

## INTRODUCTION

When uncorking a bottle of a good wine or using any of the dozens of products made from natural cork, have you ever stopped to wonder where it comes from? If so, come with us now for a trip to the western Mediterranean, home of the cork oak (*Quercus suber*), one of the most extraordinary trees on Earth. Whether fully clothed, in its arm-thick, fissured, light gray bark, or with brick red trunks recently undressed by a once-a-decade harvest of its corky clothing, the tree has great beauty, mystery, and charm, as writers and travelers have long recounted. The landscapes where it occurs have the same charm or even more to those who know how to read them.

We travel to the western Mediterranean because today no cork oak tree grows naturally east of Tuscany, Liguria, and Sicily. And yet, four and a half millennia ago, fishing floats made of cork were used along the Nile River. Two and half millennia ago, natural cork was used throughout the eastern Mediterranean to make stoppers for earthenware jars and soles for shoes and sandals.

Theophrastus (372–285 BC) described the cork oak in detail, followed by Virgil, who had Aeneas (in *Aeneid* VII) mention that the head covering of the soldiers of ancient Latium was “stripped bark of the cork tree.” Pliny the Elder (AD 23–79) also gave a detailed description of the cork tree and the use of its bark in his *Naturalis Historia* XVI. Horace (65–8 BC) wrote of wine casks being sealed with cork and Columella (AD 20–75) referred to cork used in the making of beehives. Plutarch related that Camillus used cork as a life buoy for swimming. Alexander the Great is said to have avoided drowning one day while crossing a turbulent river by clinging to a large piece of cork that happened to be nearby. From North Africa we know of very few written

accounts, but it seems likely that cork oak was just as widely used, cared for, and appreciated as in southwestern Europe.

So, did the cork oak tree occur in Greece and further east millennia ago, or was cork simply imported as a product of commerce, accompanied by tales of the tree growing farther west? The second explanation is more plausible. As we shall learn in the opening chapters of this book, the natural distribution of cork oak trees in the western Mediterranean region but not in the east seems to have been constant at least since the last European ice age, which ended eleven thousand years ago.

What is the story in the western Mediterranean? What are the cork oak ecosystems, economy, and landscapes like there today? For the last few centuries, in many parts of the Iberian Peninsula, parts of France and Italy, and northwestern Africa, people have consistently protected, managed, and indeed cherished the cork oak tree, not only for its thick, useful bark but also for its shade, foliage, and wood; for its beauty, longevity, and cultural significance; and for the acorns. Some years at least, the acorns of cork oak provide a copious feast for domestic livestock, wildlife, and, in some areas in North Africa and Spain, for people. The associated flora and fauna are also valuable to people.

It is no wonder that the trees have impressed so many travelers, painters, and poets. For example, Cervantes mentioned the cork oak tree at least seventeen times, and Don Quixote often shelters in the hollow of a large cork oak tree. In many places, the local name of the tree was applied to towns and rural sites of note. In parts of southwestern Europe and northwestern Africa, the cork oak became emblematic of entire microregions. The Maamora *woodland* of northern Morocco is the largest single stand of cork oak found anywhere, but the Iberian Peninsula harbors the most cork oak woodlands, and Portugal is the country with the highest cork production in the world, followed by Spain. Cork oak management persists in Tunisia and Algeria. But what are the prospects for the future?

Our subject in this book is not only the tree but the forests, woodlands, and managed agroforestry systems of which cork oak is the major or one of the major components. Naturally, cork oak can occur in mixed forests, sharing the arboreal stratum with other evergreens and deciduous oaks, with pines and other conifers, and with a few other hardwoods. The cultural derivatives, which are open woodlands or parklands—sometimes called pseudosavannas or anthropogenic savannas—usually have just one or a few kinds of trees selectively maintained and carefully cultivated. These agroforestry systems are widely known by the generic Spanish term *dehesas*, but many other names exist. Some of them (e.g., the *montados* of Portugal and

some of the *azaghar* in parts of Morocco) were specifically structured around cork oak. The trees spread over vast plains and hills and have been tended, pruned, selected, shaped, and sculpted by people for generations. Together these forests and woodlands form a certain type of landscape that has evolved over centuries as a special mix of nature and nurture that is the very heart and soul of the Mediterranean region. Indeed, the sheer beauty, mystery, and profound cultural significance of the cork oak and cork oak landscapes must not be overlooked at any point in our journey. For reasons related to past climate change and, especially, to the recolonization of territories after the quaternary glaciations, cork oak woodlands today are entirely limited to the western Mediterranean region, where they harbor remarkably high biodiversity, including many rare and endangered species. Like the olive tree (*Olea europaea*), they are emblematic of this region. Furthermore, all western Mediterranean landscapes involving the cork oak reflect a dynamic, co-evolutionary relationship between people and nature that is literally priceless but also extremely valuable as humanity seeks ways toward sustainable and desirable futures in a very crowded world.

Yet something has gone awry. Cultural cork oak woodlands are in trouble, as are many other cultural and natural ecosystems and traditional rural cultures and land uses around the world. Cork oak is not in any danger of extinction, but many of the ancient Mediterranean cultural landscapes dominated by this species may disappear unless something happens soon.

Over the millennia, cork oak woodlands have undergone numerous changes and fluctuations in land use type and intensity. The Middle Ages saw the regression of organized Roman agriculture; historians note the growing importance of agroforestry systems during this period and afterward, in both southern Europe and North Africa. In Iberia, for example, a driving force for this trend, especially in the fifteenth and sixteenth centuries, was the fact that the wool-based economy of long-distance *transhumance* gradually gave way to swine herding (Grove and Rackham 2001).

Moreover, although there was continuity and abundant cork oak in many places, such as the Alentejo (southern Portugal), as described by the German botanist and traveler H. F. Link at the end of the eighteenth century (Grove and Rackham 2001), and cork was an asset in Portuguese exports in medieval reports, most modern *montados* and *dehesas* are less than 150 years old. After the Peninsular War (1808–1814) and the ensuing political instability in Portugal and Spain, agriculture was so disorganized that it took until after the mid-nineteenth century to reconstitute the system (Picão 1903; Grove and Rackham 2001). But whereas the holm oak (*Quercus ilex*) *dehesa* systems may be one of the diehard survivors of the old European oak acorn swine-herding

tradition, cork oak expanded more in the context of the emerging cork industrialization, first in Catalonia and then in Portugal.

At present, cork oak forests and open woodlands are undergoing an unprecedented rate of change. Many are aging and are unable to regenerate because of overgrazing. There is an ethical and philosophical question at issue. Modern societies change much faster than trees grow and develop. So does climate. Caring for trees is in part caring for an intergenerational legacy, and this is not very popular today. At the other extreme, a fast-growing population and clearly unsustainable increases in livestock numbers on the southern shores of the Mediterranean push North Africa to a new cycle of deforestation, leading to what can be called ecosystem and landscape collapse over large areas. Tragically, those areas include vast landscapes that were formerly diverse, productive, and beautiful, where people—in smaller numbers than live there today, of course—prospered in the shade of cork oak woodlands and other sustainable multipurpose, multiuser landscapes.

Although cork oak is well adapted to fire, bark stripping increases its susceptibility to wildfires, which are increasing in the Mediterranean region. Periodic plowing to eliminate shrub encroachment, reduce fire hazard, and facilitate grazing or cropping became widespread. The heavier machinery used in the second half of the twentieth century, as opposed to the mule- or horse-drawn plow of the past, has had equally disastrous results in terms of tree regeneration. Cork oak trees are also becoming increasingly vulnerable to pathogens and parasites, and plowing helps spread these pests. In sum, changing climate and biotic stress, changing land use patterns coupled to socioeconomic and demographic changes, and changing practices in the wine industry, where most fine cork is used as bottle stoppers—all place cork oak-dominated landscapes at high risk of socioecological collapse.

Since 1993, fluctuating and often inconsistent European Union agricultural policies have favored tree planting in the Euro-Mediterranean region but do not provide adequate measures to nurture or sustain the industries and landscapes based on those plantations. Managed ecosystems last as long as their products—tangible or intangible—are valued by society. In Europe, funding and subsidies for farming and forestry will almost certainly decline drastically in the very near future, with dramatic consequences for land use and occupation. The replanting of cork oak that occurred in the late twentieth century in the Iberian Peninsula does not amount to much in the context of the whole geographic range of the species, and very little has been done in terms of restoration or updating of management techniques in the face of changing climate and socioeconomic conditions.

In conclusion, cork oak woodlands can be viewed as a system on the edge of radical change and at clear risk of collapse, driven by rapid and turbulent socioeconomic and climatic changes. Cork production is still profitable in many places and motivates some protection, if not investment, in new stands. Furthermore, cork extraction barely interferes with ecosystem services delivered by the woodlands. As we shall see, tools and strategies are available to guide the conservation, restoration, and sustainable economic management of cork oak woodlands. But to do so intelligently, clear goals, strategies, tools, and criteria for evaluation of adaptive management will be needed. We hope that this book will contribute to efforts to define all of those and thus to ensure a sustainable and desirable future for cork oak woodlands.

### **What the Reader Will Find in This Book**

In Part I we set the scene from ecological, genetic, ecological, and historical perspectives. In Part II we present the scientific state of the art for restoration, active management, and improvement of cork oak woodlands. In a short Part III we present a suite of restoration and management techniques related to best nursery and field practices. In Part IV we devote four chapters to a detailed examination of the recent past and current economic situations of these various systems and their prospects for the near future. In today's competitive, market-driven world, economics cannot be neglected or underestimated in the evaluation, management, conservation, restoration, and long-term planning for any kind of human-dominated system. However, adopting the approach of *total economic value*, we shall fully consider both nonmonetary and monetary values of the heritage landscapes and land use systems based on cork oak. It should be noted that throughout this book, monetary values are given in euros. At the time this book was ready to go to press (January 2009), the conversion rate was 1 euro = 1.3 U.S. dollars. In Part V we conclude the book with an overview of global drivers of change, including climate change, and some models and alternative future scenarios to help decision makers and resource and land managers in planning and constructing environmental and land management programs in western Mediterranean woodlands. There is also a chapter devoted to perspectives for and obstacles to cork oak woodland biodiversity conservation and the intimately related topic of ecosystem services, both in southwestern Europe and northwestern Africa.

We also include ten site profiles at various places throughout the book. They are invited pieces by local experts and are intended to provide a more

in-depth vision of the range of cork oak woodland sites across the broad spectrum of biophysical, historical, and cultural contexts in the western Mediterranean. We hope students, managers, land owners, and decision makers will ponder and compare them in the search for integrated conservation, management, and restoration.

Moreover, sixteen color plates in the middle of the book illustrate the tree, the agro-silvopastoral systems, the different products, some of the resident biodiversity, and more.

Finally, at the end of the book we provide a glossary of terms that appear in italics the first time they appear in the text and a species index, with scientific and common names, as well as the general index.

We hope that this book will be of practical use to people in the western Mediterranean seeking ways to conserve, revitalize, rehabilitate, reinvigorate, and restore cork oak woodlands. What's more, it may be of use and interest elsewhere. The discussions, techniques, and examples provided throughout the book are applicable or relevant everywhere on the planet where traditionally managed landscapes and production systems are on the edge, under siege from land use changes driven by global climate change and related socioeconomic and political drivers in this tumultuous century.