhaps a better way to find the current extent of the disease would be to begin monitoring bay laurel leaf symptoms instead of dying oaks. Bay laurel trees seem to show symptoms quite a bit earlier than the canker-forming trees such as coast live oak and tanoak that are commonly reported by the public. The results of Sonoma County's disease monitoring efforts support this. We have found infected bay laurel trees miles from any confirmed dead oak or tanoak tree in the Mark West Springs area of Sonoma County. Some of the advantages to focusing on foliar symptoms of bay laurel trees are that this species is relatively widespread and is evergreen, which allows symptom identification and sampling throughout the year.

A better understanding of the epidemiology of the disease on its foliar hosts will facilitate disease monitoring and delineation. There is still much more that needs to be known about this subject.

Risk of Spread

Phytophthora ramorum seems to be well suited to dispersal among its hosts by both anthropogenic and natural means. Spore production appears to be greatest on foliar hosts, in some cases approaching 70,000 spores per square centimeter (figure 4) of infected leaf tissue (Rizzo, *Pers. Comm.*). Spore production on woody materials is much lower when it occurs at all. This suggests that in terms of anthropogenic spread, the transportation of foliage is of greater comparative risk than the transportation of wood or wood products, although there may still be significant risk to the movement of infected

woody material. Foliage is clearly a good platform for natural dispersal because of its position above ground and exposure to wind and rain.

For this reason, the development of phytosanitary disposal methods for host material from infected regions appears to be critical in containing the disease. Composting diseased host material appears to be a promising method of sanitizing it. During the composting trials, after one week at 55 °C, *P. ramorum* could not be isolated from most substrates, and after two weeks, *P. ramorum* could not be isolated from even the bay laurel leaves (Garbelotto, unpublished data). Dr. Garbelotto is still conducting further tests aimed at determining how much the time and temperature required to eliminate *P. ramorum* may vary with time of year and



Figure 4: Microscopic view of leaf surface crowded with sporangia

Photo courtesy of Matteo Garbelotto, UC Berkeley

substrate material. The final results will probably not be known for some time.

Firewood and other coarse plant materials also pose a risk of spread, but the exact extent of this risk is still unknown. In infected regions, firewood from host species is generally required to remain on site. Other firewood movement may be restricted or prohibited, depending upon several factors including the origin and destination of the material. Several other commodities are regulated in infected counties, including soil and nursery stock. Quarantine regulations are almost certainly going to change with time as the information on which the regulations are based changes.

Introduced pathogen?

Based on preliminary evidence, *Phytophthora ramorum* has what amounts largely to a clonal population structure (Garbelotto et al. 2001b). This microbe seems well adapted to asexual propagation; at this time sexual propagation of *P. ramorum* is not known to occur in North America. The theoretically clonal population structure has a number of significant implications.

Preliminary data on the limited genetic variability of California's *P. ramorum* population is not in agreement with the hypothesis that it is a native species. While this is far from proven, it suggests that if *P. ramorum* was introduced, then the native plants in the central coast region are unlikely to have evolved any innate ability to defend themselves against it. The inability of host plants to defend themselves adequately against introduced diseases has caused such dramatic events as Dutch elm disease (caused by the pathogen *Ophiostoma ulmi*), and chestnut blight (caused by the pathogen *Cryphonectria parasitica*). This is not to say that the situation here is so dire, but rather to illustrate the potential for the most severely affected species, such as tanoak. Tanoak has indeed suffered substantial losses in the past seven years, with some stands suffering one hundred percent mortality.

The lack of genetic variability within the *P. ramorum* population of the western United States suggests that there is very little genetic recombination occurring within the population, and thus adaptation rates for *P. ramorum* should be quite low. This bodes well for plants that show partial resistance to the disease, such as our native oaks, as it implies that it will be much more difficult for *P. ramorum* to overcome the defenses of the oak population as a whole over time. Of course, this could all change overnight with the introduction of a new, sexually compatible strain of the disease. Preventing the introduction of any new strains is likely to prove difficult, as the origin of the pathogen is as yet only hypothetical.

Treatment

Testing to develop treatment for individual trees is still underway. A number of chemical control options appear to hold promise, but results are likely to still be several months, if not years, away. This is in part due to the very slow nature of oak mortality itself. In the absence of attack by bark beetles, trees can take years to die. The long time scale required for this process in turn requires equally long experimental times to obtain treatment results from the field.

Host mortality rates also appear to vary by species. For instance, mortality rates on tanoaks appear to be higher than they are for black and coast live oaks. The rates also seem to vary with climate, with elevated mortality correlating to comparatively cool and moist climatic conditions.

If an effective treatment is found, it may be able to save horticulturally valuable trees in particular cases, but it is unlikely to be able to change the status quo of the infected landscape as a whole. This is primarily because biological controls for forest dwelling *Phytophthora* species are unknown, and the wholesale spraying of entire regions with chemicals is likely to cause as many environmental problems as it cures.

The state of Oregon has taken a comparatively aggressive approach to the recent introduction of *P. ramorum* into the southwest corner of the state. In this case, state and federal agencies are cooperating in an attempt to eradicate the disease by cutting and burning all host plants within 50 to 100 feet of symptomatic foliage (Goheen, pers. comm.). That this approach is possible is due to a combination of factors. One of these factors is the comparatively

large distance between this disease and the next closest confirmed site - a distance of over 250 kilometers. The lack of a nearby source of infection suggests that if the disease is eradicated, the region is unlikely to be re-infected in the immediate future. This is conjecture, since the method of the original introduction is not known. The other factor making an eradication attempt possible is the limited size of the site. A total of approximately 40 acres scattered over several sites in Curry County are known to be infected. This makes cutting and burning these areas in Oregon a realistic proposition. Results from this approach are forthcoming.

Eradication is not a realistic proposition in California. The current disease extent is still not fully known, but it is clear that the disease is relatively widespread on the central coast. Currently, the best management approach in California seems to be to prevent further spread of the disease.

Infected regions of California are currently under both state and federal quarantines designed to limit the movement of infectious material. As of this writing, these regulations are currently under revision so that they are consistent and compatible with one another. By the time this article is printed, they should have been reconciled. As new host species or new infection routes are discovered, these regulations will have to be amended.

Forests in flux

Most forests in western North America have been subject to somewhat routine perturbations and disturbances throughout their history. What now stands as forest may have been a field at one time, and where there are now redwoods or pines, oaks may have once stood. Fire burned through many of these forests and woodlands every few years, and helped to shape the forests themselves. In the absence of fire, oak woodlands and forests often succeeded to other forest types. Disease seems to be part of these processes, although exactly how native diseases may have caused landscape level changes in the forests is not fully understood. The effects of exotic pathogens are likely to be even less predictable.

Ultimately, *P. ramorum* is likely to result in changes to California's central coast forests. What these changes will be is difficult to estimate until we know more about the pathogen and its impacts. At this point, it seems these changes are unlikely to radically alter the landscape of the central coast over the long term, although they may be significant at a more local scale. Based on preliminary evidence, regeneration of certain species does appear to be affected. Perhaps the greatest long-term threat posed by this disease is the potential elimination of tanoak as a significant component of west coast forests.

Conclusions

Several important basic questions about *P. ramorum* remain unanswered. These will need to be addressed before we can hope to answer more complex questions regarding ecology and impact on afflicted flora. It also remains to be seen whether quarantine or eradication efforts based on our current level of knowledge will be effective. At this point, the host species list is not complete, and the methods of dispersal are not completely understood. Similarly, views on what kinds of treatment, enforcement and regulations are appropriate may change over time.

Although the common name "sudden oak death" does not really describe the ecology of the disease accurately, it does capture the essence of what we currently understand to be its major impact.

There are a number of resources available for further information on *Phytophthora ramorum*. For easy access to general background information, current host species lists, and images of symptoms, please visit www.suddenoakdeath.org. For questions regarding the movement of quarantined plant material, please contact

Jonathan M. Jones
National Forest Pest Programs Manager
USDA-APHIS-PPQ Invasive Species and Pest Management
4700 River Rd. Unit 134 Suite 4C33
Riverdale, MD 20737
Tel: 301-734-8247 Fax: 301-734-8584
email: jonathan.m.jones@aphis.usda.gov

Bibliography

- Davidson, J.M., Rizzo, D.M., Garbelotto, M., Tjosvold, S. and Slaughter, G.W., 2002. *Phytophthora ramorum* and sudden oak death in California: II. Transmission and survival, Fifth Symposium on Oak Woodlands. USDA-Forest Service, San Diego, CA.
- DEFRA, Department for Environmental, Food & Rural Affairs, 2002, News Release 177/02 - Oak Disease Alert - Government Acts to Protect Britain's Trees, London.
- Garbelotto, M., Svihra, P. and Rizzo, D., 2001. Sudden oak death syndrome fells 3 oak species. *California Agriculture* (Jan/Feb 2001): 9-19.
- Garbelotto, M., Rizzo, D., Davidson, J., Frankel, S., 2002, How to Recognize Symptoms of Diseases Caused by *Phytophthora ramorum*, Causal Agent of Sudden Oak Death, USDA Forest Service, Pacific Southwest Region.
- Goheen, E.M., Plant Pathologist, USDA Forest Service, Forest Health Protection, Southwest Oregon Forest Insect and Disease Service Center
- McPherson, B.A., Wood, D.L., Storer, A.J., Svihra, P., Rizzo, D.M., Kelly, N.M. and Standiford, R.B., 2000. Oak mortality syndrome: Sudden death of oaks and tanoaks. *Tree Notes*, 26: 1-6.
- Rizzo, D., Garbelotto, M., Davidson, J.M., Slaughter, G.W. and Koike, S.T., 2002a. *Phytophthora ramorum* as the cause of extensive mortality of *Quercus* spp. and *Lithocarpus densiflorus* in California. *Plant Disease*, 86(3): 205-213.
- Rizzo, D.M., Garbelotto, M., Davidson, J.M., Slaughter, G.W. and Koike, S.T., 2002b. *Phytophthora ramorum* and Sudden Oak Death in California: I. Host relationships, Fifth Oak Woodland Symposium: "Oaks in California's Changing Landscape". USDA-Forest Service, San Diego, CA.
- Storer, A.J., Keirnan, K.E., Palkovsky, N.K., Hagen, B.W., Slaughter, G.W., Kelly, N.M. and Svihra, P., 2002. Diagnosis and Monitoring of Sudden Oak Death. Pest Alert #6, UC Cooperative Extension and the California Oak Mortality Task Force.
- Svihra, P., 1999. Tanoak and coast live oak under attack. *Oaks 'n' folks*, 14(2): 1.
- Werres, S., R. Marwitz, W.A. Man In 'T Veld, A.W.A.M. DeCock, P.J.M. Bonants, M. DeWeerd, K. Theeman, E. Ilieva, and R.P. Baayen. 2001. *Phytophthora ramorum* sp. nov. a new pathogen on *Rhododendron* and *Viburnum*. *Mycological Research*, v. 105(10):1155-1165

Armillaria: A Pathogen of Trees and Natural Component of Oak Woodlands

K. A. Jacobs, Plant Pathologist,
The Morton Arboretum,
4100 Illinois Route 53, Lisle, IL 60525;
(630) 719-5646; kjacobs@mortonarb.org

Armillaria, known as the oak-root fungus and honey mushroom, causes a root and butt rot disease of over 700 species of woody plants (Sinclair et al. 1987). It was first recognized as a pathogen in the late 1800s in Europe and early 1900s in the United States when attempts to develop nurseries, orchards and vineyards failed due to the disease. The genus *Armillaria* has come into prominence recently because it contains the world's largest living organisms. An individual clone of *A. gallica*, a species distributed in much of eastern North America, was thought to be giant when researchers discovered that it covered about 15 ha (38 ac.) in Michigan's Upper Peninsula (Smith et al., 1992). Since then, an immense clone of another *Armillaria* species, *A. ostoyae*, has been found covering 869 ha (2,200 ac.) in mixed conifer forests of Oregon's Blue Mountains (G. Filip, Oregon State Univ., pers. comm.). This clone is believed to be at least 2400 yrs. old! The role an organism so large and long-lived plays in plant communities must be substantial, although it is not often considered due to its mostly subterranean and therefore, invisible existence. In this paper I discuss the biology of *Armillaria* and describe its diagnostic features to assist in its identification and increase awareness of how it may impact, or be impacted, by efforts to manage and preserve oaks woodlands. Specific guidelines for controlling *Armillaria* root rot are provided at the close of the paper.

Armillaria Pathology and Biology

Armillaria is now understood to be a collection of species, about 40 worldwide, that exhibit varying degrees of pathogenicity (the ability to cause disease). Aside from their primary role as decomposers assisting in nature's grand scheme of sequestering and recycling carbon, *Armillaria* kills trees. Trees of all ages can be attacked and the progression of disease is as follows: first small roots are infected, then the cambial region beneath the bark of large roots, and the lower trunk or butt log is colonized—often belowground. Colonization of the entire root system may take months to decades depending upon the size and susceptibility of the host, the aggressiveness of the *Armillaria* species, and soil conditions. New trees may become infected as healthy roots come in contact with colonized roots or rhizomorphs (dark, root like infective structures that grow in soil, along roots and underneath bark). Rhizomorphs may grow up to 2 m (6 ft) a year and are found primarily in the upper 30 cm (1 ft) of soil and rarely below 60 cm (2 ft) (Morrison, 1976; Redfern, 1973). They also may grow underneath the bark of dead and dying trees to a height of several meters. Eventually *Armillaria* begins fruiting, i.e., producing mushrooms, on or around its host and over time and following host death, *Armillaria* will begin to cause a white rot of the wood. Few pathogens can colonize both living and dead tissue; *Armillaria* is one of them!

The likelihood of root rot increases substantially in trees stressed from drought, defoliation, other diseases, over watering, soil compaction, construction damage, and numerous other abiotic and biotic factors. Native species and exotics alike are more susceptible to infection when planted in plantations and artificial landscapes that are subjected to multiple stress factors. Exotic species are inherently at risk because they have not evolved a "balance" with the endemic *Armillaria* species, and the presence of several species or clones of *Armillaria* further broadens the range of susceptible hosts.

Stress predisposes otherwise healthy plants to disease in part because of the need for plants to reallocate energy reserves away from defense against pathogens (Bazazz, et al. 1987; Herms and Mattson, 1997). Some specifics of this phenomenon have been described for *Armillaria*-host interactions. For example, compared to healthy trees, maples and oaks stressed by gypsy moth defoliation had lower levels of antifungal enzymes and higher levels of

Armillaria-stimulating sugar in roots (Wargo, 1972; 1981). Stressed trees are unable to maintain biochemical barriers that block the enzymes *Armillaria* produces during infection (Wargo, 1984). Like gypsy moth, other defoliators including the oak leaf roller and powdery mildew fungi, reduce photosynthesis and predispose oak trees to infection (Day, 1927; Staley, 1965). Numerous other insect pests and fungi that attack tree trunks and branches and pathogens that cause wilts can worsen or be worsened by *Armillaria*. Examples include *Nectria* canker, two-lined chestnut borer, *Leptographium* root rot and bark beetles (Wargo and Harrington, 1991). Managing these pests and diseases will help to manage *Armillaria*.

Severe drought is the most common abiotic (non-living) stress that predisposes oaks in woodlands and forests to *Armillaria* root disease. This has been well documented in the mixed oak forests of the Eastern United States. The legendary drought of 1925, in which annual precipitation was 40% less than normal, and the 1985-88 droughts, in which annual precipitation was 25% less than normal, were followed by widespread *Armillaria*-induced mortality of scarlet, red and black oak (Clinton et al., 1993; Hursh and Haasis, 1931). Of course, drought and other naturally occurring weather events cannot be prevented. However, root disease can be minimized if efforts are directed at maintaining plant and community health before and after stressful events occur. This requires periodic assessment of tree health and should include more than above ground measures. Evaluation of the "landscape beyond ground", including root biomass, soil structure, soil nutrient status, occurrence of mycorrhizae and soil-borne pathogens such as *Armillaria*, will provide an accurate picture of the true health of an individual tree or a woodland community.

Man-made stresses may act like other abiotic and biotic stresses to augment *Armillaria* disease. Forests and woodlands that are over-thinned have hotter, drier soils, and more sun-scall and winter injury compared to unmanaged stands. These conditions collectively were found to stress mixed oak stands and encourage *Armillaria* disease (Gottschalk, 1989). Fire suppression and logging and the resulting build-up of stumps and debris led to increased *Armillaria* root and butt rot in national forests and parks in the United States (Byler et al. 1990; Slaughter and Rizzo, 1999). The practice of periodic burning of woodlands and forests may help keep *Armillaria* at bay due, in part, to the burning of potential substrates that *Armillaria* needs for food and by directly killing rhizomorphs (Filip and Yang-Erve, 1997). At the Morton Arboretum in Illinois, we have found that annual burning of a dry mesic oak woodland not only kills rhizomorphs, but appears to reduce *Armillaria* mushroom production (Table 1).

Table 1.

Comparative abundance of *Armillaria* mushrooms in 10 burned and 10 unburned plots.

Treatment	Plot frequency (% of plots with mushrooms)		Average density (number of collections per plot)	
	2000	2001	2000	2001
Unburned	0.3	0.5	2.0	8.0
Burned	0.3	0.3	1.0	2.3

Burning may also inhibit *Armillaria* indirectly by the alkaline pH of post-burn ash leachates and the influx of antagonistic microbes including *Trichoderma* spp. (Reaves et al., 1984; 1990). Perhaps periodic burning and even targeted burning of stumps and debris may be a useful tool for natural areas land managers who identify an *Armillaria* problem.

Over watering is the most common stress leading to *Armillaria* outbreaks in landscaped areas that are usually watered in accordance with the needs of turfgrass. Too much moisture can have a detrimental effect on trees because it reduces root growth due to the lack of soil oxygen (Kozlowski and Pallardy, 1997). Trees adapted to woodland conditions, e.g. oak, are



Figure 1. 1880 map of the distribution of *Quercus* in North America (excluding Mexico) showing the numbers of oak species in each region, beginning with one species in the lightest zone and ending with 14 or more species in the darkest zone.

Source: Sargent, C.S. 1884. Report on the forests of North America. vol. 9 of the 10th United States Census, 1880. Gov. Printing Office, Washington D.C.

especially vulnerable. In contrast, dry conditions can kill mycelial fans of *Armillaria* and for this reason control guidelines sometimes state that partial excavation of soil around infected trunks will delay the progression of disease (Horne, 1914; Shurtleff, 1987). In fact, ethanol that forms in the rhizosphere of over watered and flooded plants may actually stimulate *Armillaria* growth (Weinhold, 1963). Replacing turf with a 7.5-10 cm (~3-4 in) mulch layer (kept away from the trunk) below the dripline of trees in landscapes may help to reduce overwatering stress and keep the balance between tree and *Armillaria* in favor of the tree.

Armillaria and Oak

The affinity of *Armillaria* for moist, cool conditions is an important factor in its distribution worldwide. Most *Armillaria* species occur in temperate and boreal forests and woodlands, and those existing in tropical regions are found at upper elevations (Kile et al., 1991). On a local scale, *Armillaria* diseases occur on wooded sites or sites that were once wooded. An association of *Armillaria* with native woody plants, including the genus *Quercus*, was noted long ago by pathologists such as the pioneering Robert Hartig who noted the commensalistic (neither detrimental nor beneficial) relationship between *Armillaria* and native trees and first described *Armillaria* root rot on introduced pines in Germany (Hartig, 1874). He wrote "*Armillaria* is found especially frequent on roots and crowns of native beech, hornbeam, oak, birch and mountain ash...of a completely secondary nature". Similar early references may be found from the United States. Hendriksen (1925) in speaking about California and Oregon states that "*Armillaria* exists in an oak tree, but does not kill it..." and "...so long as its native host is alive, the fungus does not leave it to attack fruit trees". It was in California that *Armillaria* was labeled the oak-root fungus and the relationship between oak woodlands and *Armillaria* root disease became legend (Gardner and Raabe, 1963). Indeed, the general distribution map of *Quercus* in North America created by C.S. Sargent for the U.S. Census in 1880 (fig 1) overlaps with reports of *Armillaria* disease in economic hosts (fig 2).

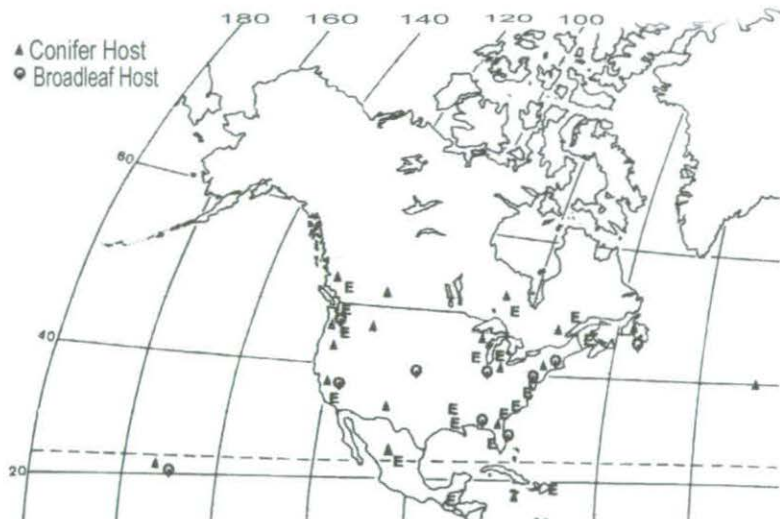


Figure 2. *Armillaria* infections recorded on hosts planted in parks, gardens, former woodlands, etc. Figure adopted from: Hood, I.A., Redfern, D. B. and G. A. Kile 1991. *Armillaria* in Planted Hosts. Pp 123-149. In C. G. Shaw III and G. A. Kile (eds), *Armillaria* Root Disease. U.S.D.A. Agric. Hdbk 691, Wash. D.C.

How long has there been an association between *Armillaria* and *Quercus*? Ancestors of both appear to have emerged some 50 to 80 million years ago. Fossils of mushroom-like gilled fungi have been discovered in 80 million year old (Cretaceous) formations and, based on DNA evidence, are believed to be the earliest ancestor of modern mushroom fungi (Hibbett et al, 1997). The earliest oak fossils appear somewhat later during the Eocene and Oligocene epochs (55-25 million years ago) (Crepet and Nixon, 1989). Perhaps the movement of ancestral *Armillaria* species was, in some cases, linked to that of *Quercus* that extended into Eurasia from the North American continent via Tertiary period land bridges (Crepet and Nixon, 1989). Indeed, two modern *Armillaria* species (*A. mellea* and *A. gallica*) are widely distributed in mixed hardwood forests containing oak on both continents. Current host specializations and the varying degrees of parasitism existing between *Armillaria* and oak are descendents of

ancestral plant-fungi interactions and the result of co-evolution (see Pirozynski and Hawksworth, 1988). Early plants probably relied upon nutrients released from saprophytic (decomposer) fungi while the plants provided fungi with a source of fixed carbon (Taylor and White, 1989). *Armillaria*, unusual in their capacity to be both saprophytic and parasitic, would have been well-prepared to co-evolve with plants and ensure their evolutionary survival.

Three *Armillaria* species prevail in oak woodlands and are commonly found on oak: *A. mellea*, *A. gallica* (= *A. bulbosa*), and to a lesser degree, *A. tabescens*. All three species infect many other genera and it is difficult to determine if oak is, in fact, a preferred host. Anecdotal evidence suggests that oaks are often the foci of large disease centers, and it appears that species in the red or black oak subgenus are most vulnerable to attack. However, comparative studies of the susceptibility of different oak species are scarce and additional data are needed. Many *Armillaria* species worldwide are not pathogens of oak. *A. ostoyae*, for example, may grow in mixed oak forests but it attacks, almost exclusively, conifers. Australian species, including *A. luteobalina*, are partial to the indigenous *Myrtaceae* found 'down under'.

It's safe to assume that most oak woodlands, forests and their derived landscapes can claim at least one *Armillaria* species. In natural areas, *Armillaria* contributes to a balanced, or endemic, level of disease that drives succession by creating small canopy gaps and influencing stand structure and composition. (Castello et al., 1995; Lundquist and Negron, 2000; van der Putten et al. 1993). However, *Armillaria* may overwhelm a community that is exposed to prolonged, or numerous, stresses. For example, in Australian coastal woodlands in which *A. luteobalina* is the primary pathogen and *Banksia* and *Acacia* are its indigenous hosts, an entire woodland nearly collapsed from attack by *Armillaria* and detrimental factors associated with its proximity to urban areas. *Armillaria* killed off dominant tree species and produced too many canopy gaps and bare ground that encouraged increases in sedges/ground cover species, wind erosion and weed invasion (Shearer et al., 1997).

Identifying and Managing *Armillaria*

In the Chicago metropolitan area most urban woodlands are (or were) dominated by oak and are likely harbor at least one *Armillaria* species. Its presence magnifies the effects of other pressures imposed upon the urban forest by urbanization. These include heavy visitation, soil compaction, vegetation damage, construction disturbance, alteration of site hydrology, increased number and variety of invasive plants, etc. Vital socio-economic and environmental benefits of sustaining the urban forest are recognized (Dwyer et al., 1994) and *Armillaria* ought to be considered as one of many potential threats to this goal.

Armillaria can be managed, but it is unlikely to be eradicated. The first step toward management is recognizing its signs and symptoms. There is a certain amount of variation among these global toadstools, but they can be readily identified to genus by several macroscopic features (no need for a microscope!):

- honey-colored mushrooms (fig 3) that produce white spore prints and are formed (mostly) in clusters;



Figure 3. Clusters of *Armillaria* mushrooms at base of tree.

Photo courtesy of author.

- blackened (sometimes reddish) rhizomorphs (fig. 4), the so called "shoe-strings" that develop from fans or mushrooms and grow along roots, through the litter layer, soil, and underneath bark;

- a creamy white mycelial mat or "fan" (fig. 5) confined to the cambial region underneath bark of tree trunks and large roots;

- white rot of wood produced in the basal log and large roots of trees after they have died.

Mushroom characteristics including the presence and form of a ring on the mushroom stem (stipe), scales on the cap and host species can help to determine the species of *Armillaria* present. This is important for assessing the relative disease threat in an area as some species, e.g. *A. mellea*, are more pathogenic than others, e.g. *A. gallica*. Dr. Tom Volk, University of Wisconsin, has developed a website (TomVolkFungi.net) with pictures and descriptions of all *Armillaria* species in North America.

Sometimes infected trees may appear to die suddenly, like a wilt, even though colonization of the roots and above ground symptoms has been developing for a long time (years or decades). The first clue to a problem is usually seen in the canopy. Symptoms result from root death and include: yellow or off-color,

sparse foliage; slowed growth manifest as shorter stem internodes; gradual twig and branch death; and gradual canopy decline. On the surface of infected trunks, bark may be loose, and on coniferous hosts especially, bark may be cracked with resin and exudates present. If there are no signs of



Figure 4. Black *Armillaria* rhizomorphs and underlying white rot of wood.

Photo courtesy of author.



Figure 5. White mycelial fan of *Armillaria*.

Photo courtesy of Univ. of California

Armillaria (remember that mushrooms are produced only once a year- during autumn in Illinois and the Eastern U.S.), but a tree is declining, look for rhizomorphs in the soil around the trunk and mycelial fans underneath the bark of the trunk and large roots below the soil line. Unfortunately, there isn't a strong correlation between above-ground symptoms and the extent of root colonization and it is hard to predict when an infected tree will die. If the basal portion of a tree has mycelial fans, death can be assumed to be imminent. See The Morton

Arboretum's Plant Health Care Reports (index at www.mortonarb.org) or various university extension leaflets for more information and pictures to aid in recognizing *Armillaria*.

Below is a list of guidelines for managing *Armillaria*:

1. Invest in preventative measures to minimize stress. This is the single most important tool for managing *Armillaria* disease, as it will help prevent colonization in the first place. For example,

- Avoid drastic thinning practices that might increase the likelihood of winter injury, wind damage, etc.
- Reduce weeds (especially woody invasive plants) to diminish competition for resources. Be aware that incomplete removal of stumps and resprouts may provide substrate to *Armillaria* (we have found this to be the case for buckthorn, *Rhamnus cathartica*, in Illinois).
- Prevent construction damage to trees that causes soil compaction and alters a site's hydrology when building on or near woodland habitats.
- Prune moderately as over-pruning (e.g. more than 1/4 to 1/3 of a tree's canopy at one time) is stressful and has been directly related to increased *Armillaria* disease.
- Do not over water or wound trees in landscapes.
- Practice good planting practices and horticultural care, e.g. mulching, watering and fertilizing only if necessary.
- Encourage root system development by planting smaller trees and using container stock. The increased surface area that comes from great numbers of small roots can help to alleviate stress from droughts.

2. Remove dead and dying trees, stumps, woody debris, roots and rhizomorphs from the upper soil layers. *Armillaria* can utilize the host materials as a food base for many years.

3. Replant with tolerant or resistant hosts that are suited to a given site. See the University of Illinois Report on Plant Disease (http://www.ag.uiuc.edu/~vista/pdf_pubs/) and Raabe (1962, 1979 a,b) for lists.

4. Monitor regularly for insect pests and diseases in order to respond rapidly to outbreaks. Remove winter-killed and cankered branches and diseased leaves. If need be, apply least toxic insecticides at appropriate times to control defoliating and boring insects.

5. Ask for and support development of environmentally-sound methods of controlling *Armillaria* and other predisposing diseases and pests. Biological control mixtures of antagonistic fungi and nematodes have been proven to be effective against *Armillaria*, but remain only available experimentally.

6. Trees already infected with *Armillaria* can be treated by removing soil from around trunks bases to expose the fungus to drier and hotter conditions. The longevity of this treatment is unknown.

7. Treating stumps with fungicides and soils with fumigants has been useful in orchards and plantations. Be sure to follow the label restrictions. Spot burning of stumps and debris may be an alternative means of getting rid of *Armillaria* and potential substrates.

Literature Cited

- Bazazz, F. A., Chiariello, N. R., Cley, P. D. and L. F. Pitelka. 1987. Allocating resources to reproduction and defense. *Bioscience* 37: 58-67.
- Byler, J. W., Marsden, M. A. and S. K. Hagle. 1990. The probability of root disease on the Lolo National Forest, Montana. *Canadian Journal Forest Research* 20: 987-994.
- Castello, J.D., Leopold, D. J. and P.J. Samillidge. 1995. Pathogens, patterns, and processes in forest ecosystems. *BioScience* 45: 16-24.
- Clinton, B. D., Boring, L. R. and W. T. Swank. 1993. Canopy gap characteristics and drought influences in oak forests of the Coweeta Basin. *Ecology* 74: 1551-1558.
- Crepet, W. L. and K. C. Nixon. 1989. Earliest megafossil evidence of Fagaceae: phylogenetic and biogeographic implications. *American J. Botany* 76: 842-855.
- Day, W. R. 1927. The oak mildew *Microsphaeria quercina* and *Armillaria mellea* in relation to the dying back of oak. *Forestry* 1: 108-112.
- Dwyer, J. F., McPherson, E.G., Schroeder, H. W. and R. A. Rowntree. 1994. Assessing the benefits and costs of the urban forest. *J. Arboriculture* 18: 1-8.
- Gardner, M. W. and R. D. Raabe. 1963. Early references to *Armillaria* root rot in California. *Plant Disease Reporter* 47: 413-415.
- Gotschalk, K. W. 1989. Effects of previous stand management on mortality following gypsy moth defoliation: preliminary results. Pp.573-578 In Miller, J.H. (comp.), Proc. of 5th Biennial Southern Silvicultural Research Conference. Memphis, TN, U.S.A., Nov. 1988. USDA For. Serv. Gen Tech Rep. SO-74.
- Graham, A. 1993. History of the vegetation: Cretaceous -Tertiary. Pp.57-70 In Flora of North America, Oxford University Press, New York.
- Hartig, R. 1874. Important Diseases of Forest Trees- Contributions to Mycology and Phytopathology for Botanists and Foresters. 127 p. [Translated as Phytopathological Classics No. 12. 1975. American Phytopathological Society, St. Paul, MN, U.S.A.]
- Herns, D. and W. Mattson, 1997. Trees, Stress, and Pests. Pp.13-25 In Plant Health Care, International Society of Arboriculture and University of Illinois, Champaign
- Hibbett, D. S., Pine, E. M., Langer, E., Langer, G. and M. J. Donoghue. 1997. Evolution of gilled mushrooms and puffballs inferred from ribosomal DNA sequences. Proc. National Academy of Science. 94: 12002-12006.
- Horne, W. T. 1914. The oak fungus disease of fruit trees. California Dept. Agriculture, The Monthly Bulletin III: 275-283.
- Hursh, C.R. and F. W. Haasis. 1931. Effects of 1925 summer drought in southern Appalachian hardwoods. *Ecology* 12: 380-386.
- Kile, G. A., McDonald, G. I. And J. W. Byler. 1991. Ecology and Disease in Natural Forests. Pp.102-121 In C. G. Shaw III and G. A. Kile (eds.), *Armillaria Root Disease*. U.S.D.A. Agric. Hdbk 691, Washington, D.C., U.S.A.

- Kozlowski, T. T. and S. G. Pallardy. 1997. *Physiology of Woody Plants*. (2nd ed.) Academic Press, San Diego, CA, U.S.A. 411 p.
- Lundquist, J. E. and J. F. Negron. 2000. Endemic forest disturbances and stand structure of Ponderosa pine (*Pinus ponderosa*) in the Upper Pine Creek Research Natural Area, South Dakota, USA. *Natural Areas Journal* 20: 126-132.
- Morrison, D. J. 1976. Vertical distribution of *Armillaria mellea* rhizomorphs in soil. *Trans. of the British Mycological Society* 66: 393-399.
- Pirozynski, K.A. and D. L. Hawksworth. 1988. Co-evolution of fungi with plants and animals: Introduction and overview. Pp.1-23 In (K. A. Pirozynski and D. L. Hawksworth (eds.), *Co-evolution of Fungi with Plants and Animals*. Academic Press, London, England.
- Raabe, R. D. 1962. Host list of the root rot fungus, *Armillaria mellea*. *Hilgardia*: 33: 25-88.
- Raabe, R. D. 1979a. Resistance or susceptibility of certain plants to *Armillaria* root rot. Cooperative Extension Service Leaflet No. 2591. University of California, Berkeley. 11 p.
- Raabe, R. D. 1979b. Some previously unreported hosts of *Armillaria mellea* in California (USA). *Plant Disease Reporter* 63: 494-495.
- Reaves, J. L., Shaw, C. G., III and J. E. Mayfield. 1984. Effects of ash leachates on growth and development of *Armillaria mellea* in cultures. U.S.D.A. Pacific Northwest Forest & Range Experiment Station Research Note. 419. 11 p.
- Reaves, J. L., Shaw, C. G., III and J. E. Mayfield. 1990. The effects of *Trichoderma* spp. isolated from burned and non-burned forest soils on the growth and development of *A. ostoyae* in culture. *Northwest Science* 64: 39-44.
- Redfern, D. B. 1973. Growth and behavior of *Armillaria* rhizomorphs in soil. *Trans. British Mycological Society* 61: 569-581.
- Shearer, B. L., Crane, C.E., Fairman, R.G. and M. J. Grant. 1997. Occurrence of *Armillaria luteobubalina* and pathogen mediated changes in coastal dune vegetation of south-western Australia. *Australian J. Botany* 45: 9050-917.
- Slaughter, G. W. and D. M. Rizzo 1999. Past forest management promoted root disease in Yosemite Valley. *California Agriculture* 53: 17-24.
- Shurtleff, M. C. 1988. *Armillaria* root rot of trees and shrubs. University of Illinois Cooperative Extension Service Report on Plant Diseases. Report on Plant Diseases No. 602. 8 p.
- Sinclair, W. A., Lyons, H. H. and W. T. Johnson. 1987. *Diseases of Trees and Shrubs*. Cornell Univ. Press, Ithaca, NY, U.S.A.. 575 p.
- Smith, M. L., Bruhn, J. N. and J. B. Anderson. 1992. The fungus *Armillaria bulbosa* is among the largest and oldest living organisms. *Nature* 356: 428-431.
- Staley, J. M. 1965. Decline and mortality of red and scarlet oaks. *Forest Science* 11: 2-17.

- Taylor, T. N. and J. F. White, Jr. 1989. Fossil Fungi (*Endogonaceae*) from the Triassic of Antarctica. *American J. of Botany* 76: 389-396.
- Van der Putten, W. H., Van Dijk, C. and Peters, B. 1993. Plant-specific soil-borne diseases contribute to succession in forest dune vegetation. *Nature* 362: 53-56.
- Wargo, P. M. and T. C. Harrington. 1991. Host Stress and Susceptibility. Pp. 88-101 In C. G. Shaw III and G. A. Kile (eds.), *Armillaria Root Disease*. U.S.D.A. Agric. Hdbk 691, Washington, D.C.
- Wargo, P.M. 1972. Defoliation induced chemical changes in sugar maple roots stimulate growth of *Armillaria mellea*. *Phytopathology* 762: 1278-1283.
- Wargo, P.M. 1981. Defoliation and secondary-action organism attack with emphasis on *Armillaria mellea*. *J. Arboriculture* 7: 64-69.
- Wargo, P.M. 1984. How stress predisposes trees to attack by *Armillaria mellea*-a hypothesis. Pp. 115-121 In G. Kile (ed.) Proc. IUFRO 6th International Conference on Root and Butt Rots of Forest Trees. August 25-31, 1983, Melbourne, Australia.
- Weinhold, A. R. 1963. Rhizomorph production by *Armillaria mellea* induced by ethanol and related compounds. *Science* 142: 1065-1066.
- Jacobs, 8

Aiken, South Carolina - Oak City, U.S.A.!

Bob McCartney,
Woodlanders, Inc.
1128 Colleton Ave.,
Aiken, S.C. 29801

Aiken, South Carolina was honored to have the International Oak Society visit our city during their post-conference field trip in October of 2000. Conference hosts organized this trip to the warmer climate region of coastal South Carolina and Georgia so members could see noteworthy oak specimens and view an additional variety of oak species.

Aiken, a town of about 26,000 is located in the Fall Line Sandhills of South Carolina about 15 miles from Augusta, Georgia. The Fall Line Sandhills are an ancient coastline with high rolling hills of deep, sandy soil. Lying between the relatively flat Coastal Plain and the rolling dry hills of the Piedmont Plateau, the Sandhills once supported an extensive forest of longleaf pine (*Pinus palustris*) maintained by relatively frequent ground fires. Originally ignited by lightning and later also by humans, these low-intensity fires burned unimpeded over vast areas and maintained a uniquely adapted ecosystem. With land-use changes and fire suppression, this ecosystem has almost disappeared. Many fire-adapted species that characterized this ecosystem have become quite rare.



Fig. 1. A majestic old sand post oak (*Quercus margaretta*) preserved along a street in Aiken, SC.
Photo copyright Guy and Edie Sternberg

Many oak species are native in the Sandhills region and in the absence of fire have become more abundant. On xeric upland sites the common species include turkey oak (*Quercus laevis*), sand post oak (*Q. margaretta*), and bluejack oak (*Q. incana*). Where there is more clay in the soil, blackjack oak (*Q. marilandica*) may be present. On steeper slopes with better soil and where fire was less frequent, southern red oak (*Q. falcata*), scarlet oak (*Q. coccinea*), post oak (*Q. stellata*), black oak (*Q. velutina*), and white oak (*Q. alba*) occur with water oak (*Q. nigra*). On some upland sites Darlington Oak (*Q. hemisphaerica*) is common. Locally common in the Sandhills is a shrub or small- to medium-sized tree in the live oak (*Q. virginiana*) complex. Occasionally with quite pendulous branches or with very small leaves, this plant

may merit further taxonomic study. Finally, the floodplains of larger rivers such as the Savannah River harbor other oak species such as the cherrybark oak (*Q. pagoda*), overcup oak (*Q. lyrata*), laurel oak (*Q. laurifolia*), and swamp white oak (*Q. michauxii*).

Virtually all of these oaks, including many large specimens, are growing in Aiken. In addition, there are many non-native species in the broad tree-filled parkways, large private properties, and parks throughout the city. This provides an unusually diverse and healthy urban forest. Most of the native oaks can also be found growing naturally within the 2000 acre Hitchcock Woods Preserve almost in the middle of Aiken. Chestnut oak (*Q. montana*) and northern red oak (*Q. rubra*), both uncommon in the area, can be found in Hitchcock Woods.

Building on the extensive variety of oaks already in Aiken, Woodlanders Inc., an international source for rare and hard-to-find plants, has, over the past two decades, added steadily to the



Fig. 2. A young bluff oak (*Quercus austrina*) planted by Bob McCartney along a boulevard in Aiken, SC.

Photo copyright Guy and Edie Sternberg



collection. From seed collections throughout the South and from various sources, Woodlanders has grown and planted out an increasingly diverse selection of oaks and oak relatives. In recent years, the International Oak Society, through generous assistance of Guy Sternberg and Ron Lance, has made it possible for Woodlanders to obtain acorns of many additional oak species from around the world. These are being grown and planted out. With attention to soil and site conditions, the mild climate of Aiken makes it possible to grow many kinds of evergreen oaks and oak relatives that are not hardy enough to be planted further north.

Within the last few years, Woodlanders, working with the City of Aiken, has established a

Fig. 3. A mature Darlington oak (*Quercus hemisphaerica*) preserved as a street tree in Aiken, SC.

Photo copyright Guy and Edie Sternberg

one-mile-long linear planting of new oak species in a broad grass strip along Park Avenue on the east side of Aiken. Spaced at about 70 feet apart, these plants represent species and hybrids not previously found here. Included are both evergreen and deciduous trees with many western, southwestern, Mexican, European, and Asian species represented. Mature sizes will vary from quite small to quite large. Additional species now in production are scheduled to be established in another linear planting strip nearby.

This collection and these trees will surely prove to be an attractive asset to the community for years to come. With careful documentation, it will become a useful resource for urban foresters, horticulturists, gardeners, botanists, and serious students of the genus *Quercus*.

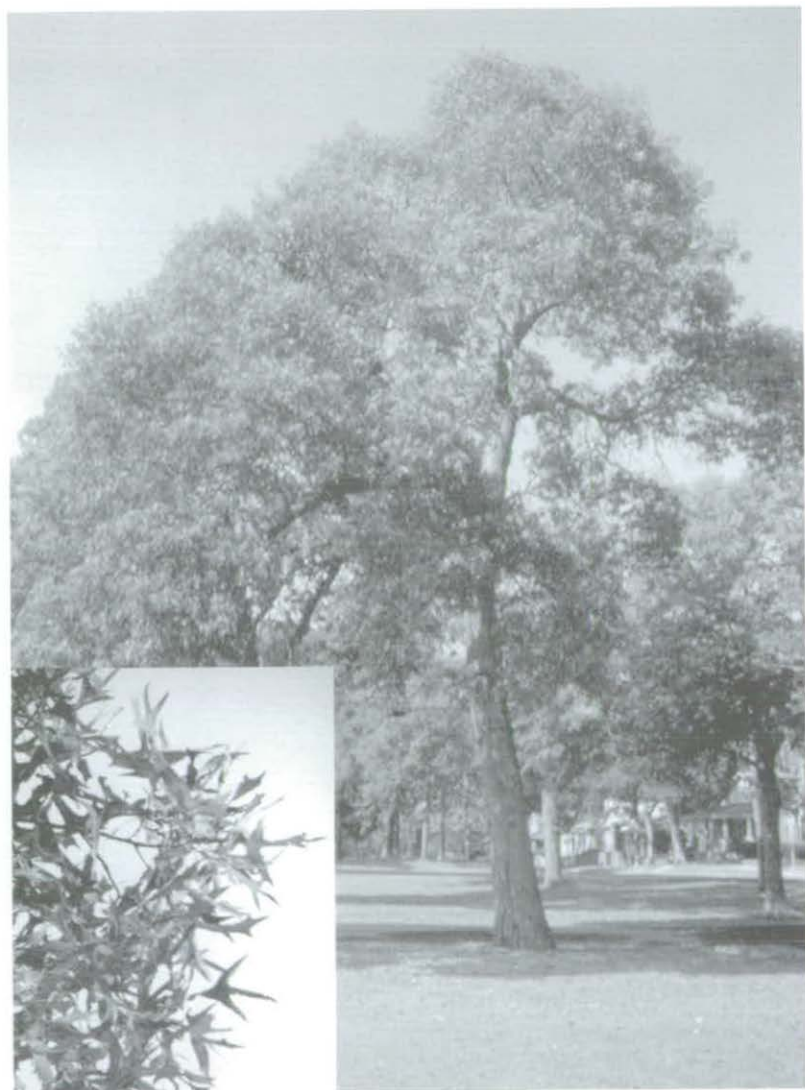


Fig. 4. A very large turkey oak (*Quercus laevis*) preserved as a street tree in Aiken, SC.

Photo copyright Guy and Edie Sternberg



Fig. 5. An Asian ring-cupped oak (*Quercus salicina*) originating from plants brought from Nagasaki, Japan, planted by Bob McCartney in Aiken, SC.

Photo copyright Guy and Edie Sternberg



Fig. 6. Monterey oak (*Quercus rhysophylla*) from Northeast Mexico, planted by Bob McCartney in Aiken, SC.

Photo copyright Guy and Edie Sternberg

OAKS AND OAK RELATIVES PLANTED OUT IN AIKEN, SC:

Oak Relatives

Castaneaopsis cuspidata
Lithocarpus edulis
L. chinensis
L. glaber
L. henryi
L. kawakami

Oaks, Various locations

Quercus acuta
Q. alba
Q. austrina
Q. chapmanii
Q. coccinea
Q. durandii
Q. falcata
Q. geminata
Q. hemisphaerica
Q. hypoleucoides
Q. laevis
Q. margaretta
Q. marylandica
Q. michauxii
Q. minima
Q. mohriana
Q. myrsinaefolia
Q. nigra
Q. oglethorpensis
Q. palustris
Q. phellos
Q. pumila
Q. rubra
Q. salicina
Q. shumardii
Q. sp. (Chiricahua Mtns, AZ)
Q. stellata
Q. velutina
Q. virginiana

One mile planting along R.R. (W to E)

Quercus sartorii x *canbyi*
Q. dalechampii
Q. agrifolia
Q. schotkyana
Q. pungens
Q. polymorpha
Q. glauca
Q. incana
Q. sp. (Querretaro, Mexico)
Q. arkansana

Q. castanea x *sapotifolia*
Q. ilicifolia
Q. montana
Q. robur 'Fastigiata'
Q. canariensis
Q. polymorpha
Q. myrtifolia x *nigra*
Q. virginiana x *lyrata* (*Q. xcomptonae*)
Q. rhyssophylla
Q. georgiana
Q. obtusata
Q. sartorii
Q. lyrata
Q. phillyreioides
Q. pagoda
Q. bicolor
Q. laceyi
Q. muhlenbergii
Q. imbricaria
Q. ilex
Q. graciliformis
Q. fusiformis
Q. cerris
Q. affinis
Q. virgiliana
Q. pubescens var. *anotolica*
Q. sartorii
Q. prinoides
Q. grisea
Q. gravesii
Q. vaseyana
Q. polymorpha (S. Texas source)
Q. oblongifolia
Q. faginea
Q. arizonica
Q. nuttallii
Q. sinuata breviloba
Q. xlibanerris
Q. robur x *dalechampii*
Q. inopina
Q. muhlenbergii (Mexico)
Q. sp. (Mexico)
Q. myrtifolia
Q. engelmannii
Q. laurifolia
Q. pungens
Q. marylandica var. *ashei*
Q. undulata
Q. tomentella
Q. emoryii

Some species in one-mile planting along railroad may also be found at other locations elsewhere in Aiken. Also, some naturally-occurring hybrids may not be listed here. Many additional oak species are being grown and are being added to this list as they are planted.

Editor's note: This article by Mike Dahl is a special treat for readers who enjoy historical accounts. It is written in the vernacular form of a Tennessee storyteller's true account of a famous old oak and its historic context, with details of current efforts to preserve both. The text has been minimally edited, in order to preserve the colorful flavor that is unique to this Southern cultural literary style.

Spaces Between the Footsteps The Pemberton Oak

Mike Dahl

Overmountain Victory Trail Association
P.O. Box 242421
Charlotte, NC 28244

In 1975, a small group of people took their first steps toward a dream they shared. On September 24th of that year, they stood together at a place called Dunn's Meadows near downtown Abingdon, Virginia. Their dream and all that it might encompass lay right there before them. All they had to do was take that first step. They did.

The Overmountain Victory Trail Association (OVTA) was born that year. Their dream: to make sure the story of the Overmountain Men and their campaign to the Battle of Kings Mountain would never be forgotten. They set out that September 24, 1975 to retrace the steps of the Overmountain Men. Steps that led them 225 miles and 14 days to a small mountain top along the South Carolina border. A small mountain called Kings Mountain. A mountain where the courage and commitment to the ideals of independence were tested on October 7, 1780. A mountain where those ideals prevailed. A mountain where the dream was born.

Its now over 25 years later. All but two of those original dreamers are gone-passed on or moved on. But the dream is still there, unchanged, undiminished, serving as the guide for a whole new set of dreamers. New dreamers who still follow the footsteps.

The story of the Overmountain Men — it is simply one of the great stories in the chronicles of the American Experience. It starts back in the latter part of the 18th century when people began moving over the Appalachian Mountains into what is now upper east Tennessee. 1770 it was. They came from Virginia, from North Carolina, from Pennsylvania. They came to this vast wilderness where none of European descent had lived before. They came to the lands of the Cherokee. They came, they built their homes, they came to stay.

They came to lands that were called the Western District of North Carolina. This western district ran from the crest of the Appalachians all the way west to the Mississippi River. They were "over the mountains" now and they became known as the Overmountain People.

The Watauga Settlement was first. Covered the modern day area of Elizabethton and Johnson City, Tennessee. The Sycamore Shoals of the Watauga River was the center of the settlement. Watauga is the Cherokee word for beautiful. The shoals had served as the primary river crossing on the Great Warrior's Path for thousands of years. The Watauga Old Fields, flat rich bottom land, stretched along the river's southern bank. The Old Fields became the heart of the new settlement. This was to become the first permanent settlement outside the original 13 colonies.

Over the next couple of years, two more settlements sprang up. The Settlements North of the River Holston, in modern day Bristol, Tennessee/Virginia (the city is split by the state lines) and the Nolichucky Settlements further south between modern day Johnson City and Greeneville, Tennessee.

By 1772 there were enough people in the Watauga Settlements that they had difficulty managing their civic affairs. Petitions to the North Carolina legislature to assist them in land disputes and criminal proceedings and military help against the Cherokee and Shawnee went unanswered. They were Over the Mountains. They were on their own.

Their solution tells us a great deal about these people. They formed the Watauga Pact and drafted a set of rules for them to live by. The first instrument "declaring self governing" to be approved on this continent. Four years before the Declaration of Independence it was.

And then the War came. The Revolutionary War. They were lucky. It started in the north and had stayed there for 5 years. They were untouched and unbothered by the travails that are a part of the landscape of war. But then things changed.

The war had drag on for 5 years. Britain's King George wanted out. It was a stalemate. The British army under General Clinton was locked down in the North against General Washington and his Continental Army. The King thought it had become too expensive to fight this war across the expanse of an ocean. The British War Minister proposed a solution. Why not sail into the southern colonies, seize the sea ports, raise an army of Loyalists from the countryside—an army they wouldn't have to pay or clothe—and then march north through the Carolinas and Virginia building the army even larger as they went and trap General Washington up against Clinton and the British red-coat regulars.

In February, 1780 the British fleet sailed into Charleston Harbor and laid siege. Charleston fell in early May. The British now had their foothold in the southern colonies. General Charles Cornwallis, appointed commander over this British southern invasion, issued a proclamation when Charleston fell.

"Any man who shall raise arms against the King, or assist others in the raising of those arms, SHALL BE SUBJECT TO HAVE HIS PROPERTY CONFISCATED."

These words began a reign of terror in the Carolinas that has not been rivaled in our country's history. Bands of Tories, the Loyalists who supported King George and adhered to the Crown's sovereignty, roamed the countryside, persecuting those they suspected of being Whigs or separatists. Riders would come into a house in the middle of the night and take what they wanted—clothing, livestock, dishes, cookware, guns....the women. The men would sometimes be beaten, sometimes killed. The peace that these people had known and had built out of the raw land was shattered and gone. Maybe forever.

And then the approach of summer of 1780. The Waxhalls in late May—the area south of what's now Charlotte, North Carolina. General Buford and his American army meet Colonel Banastre Tarlton and his mounted dragoons. Tarlton, probably the most ruthless officer in the British army. Buford's men were defeated and surrendered—raised the white flag. Tarlton rode his dragoons into their midst and with saber hacked 113 of them to pieces. The terror reached a new level.

Then Camden in August. The entire American Southern Continental Army was crushed and wiped out in one afternoon. There was nothing or no one left to protect the countryside. The British Army was on the move, northward, unstoppable. The terror grew and it spread.

A British Army major, Patrick Ferguson, was given the job of building the western wing of this Tory Army from the countryside (the mountain wing). Cornwallis was in the middle and Tarlton was at work on the right (the coastal wing).

Ferguson was a brilliant organizer and soon had over a thousand well-trained men at his disposal—the American Legion they were called. In his eyes, everything was as it should be. His army was growing and new ground was being taken. Everything except for one thing that is. Those militiamen from over the mountains who appeared out of nowhere, struck hard and fast, and then dissolved back into the darkness of the forest. Colonel Issac Shelby. Twenty-nine years old. Commander of the Sullivan County Militia of the Western District of North Carolina—the Settlements North of the River Holston. Lt. Colonel John Sevier. Commander of the Washington County Militia of the Western District of North Carolina—the Nolichucky Settlements.

Through July and August of 1780 the militias of the Overmountain Men came. They pricked Ferguson with small victories and became a constant worry. Ferguson responded in late August with a message sent by a prisoner he released:

"Lay down your arms or I will march my army over the mountain and hang your leaders and lay fire and sword to your homes and fields."

Do not doubt that that was the wrong thing to say to those people—to those Overmountain Men. The morning of September 25, 1780 saw over a thousand of those Overmountain Men

muster at the Sycamore Shoals of the Watauga River. The site is now Sycamore Shoals State Historic Park in Elizabethton, Tennessee. Colonel Shelby, 240 men. Colonel Sevier, 240 men. Colonel William Campbell of (Abingdon) Virginia, 400 men, Colonel McDowell of the North Carolina Piedmont (current day Morganton, NC), 150 men. Their purpose, their plan, was simple. Do not let Ferguson and his army cross the mountains. Find him, stop him, destroy him. That was their dream. The next morning, they took their first footsteps towards their dream.

But what does all this do with the Pemberton Oak? Captain John Pemberton commanded a company under Colonel Isaac Shelby. When the call for the grand muster at Sycamore Shoals went out, each captain mustered his company at his home or place of choosing and then they rode together to Sycamore Shoals. Captain Pemberton mustered his company at his home, beneath a large oak tree in his yard. The same tree we today call the Pemberton Oak.



Fig. 1. The old Pemberton oak as it looks today.

Photo courtesy of the author.

It is a big tree-an old tree, a white oak (*Quercus alba*). Testing by the National Park Service back about 1980 showed it to be over 500 years old. The DBH, while hard to measure because of the butt swell, is nearly 8 feet. There are huge, thick laterals that were cabled in the 1960's to prevent their breaking in high winds.

Such advanced age is pretty rare for a white oak. Indeed 300 or so years is considered advanced old growth for this species. But it stands there. Still. It's owned by Sue Vaughan, a descendent of Captain Pemberton. The farm has stayed in the Pemberton Family all these years. Sue is a sweetheart, opening her yard to all who wish to visit with the tree-pass an hour in its shade, contemplate what it has to say. Those who admire old trees have no doubt walked up to one and wrapped their arms around it to feel the age, the essence, the passing of the years. The awe! The Pemberton Oak has much to say.

The work of those dreamers back in 1975 finally bore fruit (naw, not acorns) in 1980 when President Carter signed legislation designating the route of the Overmountain Men from Abingdon, Virginia to Kings Mountain South Carolina as one of American's National Historic Trails-the Overmountain Victory National Historic Trail. It joined the ranks of Lewis and Clark, Pony Express, The Oregon Trail, the California Trail and the Mormon Trail. Respon-

sibility for managing the trail was given to the National Park Service. Their first chore was to develop a Comprehensive Management Plan that defined the trail, its associated historic sites, and how it would be taken care of. The management plan identified 34 sites along the trail that warrant preservation and protection. The Pemberton Oak is one of those sites. The Overmountain Victory Trail Association (OVTA) became the primary vehicle to take care of the trail and to.....tell it's story.

And the OVTA has been doing that for more than a quarter century now. Each year, on September 24th we take our first steps from Dunn's Meadows in Abingdon. We stop at the Pemberton Oak about 2:00 PM that afternoon and we hold muster just as Captain John Pemberton did on that same day back in 1780. We stand under the same tree and pay tribute because it is the only known living "artifact" from the Campaign of the Overmountain Men.

And then we move on down the trail, following the same route (as much as we can), camping in the same campsites (as much as we can) for the next 14 days until October 7th, the anniversary of the Battle, when we walk into Kings Mountain National Military Park at 3:00 PM in the afternoon.

We follow the footsteps. We tell the story. Boy, do we tell the story. Each day, each night, the communities turn out to feed us our meals and to hear the story of the Overmountain Men. School children, old timers, eager minds and questioning eyes regardless of age, hang on the words. For a moment or two they ride their imaginations and follow the footsteps. They explore the spaces between left foot and right where the story of the Overmountain Men, the story of America resides.

This story was brought to life last year by Charter Communications of Hickory, North Carolina and their production, in association with OVTA, of a new video called, *The Road to Kings Mountain*. A grant from Stonecutter Foundation in Spindale, North Carolina, allowed OVTA to place that video in over 100 schools along the trail just weeks before the 2001 reenactment.

The dream is being achieved by the new dreamers. The story IS being told. But wait! Stop! When we lose a piece of the trail, we can never stand on that spot and tell the story quite as well ever again. That is becoming our new dream. That is our new reality.

Of the 312 total miles in the trail, only some 50 remain that have not been covered up by modern highways or shopping centers or subdivisions. At the annual meeting in October 2000, the OVTA pledged itself to the protection and preservation of what remains-of those last 50 or so miles of the Campaign of the Overmountain Men. We have developed a trail protection plan and we have contracted to begin the GIS computer mapping of the trail. When that's done, we'll find out who owns the land. We'll find ways to work with those landowners to achieve the highest level of protection that is practical and possible. We'll keep walking the trail each year. We'll keep telling the story. We'll do our best to make sure there's as much of the trail left to stand on and tell the story from.

But I've left you hanging haven't I? Up over the mountain on the morning of September 26th, 1780. Following the Yellow Mountain Road over the crest of Roan Mountain. Down into Roaring Creek and the headwaters of the North Toe River. Down to Grassy Cove, now Spruce Pine. A choice. From here they must drop off the crest of the Blue Ridge (actually the Blue Ridge Parkway today). There are two routes. If they chose one, Ferguson and his army might be coming up the other at the same time and get in behind them. Their homes, their families would be at the mercy of Ferguson and his men. The decision is made. They split their forces. Campbell and his Virginians go down through Turkey Cove and the waters of Armstrong Creek where they spend the night of September 29th. Shelby and Sevier follow the Yellow Mountain Road down into the North Cove where they spend the night of September 29th (current OVTA president Allen Ray lives on the lands where the Overmountain Men camped that night). Shelby and Sevier receive a visitor that night, Colonel McDowell, himself. He brings word that some 350 militia men from north Central North Carolina will meet them tomorrow at his home in what is now Morganton, NC. He also brings word that Ferguson is encamped at Gilbert Town (current-day Rutherfordton, NC)-three days ride south of his home.

Then the next morning, September 30th, Shelby and Sevier up over Linville Mountain (overlooking Linville Gorge and Hawk's Bill and Table Rock). Campbell and his men follow

the North Fork of the Catawba River (north of Marion, NC). They come back together later that day and finish their march to McDowell's -Quaker Meadows is the name his home is known by. Early evening, Colonel Ben Cleveland and Major Joseph Winston ride in with their 350 men. There is great cheer in camp this night. Their army has grown. They know where their enemy is.

October 1st, on the road. Hard rain. Stop. Send out scouts. No sign of Ferguson. Decide to spend another day at the same camp. Also decide they need an overall commander—a general officer. Militias were not military men. They were volunteers who were called up or called upon to meet some emergency or community need. Enlistments ranged from 30 to 90 days. When the job was done, they went home. They were not issued uniforms or arms. They came to the muster at Sycamore Shoals with their own food, own rifles, own horses, own resolution to bring this business to an end.

So, on October 2nd, 1780 Colonel William Campbell of Virginia was selected to lead the campaign of the Overmountain Men. He had traveled the furthest, brought the most men, and, was the only colonel not from North Carolina. He was the likely choice.

The next morning, October 3, the chase resumed. Traveled about five miles and camped along the waters of Cane Creek. Most important now to get scouts out and not be trapped or ambushed by Ferguson. Next morning October 4, approach Gilbert Town prepared to do battle. Ferguson is gone. Has been gone since late September. Heads hang. Disappointment covers the ranks. They've been on the road over a week now. Snow on top of the Roan. Hard rain the last two-and-half days. Food's almost gone. Eating parched corn and jerky. They are chasing a ghost across the countryside. They are following a thousand-man army. There is nothing left to eat. They are tired. They are hungry. Their dream is dimming.

The pursuit begins anew the next morning. Travel 15 miles or so. Camp at Alexander's Ford of the Green River (south of Rutherfordton, NC). Middle of the night. A rider comes in yelling loudly for the camp commanders. The sentries almost shoot him. He is blindfolded and taken to Shelby and Sevier and Campbell. He is Colonel William Lacy of the South Carolina militia who has been tracking Ferguson. His men have captured scouts taking a message from Ferguson to Cornwallis. The message asks for reinforcements (Tarleton and his murderous dragoons?) and says that he is retreating towards Charlotte and Cornwallis's headquarters by way of the road passing Kings Mountain.

Lacy suggests they meet up the next day at the Cowpens in South Carolina—a Tory-owned gathering place for cattle to be shipped to market in Charleston. Lacy and his men arrive in the afternoon. The Overmountain Men arrive just after sunset. They have ridden 29 miles this day. It is the evening of October 6th. It is their thirteenth day on the campaign. It begins raining. Harder. The night is dark—the first quarter moon was two days ago on the 5th.

The best 900 men, the best 900 horses, are selected. The drive for Ferguson has to happen now. If he is reinforced, or if he reaches Cornwallis in Charlotte, the day is lost. Into the night they ride. They remove their frocks or blankets to wrap their flintlocks to keep them dry. Through the night, through the rain and the dark, they ride. Resolute men, bound together by their common purpose. They will not fail. They must not fail.

Crossing the Cherokee Ford of the Broad River (east of Gaffney, SC). They stop. They must rest. Shelby rides up. "NO, I will NOT stop, I will ride into the very heart of Cornwallis himself before I stop." They continue on.

It is mid-day on October 7th. The rain stops. They pause near a house and send in a scout to collect information. They learn that Ferguson and his Army have set camp atop the open, flat crest of Kings Mountain. A girl in the house had delivered eggs to Ferguson's own camp that morning. These men, these Overmountain Men, do not stop to hold council as an army of military men might do. They simply do not stop. From horseback, they make their battle plans. They will surround the mountain. Each colonel with his militia will take their position and as one, will drive to the crest. (We learn later that Ferguson has said the God Almighty and all his angels will not remove him from this mountain).

The Overmountain Men dismount and hobble their horses back a ways from the mountain. They approach on foot. It is three o'clock. Campbell and his men up one side approaching the crest. They are spotted and fired on and driven back down. Shelby and his men from the other side of the mountain. They too are spotted and fired on. The first ten minutes of the

Battle of Kings Mountain have passed. In those ten minutes, all the other colonel's have gotten their men in place and are ready. As one, the Overmountain Men, the "yelling boys", split the air with their war cries and the fire of their rifles. Three times they charge the crest. Three times they are driven back down. Ferguson rides the crest, a blue and white checkered shirt, atop a white horse, blowing commands on his silver whistles. The fourth time the charge comes, the Tory line breaks. Ferguson sees that it is not God Almighty and his angels that have come to remove him, it is the Overmountain Men. It is his end.

He breaks for the end of the mountain, right into John Sevier's men. Nineteen year old John Gilliland sees him coming. Raises his rifle, aims, pulls the trigger. Click. Doesn't fire. Turns to the man beside him. Sixty-two year old Robert Young. "There's Ferguson, Get him." Robert Young answers, "I'll see what 'Ol' Sweet Lips" can do, (he'd named his rifle after his wife). When Ferguson hit the ground he had eight bullet holes in him. No one knows who did the killing for sure, but Robert Young gets credit. His rifle, Sweet Lips, hangs in the State Museum in Nashville, Tennessee.

A little after four o'clock in the afternoon. The battle is over. It lasted an hour. There are some 65 wounded patriots. There are 28 who will not see the sun set that day. Every single soldier under Patrick Ferguson is either dead or captured. Every single one. The battle is over. The dream is real. Hope begins to spread again.

The Battle of Kings Mountain was the turning point of the Revolutionary War. Three months later, Tarlton and the entire light infantry capability of the southern British Army was defeated at Cowpens (January, 1781). Three months after that, Guilford Courthouse (March, 1781). While the British won the field that day, their commanders lamented that "one more such victory and our cause shall surely be lost." And it was. Cornwallis surrendered to General Washington at Yorktown in October. The war was over. The American colonies were a free and independent country. The Battle of Kings Mountain helped make that happen.

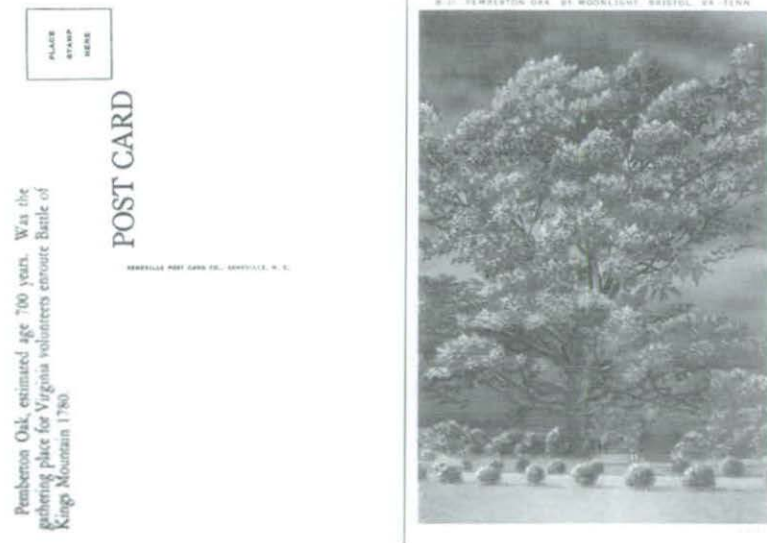


Fig. 2. An antique postcard (front and back views) from the early 1900's, showing the famous Pemberton Oak.
 Courtesy Guy and Edie Sternberg.

The Pemberton Oak? It's days are numbered, I am afraid. Martin Milner of the Tennessee Division of Forestry inspected the tree back in 1998 and gave us a prescription to extend its life as long as possible. The tree has heart rot, nearly hollowed out. You wouldn't know it to look at it, though. A crown spread of probably 150 feet or so. Good mast production in peak years. Martin's advice was to apply balanced fertilizer under the crown spread twice a year and apply fungicide and insecticide up in the cavity. We've been doing that. We have a little revolving fund that helps pay for that.

Oh yeah, Allen Ray picked up a fallen limb. He cut a 2-inch thick disk and then hand sanded and hand rubbed it with linseed oil to a deep, glowing luster. We mounted that on a plaque. The Pemberton Preservation Award. We've only given out two. They go to someone who has made a significant, tangible, on-the-ground contribution to the protection of the trail—someone who has actually saved a piece of the trail. What better legacy, huh?

And speaking of legacy, we had some new people join the march last year for the first time. The Bowen's from Georgia. They had a whole handful of ancestors in the Battle. They collected a bag full of acorns from the Pemberton Oak. Alan and Scott Bowen, they own a large tree farm in North Georgia. The acorns are in the ground now. Some are growing.

And so I close. We know, one day, a big wind or snow or an ice storm will bring the tree down. It will fall and take its place among the ranks of the Overmountain Men as a memory that we cherish. It will take its place in the Story.

Thanks for listening to our story. Good-bye my friends. Mike.

For more information about the annual reenactment or joining or supporting the Overmountain Victory Trail Association, or to order the Road to Kings Mountain Video, contact OVTA at PO Box 242421, Charlotte, NC 28224-2421. The cost of the video is \$25.00. Please make check payable to OVTA. Half the proceeds go towards protecting the Trail!

Mike Dahl has been with the OVTA since 1978. He has followed the footsteps of the Overmountain Men during the annual reenactment over 20 times. He worked as a planner with Tennessee State Parks for 22 years and is a 1977 graduate of the Forest Recreation program at the University of Tennessee in Knoxville. He has wrapped his arms around the Pemberton Oak. Didn't even go half way around.

(Editor's Note: Watch for an update on the Pemberton Oak in the next issue.)

Northbrook's Champion Bebb Oak (*Quercus xbebbiana*)

Compiled by **Terry Cichoki**

Village of Northbrook, Department of Public Works,
Northbrook, Illinois

with editorial comments by

Thomas Green, Ph.D.

Village of Northbrook Public Works Staff

The Village of Northbrook is located in the Northfield Township of Cook County in metropolitan Chicago. The land was originally wet prairie with the swells and swales typical of glaciated landscapes of the Midwest. Many of the swells are uplands that had contained numerous mesic tree species, primarily the oak and hickory savannas recorded by early settlers to the area. In 1839 and 1840 the surveyors made excellent records of what they saw, including the identification of original vegetation. Their records give a vivid picture of what was prairie ("fit for cultivation"), marsh ("worthless"), slough, creek, river (Chicago), and timber groves. Most of the tree species recorded are still growing in Northbrook.

Northbrook's champion oak, which is believed to be a Bebb oak (*Quercus xbebbiana*), has been growing on the northwest side of town in the originally recorded timber grove for an estimated 245 to 400 years. Core samples to determine the true age have not been taken with an increment borer for fear of endangering the tree's health. Other oak trees removed in the area have been dated between 186 to 271 years old, (based on an index provided by Dr. Thomas Green, Ph.D.) and their sizes ranged from 42" to 47" DBH (diameter at breast height). The Bebb oak measures 56 feet in height (17.1 m) with a 155" (3.9 m) circumference. The DBH is 49.3" (1.3 m), last recorded in September, 2001. It has a thick trunk, which supports a massive, 84-foot wide (25.6 m) low canopy attesting to its growth in a presettlement savanna. Most oaks which grew in this habitat tended to have a more open habit with extensive lateral branches that were as thick as trunks of other smaller trees nearby.

The Bebb oak grows on private property on Sunset Lane in northwest Northbrook. The tree, growing in a grove surrounded by smaller, offspring oaks, was well cared for by a couple who



Fig. 1. The old Bebb oak, arboreal emblem of Northbrook, IL.

Photo courtesy of the author.

bought the house in 1949 and later sold it to the current owners in 2000. The former owner reminisced in 1998 how thickly forested his neighborhood had been with bur and white oaks before construction and development in the town caused a lot of the larger oaks to be removed.

The tree was considered a bur oak (*Quercus macrocarpa*) until Dr. Thomas Green, Professor of Forestry at Western Illinois University, was asked to evaluate it in 1999. Dr. Green performed an intensive survey of many oaks in Northbrook that year. After looking at this tree's leaves and bark over one growing season, Dr. Green believed that the tree was a naturally occurring hybrid called *Quercus xbebbiana*, or Bebb oak. The leaves indicated a mix of white oak (*Quercus alba*) and bur oak leaves.

RESOLUTION

During the past several years the Village of Northbrook has worked to preserve and protect existing trees and enhance community appreciation of the importance of trees in the environment and ambiance of the community.

In 1994, Northbrook was designated as a Tree City USA in recognition of the forestry programs of the Village in preserving our trees and the annual planting of additional trees on parkways and public properties. Each year as part of the Earth Day Celebration, seedlings are distributed for planting by the residents to further promote the tree environment in Northbrook.

*With all these efforts and as the Centennial approaches, it seems appropriate that the Village officially recognize and declare a specific species as Official Tree of the Village of Northbrook. The oldest "Champion" tree in the community - the Bebb Oak (*Quercus x bebbiana*) - is located on Sunset Lane. This tree is estimated to be between 245 and 400 years old. It is a hybrid tree of Bur and White Oak parents and was originally part of the Northbrook Grove which was surveyed and described as early as 1840, just after the first Sherman family settlement in Northbrook. This particular Bebb Oak is now a magnificent 48 inches in diameter, the largest and oldest quality tree in Northbrook and is representative of this unique species. Bebb Oaks are found throughout the Village wherever Bur and White Oaks are found.*

NOW THEREFORE, BE IT RESOLVED by the President and Board of Trustees of the Village of Northbrook, County of Cook and State of Illinois, THAT:

The Bebb Oak

is hereby named as the Official Tree of Northbrook in recognition and the magnificent and historic stature of this unique species in our community.

As the Official Tree of Northbrook, all Bebb Oaks are to be protected from removal or excessive trimming without specific authorization of the Forestry Manager in the Public Works Department.

ENACTED AND PASSED: This 11th day of January, 2000

Mal W. Daniel
Village President

ATTEST:
Dona N. Lewis
Village Clerk



Fig. 2. The proclamation naming *Quercus xbebbiana* the municipal tree of Northbrook. Photo courtesy of the author.

Generally Dr. Green looks at the leaves and bark of an oak. When he finds characteristics that do not fit one or the other species, he determines the oak is most likely a hybrid. Acorns are very useful in identification, but they were not present at the time of the initial survey. The acorns picked in 2001 had characteristics of a bur oak with the fringed cap. However, the cap did not cover the whole acorn. Rather the acorns appear to be narrower than a typical bur oak and the cap only covers the acorn about 3/4 of the way down. The fall color of the Bebb oak is a bur oak color- golden yellow brown.

The Bebb oak was named by C.M. Schneider in honor of Michael Shuck Bebb, an Illinois botanist. Dr. Schneider was the first to describe the Bebb oak in 1906 from a sample of a tree from the Bebb family farm southwest of Rockford, Illinois. Although the hybrid oak is named for Mr. Bebb, Bebb's true acclaim comes from his taxonomic work with willows.

Because of the unique characteristics and powerful stature of the tree, the Director of Public Works, Jim Reynolds, took an interest in the tree. Mr. Reynolds, a public servant for Northbrook for over 33 years, had an opportunity to observe the tree over many growing seasons. He soon deemed it his "favorite tree in Northbrook". Because of his growing affection and interest for the Bebb oak, he worked diligently to have the tree recognized for its contribution to Northbrook. He petitioned the Village Board to have the tree designated as the official Village tree.

Other oaks found growing in the Village during the survey conducted by Dr. Green were found to be Bebb oaks. However, the designation of the most notable tree of them all went to the historic Bebb oak on Sunset Lane. On January 11, 2000, Northbrook's President and Board of Trustees officially designated the Bebb oak as the Official Tree of Northbrook. The Bebb oak has been recognized in various promotional works relating to the trees of Northbrook, most notably "Gems of Northbrook", a 4 color, award-winning booklet.

Since propagation of future generations from our Village tree is of utmost importance, the Village contracted with St. Aubin's Nursery of Kirkland, Illinois to propagate approximately 150 seedlings from acorns from the massive Bebb oak. The initial plan was to buy back the trees in 7 to 8 years at 80% of the current selling price for that species. Unfortunately, rodent predators during heavy snow cover destroyed virtually the entire crop that winter. A second batch of acorns was collected in 2001, which marked a bumper crop for acorns in the Illinois area. This batch of acorns was delivered in September 2001 to Possibility Place Nursery, in Monee, Illinois for propagation. Mr. Connor Shaw, owner of Possibility Place Nursery, specializes in native woody plants of the Illinois region. His propagation techniques include planting the acorns when their moisture content is still high, using long, fluted grow-tubes with water wells, and yards of chicken wire enshrouding each cell pack to prevent predators from destroying the crop. He keeps the seedlings in cold frames until they are ready to be moved into grow-bags for final nursery liners. We will find out this spring how well the seedlings are growing.

However, as Dr. Green cautioned, the only exact way to get Bebb oak seedlings is from vegetative propagation. As with all hybrids, the fruits can exhibit characteristics of one or the other parent. Pollen source and species makeup of the surrounding oaks would greatly influence seedling genotype. If we study the seedlings, we may be able to tell which parent characteristic predominated in the 2001 acorns, bur or white oak.

In June of 2000, new owners bought the property with the Bebb oak on Sunset Lane. The new owners showed the same enthusiasm for the grove of Bebb oaks in front of their home. They also had plans to build a new home on the 2-acre parcel. That same year, they applied for a permit to build a much larger house on the back of the lot, while still living in the smaller house in the front.

This was a situation that was unusual since most permits require demolition of the existing residence before a new home can be built. In an effort to protect the Bebb oak from the inevitable construction disturbance, Village officials negotiated an agreement with the owner. The agreement allowed the home to be built while the owners lived in the old house, if they agreed to protect the Bebb oak above and beyond what was called for in our strict tree protection ordinance. The agreement, called a restrictive covenant, established certain protective requirements. In the event anything happened to the tree because of construction, the owners

agreed to replace the tree for its entire value. In exchange, the owners would receive a variance to the existing code that allowed them to remain in their dwelling during the construction of the new home. Protecting the Bebb oak now would require unique site design and construction logistics as well as additional diligence by Village officials to monitor construction activity to ensure the tree's safety.



Fig. 3. Northbrook takes care to protect its old Bebb oaks during construction.

Photo courtesy of the author.

Northbrook has a comprehensive tree preservation ordinance that was passed on August 16, 1999. Later, in March 2001, the ordinance was modified to protect "Heritage" trees. The ordinance calls for protection of all trees 6" DBH (diameter at breast height) or larger in the entire yard. Trees that merit extra protection are trees that are considered "landmark" or "heritage".

Landmark Trees - 12" DBH and larger

Basswood, Black Walnut, Buckeye, Gingko (male), (16"+),
 Hickory (6"), Ironwood (6"), Kentucky Coffeetree, (36"+)
 Norway Maple-including Schwedler, Crimson King,
 Oak (8"+)-all species, Red maple, Sugar maple,
 White ash, Conifers-Bald Cypress, Cedar (single stem),
 Dawn Redwood, Fir, Spruce and White Pine.

Heritage Trees - 30" DBH and

Oaks (all species), Hickories
 Ironwood (10"+), American elm

Heritage trees include the very best specimens of selected landmark trees and pre-date, or correspond with, the incorporation of the Village of Northbrook in 1901. Another characteristic of Heritage trees is that they have survived catastrophic diseases that have killed trees of that species either regionally or nationally. If tree removal of any of these Landmark or Heritage trees is required, a replacement guarantee of an equal number of inches is needed before the tree removal is granted. If a Heritage tree is requested to be removed, a special

hearing is held before the Village Board of Trustees, the Village Manager, and the Village President before the permit can be granted. A zoning variance or design modification is frequently the better alternative to removing an irreplaceable tree. During construction, all trees 6" DBH or larger must be fenced off with tree-preservation fencing. Additionally, any impact by utility work must be approved prior to excavation. In some cases, the utility work must be directionally bored, or augered underneath the tree's root system. Currently, there is no fee for a tree removal or preservation permit.

Since the Bebb oak is considered the Village Tree, the Village officials met with the home's general contractor, landscape architect, engineer, and the owner before any construction work actually began. Issues regarding the logistics of the construction were discussed well ahead of time. In some instances, several meetings were held on site to go over changes that had to be made in the field. To date, the tree is surviving well during the construction.

Thanks in part to the concerted effort of the Northbrook Public Works staff, the Building Department, and the Engineering Department, the tree has been saved from repeated tree-preservation fence violations, as well as intensive utility trenching work. Augering of the pipes was required in any area that might adversely impact the root system of the oak trees. In one case, the water service was moved to the west of the oak grove to prevent any possible impact on the Bebb oak.

Because the Bebb oak is so important, the owners agreed to have the tree pruned this winter. While the tree care company was inspecting the tree during pruning, they discovered a large hollow in the top of the tree. The hollow was the result of a leader had decayed at some point in the tree's life. Upon closer inspection, the hollow was wide but not deep, and it looked as though the tree had compartmentalized any further decay. Residents told us that they believe a resident screech owl uses this hollow as a home.

Although the tree care company had prescribed fertilizing the tree, the Village arborists disagreed, stating that the high salt content in the fertilizer might be detrimental to the tree and actually cause it to decline. The Village is in the process of performing tests on the impact of using mycorrhize to help oaks recover from stress. If positive results are obtained, the Village will recommend this treatment for the Bebb oak as a preventive measure to buffer any construction injury that was incurred to roots outside of the critical root zone.

Measures are being taken to change the existing tree-preservation fencing to chain link fence because of the continued enforcement problems with the orange construction fence currently being used. Because of the small access areas, many of the perimeter trees are suffering construction damage that ultimately will be fatal to the trees. Large semitrucks continue to access the back of the lot and knock down the fence as they go. Putting up the fencing repeatedly has become a regular ritual for the general contractor.

As more trees are removed, the entire profile of the canopy trees will be changed in this area. These changes will affect water percolation rates that, with the increased impervious surface caused by the new house, will affect the groundwater table profile where the Bebb oak grows. These changes may ultimately affect the tree negatively. These kinds of subtle construction impacts account for tree mortality after construction that in many cases is diagnosed as senescence due to the tree's age.

Although Northbrook's ordinance is strong, the subtle habitat changes caused by construction are difficult to enforce and measure. Often a tree preservation official puts credence in the tree's ability to recover from the shock of the whole construction process and adapt to the new conditions it is forced to live in. However, just like with people, the older the tree, the harder it is to change and adapt. We hope that the Bebb oak will continue to be our Village Tree for many years to come. Thanks to our aggressive tree preservation efforts, the tree has an excellent chance of survival.

*For more information, contact Terry Cichocki, Northbrook Tree Preservation Officer
847/272-4711 ext. 203.*

LIVE OAK SOCIETY

By Coleen Perilloux Landry
Chairman, The Live Oak Society
3609 Purdue Drive,
Metairie, LA 7003

In Louisiana, home of the Live Oak Society, the live oak tree, *Quercus virginiana*, may be found in the center of a cleared savanna, in city park groves, in allées fronting plantation houses, and on ridges of high ground along the coast. They provide shade, food for animals and mankind, protection from storms, and peaceful solitude for the soul just by being there. Called the live oak because it is never completely bare and stays green all of its life, it is admired and respected by thousands of people.

"The live oak is the noblest of all our trees, the most to be admired for its beauty, the most to be respected for its majesty and dignity and grandeur, most to be praised for its strength, most to be cherished and venerated for its age and character, and most to be loved with gratitude for its beneficence of shade for all generations of man dwelling within its vicinity." Such eloquence was written in 1934 by Dr. Edwin L. Stephens, the first president of the University of Southwestern Louisiana, when he founded the Live Oak Society. Stephens proposed a charter list of 42 members composed entirely of live oaks, each of them 100 years old or older. Only one honorary human member was allowed, an honorary chairman to register the trees.

Stephens gave instructions on measurements for membership. "Take the girth of the tree with a tape line, at a height of four feet from the ground. Also measure the diameter of the spread, from tip to tip of the longest limbs, and estimate the height. Trees younger than a hundred years old (the requirement is that a tree be at least 16 feet in circumference to be declared 100 years old) may be noted and listed for the Junior League." Eight feet to 16 feet is considered Junior League membership. The first branch of the Junior League was 100 trees on the USL campus "including 18 that are exactly the age of the Twentieth Century, having been set out on Jan 1, 1901." In January, 2001, those 18 trees were honored in a special ceremony by the Live Oak Society and the city of Lafayette, Louisiana.

Unfortunately, Stephens died in 1938 and the Society floundered until 1957 when his daughter approached the Louisiana Garden Club Federation who agreed to assume the responsibilities and goals of the Society. The rules are few and simple. Members shall not be white washed. No member shall be desecrated with advertisements—that means no signs. And, most important, 'thou shalt not kill' — no "quercocide".

To insure each member its own identity, it is given a name by its owner or sponsor upon registration in the Society. It is also given a registration number. Some trees are named after the town in which they live, like the "Destrehan Oak" in Destrehan, Louisiana. Some are named after the owner or sponsor as "The Lee Bing Oak" in Lacombe, Louisiana. In New Orleans' City Park there are dramatically named oaks— "Dueling Oak" and "Suicide Oak". Many are memorials to family members. Only this past summer a teenage girl was killed



Fig. 1. Dr. Edwin Lewis Stephens, Founder of the Live Oak Society.

Photo courtesy of the author.



Fig. 2. The author of the article and the Chairman (and only human member) of the Live Oak Society.

Photo courtesy of the author.

But nature would not let some oaks live a life of leisure. Following the devastation of Hurricane Hugo in 1989, beloved oaks on Johns Island, South Carolina, were left mangled and useless. The good citizens offered their trees for the restoration of historic ships and more than 100 tons of live oak wood provided new life to old ships.

Today, the preamble of the Live Oak Society of the Louisiana Garden Club Federation, Inc.'s Constitution reads: "Whereas the Live Oak is one of God's Creatures that has been keeping quiet for a long time, just standing there contemplating the situation without having very much to say, but only increasing in size, beauty, strength and firmness day by day, without getting the attention and appreciation that it merits from its anthropomorphic fellow-mortals; and Whereas it has been found that organization and publication are a good means of promoting influence and service in the world; Therefore this Constitution for an universal association of Live Oaks is hereby ordained and established."

Adhering to this Constitution, the live oaks responded in great voice and today the Society boasts of 4,075 members in thirteen states. Chairman (and the only human permitted in the Society) is Coleen Perilloux Landry whose interests began as a child when her father attached her swing to a live oak tree. Her mother, who also had a great love for live oaks, forbade anyone to cut even one branch of her trees. Thus, a love affair with oaks began on the Great River Road in Montz, Louisiana.

Landry has traveled hundreds of miles measuring live oaks for registration. She has measured oaks at St. Joseph's Abbey in Covington, Louisiana, naming them for previous Benedictine Abbots. An oak in a cemetery in Reserve, Louisiana, has been named "The Msgr. Jean Eyraud Oak". Eyraud is a candidate for sainthood in the Catholic Church. In commemoration of the 275th anniversary of the Ursuline nuns in Louisiana, Landry measured and registered some 20 live oaks on the convent and academy grounds. She has tramped the banks of Bayou Teche and Bayou Lafourche in Louisiana and wherever a potential member resides. Landry recently contacted the owner of Boone Hall Plantation outside of Charleston, S.C. about registering more than 200 live oaks planted in 1748 by Captain John Hall.

when the car in which she was riding slammed into an oak tree. Her parents registered the tree and named it in her memory and honor.

In the span of centuries the live oak has had a long record of service in the United States. Its great limbs supported lynch ropes for horse thieves; duels for honor were fought at dawn under oaks; the shade of a majestic oak provided a setting for signing treaties between the French and the Indians; songs were composed and marriages proposed.

Officially, the United States Navy used its wood for ship-building for almost two centuries. Because its wood is so hard and is able to withstand drying and wetting, the government bought tracts of land in southern states, protecting live oaks that were there and planting more. After the Civil War when the United States began to turn towards ships made of iron, the live oaks began to enjoy a more relaxed life. They began to be mostly things of beauty and poetry, as in Walt Whitman's poem "I Saw in Louisiana a Live Oak Growing."



Fig. 3. The Seven Sisters Oak, shown here with owners Mr. and Mrs. Milton Seiler, is located in the Lewisburg area of Mendeveille, Louisiana and is the current President of the Live Oak Society.

Photo courtesy of the author.

pollution, mainly chemical, was thought to be the killer of the "Locke Breaux Oak" in Taft, Louisiana. Located across the Mississippi River from the Bonnet Carre Spillway, the massive oak reigned from 1934 to 1968 when it was considered legally dead by County Agent Achille Melancon. The river corridor in that area is lined with chemical plants, petroleum plants, and a nuclear power plant.

The next greatest threat to the live oak is urban sprawl, which

The largest stand of registered live oaks is in City Park in New Orleans. The largest oak, and president of the Live Oak Society, lives on the shores of Lake Pontchartrain in Lewisburg near Mandeville, Louisiana. The "Seven Sisters Oak" has a girth of 38 feet and is considered by foresters to be 1200 years old. The First Vice-President is the "Middleton Oak" in Charleston, South Carolina with a girth of 31 feet. Second Vice-President, "St. John Cathedral Oak" in Lafayette, Louisiana, enjoys a girth of 26 feet 7 inches; followed by the third Vice-President, "The Lagarde Oak" in Luling, Louisiana, with a span of 28 feet. "Martha Washington Live Oak", with a girth of 27 feet 6 inches, resides in Audubon Park in New Orleans, Louisiana and reigns as Fourth Vice-President.

Survival, the greatest challenge of the live oak, is foremost on the agenda of the Live Oak Society in 2002. Air and ground water



Fig. 4. Historic photo of the Locke Breaux Oak, the original president of the Live Oak Society, now deceased.

Photo courtesy of the author.

piles tons of concrete and soil on top of the tree's roots, literally smothering the tree to death. With urban sprawl comes new roads and highways, plowing down everything in their path. The Live Oak Society has been instrumental in lobbying states and counties to build around live oaks rather than destroying them.

Through public relations campaigns and education of the public the Society hopes to save live oaks in every possible situation. In the coastal regions of the United States it has been proven that live oaks help protect against the forces of a hurricane, and residents in those regions are being encouraged to plant live oaks. It is believed that the tree's horizontal growing habits make them more able to withstand high winds. The environment also benefits from a single live oak, as it absorbs about 30 pounds of carbon dioxide from the atmosphere in one year, while releasing 15 pounds of oxygen into the air.

If a live oak tree qualifies it can be registered in the Society at no cost to the owner. All monies supporting the Society are furnished by contributions, along with a small budget of the Louisiana Garden Club Federation Inc.

Further information may be obtained by writing to the chairman at 3609 Purdue Drive, Metairie, LA 70003 or e-mailing her at CPL70600@aol.com.

The Live Oak Society website, which has the history and the registry of all oaks in the Society can be visited at: www.louisianagardenclubs.org

**The Live Oak Society
of the
Louisiana Garden Club Federation, Inc.**

Registration

WHERE DOES THE TREE LIVE?

State _____

Parish or County _____

City or Town _____

NAME YOU WISH TO GIVE THE TREE _____

GIRTH or circumference of tree (measured 4 to 4 1/2 feet from the ground): _____
feet _____ inches.

SPREAD of tree (from farthest tip to farthest tip) _____ feet.

LOCATION of the tree (exact location, street and house number, or in relation to highway)
TOWN and CITY and Zip Code. (Please list all requested information)

NAME OF OWNER _____

ADDRESS OF OWNER _____

NAME AND ADDRESS OF SPONSOR (if other than owner)

_____ REMARKS,
if any _____

Note: Junior League Tree-Minimum girth of eight feet to sixteen feet.
Centenarian-Girth over sixteen feet.

Please mail this form to:
COLEEN PERILLOUX LANDRY
Chairman, Live Oak Society
3609 Purdue Drive
Metairie, LA 70003

Errata

This table was inadvertently left out of Emile Gardiners's article, Ecology of Bottomland Oaks in the Southeastern United States, from the last issue of *International Oaks* (Journal # 12). Our apologies to the author and our readers.

Table 1. Summary of flood tolerance rating, shade tolerance rating and species-site associations of 9 common bottomland oak species endemic to the southeastern United States (adapted from Putnam et al. 1960).

Species	Flood Tolerance ¹	Shade Tolerance ²	Species-Site Associations ³
Section <i>Quercus</i>			
overcup oak (<i>Q. lyrata</i> Walt.)	Tolerant	Moderately intolerant	common on poorly drained flats or sloughs with water hickory
swamp chestnut oak (<i>Q. michauxii</i> Walt.)	Moderately intolerant	Moderately intolerant	common on loamy, well-drained sites, particularly ridges of older alluvium with cherrybark oak, sweetgum and hickories
white oak (<i>Q. alba</i> L.)	Intolerant	Moderately intolerant	infrequent on well drained, older alluvium with Shumard oak, cherrybark oak, sweetgum, hickories, and loblolly pine (<i>Pinus taeda</i> L.)
Section <i>Lobatae</i>			
swamp laurel oak (<i>Q. laurifolia</i> Michx.)	Moderately tolerant	Moderately intolerant	common on poorly drained clay flats and margins of sloughs and swamps of Gulf coastal plain bottoms with willow oak, water oak and Nuttall oak
Nuttall oak (<i>Q. nuttallii</i> Palm.)	Moderately tolerant	Intolerant	common on poorly drained clay flats in recent alluvium of the Gulf Coastal Plain, and the Mississippi and Red River Valleys with green ash, sweetgum, and American elm
willow oak (<i>Q. phellos</i> L.)	Moderately tolerant	Intolerant	common on many site types but primarily on high flats and loamy ridges of recent alluvium with water oak and sweetgum

Species	Flood Tolerance ¹	Shade Tolerance ²	Species-Site Associations ³
water oak (<i>Q. nigra</i> L.)	Moderately tolerant	Intolerant	common on well drained loamy ridges and high flats with willow oak, cherrybark oak, sweetgum, and others, but also found on poorly drained flats with swamp laurel oak and Nuttall oak
cherrybark oak (<i>Q. pagoda</i> Raf.)	Moderately intolerant	Intolerant	common on loamy, well-drained sites, particularly ridges of older alluvium with swamp chestnut oak, water oak, Shumard oak, sweetgum, and hickories
Shumard oak (<i>Q. shumardii</i> Buckl.)	Moderately intolerant	Intolerant	scattered on well drained ridges of older alluvium, with cherrybark oak, white oak, sweetgum and hickories

¹ Rankings range from Very tolerant, Tolerant, Moderately tolerant, Moderately intolerant, Intolerant, and Very intolerant. Additional sources include Hook (1984) and McKnight et al. (1981).

² Rankings range from Very tolerant, Tolerant, Moderately tolerant, Moderately intolerant, Intolerant, and Very intolerant. Additional sources include Edwards (1990a, 1990b), Filer (1990), Krinard (1990), McReynolds and Hebb (1990), Meadows and Stanturf (1997), Rogers (1990), Schlaegel (1990), Solomon (1990) and Vozzo (1990).

³ Additional sources include Hodges (1994, 1997).

Authors' Guidelines

General Policies

The International Oak Society will accept articles for *International Oaks* from members or non-members as long as the material presented is pertinent to the genus *Quercus*. Written contributions may be scientific/technical papers, historical, horticultural, instructional or general interest material (stories/articles of a particular tree, event, place, person, etc.) or letters to the editor; a mix of categories is encouraged. Material may be previously published or unpublished. The author's name, title, address, telephone and/or (fax) number, and e-mail (if available) should be included. Any contributions longer than 7500 words must be approved in advance by the editor.

Copyrights

International Oaks is not copyrighted, but authors, photographers and artists may claim copyrights on their work. Anyone wishing to use portions of *International Oaks* for other publications should secure permission from the author, photographer or artist, and include a credit line indicating *International Oaks* for other publications should secure permission from the author, photographer or artist, and include a credit line indicating *International Oaks* as the source of the material. All contributors submitting work thereby release their contribution for publication under the terms stated herein. Authors take full and sole responsibility for securing releases for use of material obtained from other sources, and agree to indemnify the International Oak Society against any claim of plagiarism involving their contribution.

Format

Contributions will be accepted in any legible format, in English only. Text should be restricted to a single, standard font, preferably Times or Times New Roman. No more than two levels of subheadings should be included. Electronic files written in WordPerfect or Microsoft Word are preferred and must be accompanied by a paper copy. Text may be submitted via e-mail (ddmccreary@ucdavis.edu) or on a floppy disk. Do not add page numbers, borders, headers or footers. Single space between sentences, avoid bold type, custom margins, and other optional format codes. Authors submitting papers in other formats must pay US \$10 per manuscript page, in advance, to help defray the additional costs of reformatting for publication. Illustrations and photographs can be submitted in a high resolution format as jpegs if digital art is sent. Do not place art in the body of the work. Submit separately. Drawings, slides or photos may be mailed to be scanned; the art work will be returned upon request. Illustrations and photos should be sharp and compatible with monochromatic reproduction. Style, citation methods, and abstracts are left to the reasonable discretion of the author. Refer to the current Council of Biological Editors (CBS) style Manual for Biological Journals for general guidelines.

Tables and charts which are not submitted in camera-ready form (or in an electronic format approved in advance by the editor) may be rejected, or subjected to a minimum \$30 (US) production fee. *Do Not* place tables or charts within text files. All measurements should be expressed in metric units, or in metric followed (in parenthesis) by English. Scientific names, with authority or with reference to the treatment in a specified standard taxonomic manual, must be included for each taxon discussed if there is any possibility for confusion.

Review

The editorial committee and editor reserve the right to edit all contributions for grammar, correct English translation, current nomenclature, generally accepted taxonomic concepts, scientific accuracy, appropriateness, length and clarity; but assume no responsibility to do so. If such review results in significant disputes of factual material, the author will be contacted if possible, or the paper may be rejected. Every effort will be made to retain the original intent of the author.



International Oaks—

The Journal of the International Oak Society

Hardwood Range Mgt. Program

MID: **TR8** DT: 06/01/2002 ShelfID: **B4762**
 Name: International Oaks BookRev: 0
 Rec: 01/29/2010 Abxcnt: 13 Priority:
 DateTxt: Summer2002

FTFile:
 Source: Vendor: **Multi** CkInit: **JCO**
 Special: **N/A**

TOC: **ININE** A&I: **ININE**
 TOCsrc: **H** Scan: **BOS** Ship: **Y** Hold: **N**
 FT: **N/A** Authabx: **Y** AbxTyp:
 PDF: **BOS** Imtype:
 MDScan: **N** EmbDue: CDCC: **N**
 Rights: **N**



C I A a A Th Be Liv Errs