

Chapter 1

Working Landscapes of the Spanish Dehesa and the California Oak Woodlands: An Introduction

Lynn Huntsinger, Pablo Campos, Paul F. Starrs, José L. Oviedo, Mario Díaz, Richard B. Standiford and Gregorio Montero



Frontispiece Chapter 1. Gateway to a Californian oak woodland cattle ranch. California and Spain share an economic, ecosystemic, and cultural tradition of extensive properties that produce diverse goods and services. (Photograph by L. Huntsinger)

L. Huntsinger (✉) · R. B. Standiford
Department of Environmental Science, Policy, and Management, University of California,
Berkeley, 130 Mulford Hall, Berkeley, CA, MC 3110, 94720 USA
e-mail: huntsinger@berkeley.edu

Abstract Oak woodlands have offered a welcoming environment for human activities for tens of thousands of years, but how that history has unfolded has many variations. The long-time collaboration that led to this book ran into complications arising from the different meanings attached to many a term, including struggles over the most appropriate title, settling on common units of measurement and area, quantifying the woodland's extent in Spain and California, and even in deciding how many oaks constitute a woodland. Defining with anything approaching international precision such terms as oak woodlands, oak woodland ranches, and wooded dehesas is nuanced, and is compounded by distinctions in culture and language. But our efforts to dovetail one inscrutable system with another may offer insight into the relationship of humans with environments long occupied and modified, as further shaped by location, history, and opportunity. In 15 chapters we offer a comparison of conservation and management on California oak woodland ranches and in the dehesas of Spain, including economic, institutional, ecological, spatial, and geographical aspects, from how to raise an Iberian pig to what we can learn about oak woodlands with remote sensing.

Keywords Translations • Comparative study • International exchange • Multi-functional • Landscapes

R. B. Standiford
e-mail: standifo@berkeley.edu

P. Campos • J. L. Oviedo
Institute of Public Goods and Policies (IPP), Spanish National Research Council (CSIC),
Albasanz 26-28, 28037 Madrid, Spain
e-mail: pablo.campos@csic.es

J. L. Oviedo
e-mail: jose.oviedo@csic.es

P. F. Starrs
Department of Geography, University of Nevada, Reno, MS 0154,
Reno, NV 89557-0048, USA
e-mail: starrs@unr.edu

M. Díaz
Department of Biogeography and Global Change, Museo Nacional de Ciencias Naturales
(BGC-MNCN), Spanish National Research Council (CSIC), Serrano 115bis 28006 Madrid,
Spain
e-mail: Mario.Diaz@ccma.csic.es

G. Montero
Forest Research Centre, National Institute for Agriculture and Food Research
and Technology, Ctra. de la Coruña km. 7,5 28040 Madrid, Spain
e-mail: montero@inia.es

1.1 Origins, Language, and Expectations

When we began writing a book in 2002 comparing what might on the surface appear to be similar oak woodland landscapes in California and Spain, the proposition hardly seemed difficult. Over the years, a group of scholars from Europe and the United States interested in oaks and who study the ways that humans occupy oak landscapes developed close connections and a shared interest in what a comparison of landscapes could offer. Every chapter in this book is written by locally based authors well versed in the oak woodlands of Spain, of California, or both. There is added work from colleagues resident in Germany, Portugal, France, other parts of Europe, and from across the United States. Our goal is to compare the history, economics, ecology, and management of the oak woodland ranches of California and the dehesas of Spain (Fig. 1.1). But as the work progressed over coffee breaks, on joint field studies, and when sifting through the many-language and various-disciplined contributions, we found our efforts to navigate comparisons washing up regularly on savage shoals of awkward translation.

Problems arose from the different dimensions of meaning attached to many a terms that permeate this book, starting with struggles over the most appropriate title, but extending to working with different units of measurement and area, defining the woodland's extent in Spain and California, and even deciding how many oaks are needed to constitute a woodland. But we hope these efforts to dovetail the inscrutability of one system to another may offer insight into the



Fig. 1.1 The Iberian pigs historically characteristic of the dehesa were often accompanied by swineherds, now a rarity, but featured with long cloak and shepherd's staff in this 1960 view captured by the Berkeley geographer James J. Parsons. Herds of black-hued pigs such as these are still common users and grazers on the oak woodlands of Spain, although escorts are less common now than 50 years ago. (Photograph from the collection of P.F. Starrs)



Fig. 1.2 A gateway, with ornate tiles of painting by the famed illustrator Mariano Aguayo showing dogs assembled for a hunt, offers an entry into a dehesa near Cazalla de la Sierra, north of Seville. Properties in the oak woodlands of Spain and California are reflections of the aspirations and pleasures of their owners—whether absentee or resident on the land. (Photograph by S. García)

distinct ways that the relationship of humans with the environments they have occupied and modified plays out, as shaped by location, history, and opportunity.

This is very much an effort to forge an understanding of landscapes grounded in economies, geographies, histories, and ecologies that are distinct yet allied by increasingly common outwash from the global economy including the elusive—yet findable—human preference. The main difference in studying a “working” landscape, as compared to another kind of landscape, is that the human dimension is at least as important as the ecological one (Fig. 1.2).

1.2 Complexities in Translation and Definition

Translating a word from one language to another might seem a straightforward process, but when it comes to oak woodland dehesas and ranches, problems of translation reflect the need to translate one world to another: old to new, Iberian Peninsula to North America, Spain to California. As an opening example there is no word in American English that does justice to the term “dehesa.” For the 47 million residents of Spain, the California term “oak woodland” may seem vague, ill defined, and even banal. Certainly lacking are the savory connotations of a southern European vocabulary describing the remarkably varied and humanized

woodlands of the dehesa. Those have been appreciated and exploited for—literally—millennia, since well before Roman and Arab occupiers began spreading everything from culture, hunting, seeds, livestock, economies, and ambitions around the Mediterranean basin. The French historian-geographer Fernand Braudel pondered this while imprisoned during World War II and came to the conclusion that occupation of the Mediterranean realm involved one of the great transformations of human society (Braudel 1975). We do nevertheless in this book attempt to explain one continent to the other, to share, synthesize, and compare what is known, loaned, and retrieved from each society.

Words do not always add up to worlds, and instead require context and explanation. To offer one example, an oak woodland in California generally refers to an oak-dominated area with 10 % or more canopy cover of oaks and a canopy that is open enough to allow a grassland and occasionally a shrub understory (Gaman and Firman 2006). Landscapes of lower canopy cover but still with oaks as a prominent feature are often referred to as oak savanna. The oaks may be of more than 10 different species or their readily-formed hybrids; they may be deciduous or evergreen, a monoculture or of mixed species. The oak woodland may be owned by government—either local or national—or it may be the property of private individuals, families, corporations, or non-governmental organizations (NGOs). A nature preserve may include oak woodland—and in fact often does. Landscape ecologists define the beginning and end of oak woodland by oak tree cover and density over a given area. When oaks are set far apart, and the understory is grass, it becomes an oak savanna (another term argued over). When the oaks are close together, and the closed canopy puts the understory in shade all the time, it becomes an oak forest. Sometimes, if a specific species or oak type predominates, the term is modified to specify this, as in “blue oak woodland” (*Quercus douglasii*) or “live oak woodland” (evergreen oaks). The name oak woodland, however, does not necessarily carry with it any implication of a particular use or form of management.

A ranch, on the other hand, is an enterprise traditionally grounded in the raising of livestock, though the term can be used for one that focuses on wildlife or recreation, especially if modified, as in “wildlife ranch” or “dude ranch.” A ranch implies a place in the western United States of extensive acreage—the term has been borrowed for many types of enterprises, including “chicken ranches” and housing developments, and the always-popular “mobile home ranch.” It is loosely used. It does not imply any particular vegetation type, other than one in the American West, and a ranch is generally relatively dry in prevailing climate. When you put “oak woodland” and “ranch” together you get an “oak woodland ranch,” which moves the terminology closer to dehesa, but nonetheless, can mean a chicken ranch or a wildlife ranch, or just an expansive property located in the oak woodlands. An “oak woodland cattle ranch” would at least mean some form of livestock production, but it says nothing about the complex oak management and multifunctional agriculture that is embodied within the simple term “dehesa.” Throughout this book, when we use the term “oak woodland ranch” we mean



Fig. 1.3 A California cowboy is preparing to rope the back legs of a calf to bring it to a ground crew, where the animals will be branded to identify ownership. While the “cowboy” may seem characteristically American, the reality is that the chaps, the bit in the horse’s mouth, the rope, and even the techniques of branding are all borrowed or transfers from Spain that came with the Spanish–Mexican presence into Alta California in the late eighteenth century. The rope, for example, is a lariat in English—from *la reata*, or alternatively, a lasso—from *lazoga*, both long-ago Spanish terms. (Photograph by L. Huntsinger)

“oak woodland livestock ranch” as the closest approximation that we can get to *dehesa* (Fig. 1.3).

The *dehesa* is an enterprise and a kind of vegetation. The two are inseparable. *Dehesa* by government definition must meet specific parameters, but “*dehesa*” is also a form of agro-sylvo-pastoral economy with oaks managed deliberately for a well-developed grass or crop understory, as part of a multifunctional agricultural unit that often includes the grazing of more than one type of livestock and vegetation type and other enterprises such as cork production, cereal and grain cropping, hunting, mushroom harvesting, and beekeeping. There are a number of species of oaks that can be managed as a *dehesa*—but by far the most common are holm oaks (*Q. ilex*) and cork oaks (*Q. suber*)—although there are longstanding disputes, about the exact cladistics of holm oak. Most *dehesa* is owned by individuals and families, but in all *dehesa* regions except Andalucía, for which there is no available data, 17 % of *dehesa* is in collective ownership. This includes properties shared by a community or municipality; generally, a *dehesa boyal*. In Andalucía, collective ownership is less common than in other *dehesa* regions (MARM 2008: 34 and 40).

In Spain, if we want to talk about oak woodlands, there is a term for each type. *Alcornoque* is a cork oak, *alcornocal* a woodland of such trees (Fig. 1.4). *Encinar* is largely comprised of holm oaks, known as *encina*. *Quejigal* is a woodland largely made up of *quejigo*, the semi-deciduous Lusitanian oak or Algerian oak



Fig. 1.4 Learning from the land, in this case a cork oak woodland or *alcornocal*. (Photograph by L. Huntsinger)

(*Q. faginea* or *Q. canariensis*). *Melojo* is the deciduous Pyrenean oak (*Q. pyrenaica*), found at higher latitudes and elevations, in a woodland referred to as *melojar* (or *melojal*). And so on. The terms roll off the tongue in a way evocative of the environment. There are similar syntactic and definitional problems with *monte*, a Spanish term sometimes translated as montane, forest, or wildland, that also refers to vegetation, with *monte abierto* or *hueco* specifying an open woodland without identifying a particular kind of tree.

We don't know of a generic word for oak woodland in Spain that is lacking in species specificity—except *dehesa*, which also means a particular kind of eco-social enterprise that includes a mosaic of oak woodland, grassland, shrubs and cropped areas. Part of this is a result of the fact that *dehesa* disappears without regular human intervention and the California oak woodland, though no doubt shaped by the management of indigenous Californians over millennia, persists for an as-yet unknown length of time without human intervention. Unmanaged oak woodland in Spain is most often what would be referred to in California as chaparral or shrubland.

The *dehesa* derives from a history that goes back more than 2000 years, part of a deliberate effort to maximize the production of multiple goods and services from the ecosystem. The question is, has the culture and the practice changed so much that the *dehesa* is being abandoned by the people and the practices needed to

sustain it? The oak woodlands of California are usually viewed as the creation of a previous era, flourishing in open stands when Native Californians managed with fire. Later many woodlands were cut down for mining, and where irrigable and reasonably flat, cleared for farming by colonists. The non-arable hilly remnants are today grazed by livestock, providing a large part of the resource base for the range livestock industry in California. No one is sure how the future woodlands will develop in an environment that is so much changed. The long lifespan of oaks means the woodlands retain today evidence of earlier management and use-regimes that reach into the future: What imprint are we today making on the landscape? What management (and supported by whose funds) will persevere and prevail? Is the motive force personal profit, societal benefit and social capital, or biodiversity—or a heady mix of all of these?

1.3 What this Book is About

Californian oak woodlands and Spanish *dehesas* are beautiful Mediterranean-type landscapes. Oaks share space with annual grasses and shrubs. Both woodlands are vulnerable to demographic, economic, and climatic change. Each environment is rich in biodiversity, and important historically and culturally.

Most important to understand is that today these are landscapes at risk. Scientists, academics, managers, and policy-makers are working on both sides of the Atlantic Ocean to understand the dynamics and drivers of these ecosystems. An overriding goal is to sustain their value as economic and ecological systems, and to preserve the oak woodlands themselves, trying to adjust to current climate change effects and changes in societal preferences.

In California, scientists and policymakers are beginning to learn how to foster the conservation and stewardship of oak woodland ranches. The term “working landscape” has come to embody the goal of joining agricultural commodity production to a flow of diverse ecosystem services like carbon sequestration, sight lines and view shed, watershed, and wildlife habitat. Spain’s ancient *dehesa* reflects dozens of generations—over several millennia—of stewardship and efforts to enhance production of multiple goods and services from the ecosystem (Chap. 2). A *dehesa* does not exist without human care and maintenance—it is truly a working landscape created in large part by human labor, livestock, tending of cork and acorn-bearing trees, and steady use. Our rapidly changing society and economic base have vast implications for each of these landscapes.

The oak woodlands known as a *dehesa* in Spain (and in Portugal, *montado*), are prevalent in the south–west portion of Spain. The government definition of *dehesas* is that they are livestock producing properties, including the grasslands and shrublands that typically form a mosaic with *dehesa* oak woodlands, with at least 20 % of their area occupied by oak woodland with a canopy cover of between 5 and 60 % (MARM 2008, 7). The *dehesa* area in Spain according to this definition totals 3.6 million hectares in 5 Autonomous Regions (known as *Comunidades*

Table 1.1 Dehesa in the Spanish autonomous regions according to the Ministry of the environment's definition (MARM 2008, 7)

Autonomous Region (Spain)	Dehesa area (ha) including croplands, shrublands, grasslands, and woodlands.	Percentage of dehesa that is at least 20 % oak woodland with a canopy cover of 5–60 %.
Extremadura	1,065,188	77.8
Castilla-La Mancha	1,048,713	46.4
Andalucía	743,774	62.1
Castilla-León	687,407	57.1
Madrid	61,069	54.2
Total	3,606,151	61.1

**Fig. 1.5** Defining the dehesa is no simple matter, as the main text and Table 1.1 reveal. To establish with precision just how much of an area is “dehesa” requires accurate estimates of canopy cover and knowledge of whether or not the area is used for livestock production. As this aerial view of a dehesa region in the Sierra Norte de Sevilla (Andalucía) suggests, oak density can be remarkably variable even across a small area. (Photograph by P.F. Starrs)

Autonomas), which are Andalucía, Extremadura, Castilla-La Mancha, Castilla-León and Madrid (MARM 2008, 8). This area includes 2.2 million hectares of oak woodland with 5–60 % cover (MARM 2008, 43). Although holm oak is the dominant oak species, and present in 84 % of the woodlands (MARM 2008, 34), cork oaks dominate in a few areas (e.g.: Alcornocales Natural Park in Cádiz province) and are commonly interspersed with holm oaks. Table 1.1 shows the distribution of dehesa and the percentage of oak woodland within it for the five Autonomous regions that have dehesa in Spain (Fig. 1.5).



Fig. 1.6 Areas defined as “oak woodland” in California are less intensively managed and may or may not be grazed by livestock. Stands may be dense and nearly closed, or have only a few isolated trees. Those with low canopy cover are often called oak savanna. This view in Shasta County, California, illustrates the irregular canopy cover throughout the woodlands. (Photograph by R.B. Standiford)

Extremadura is the most representative dehesa region, with its high proportion of oaks to grassland, and from there came many Spanish colonists, explorers, and missionaries who went to Mexico and eventually California to establish religious and secular range livestock enterprises starting in the eighteenth century. Spanish officials of early California often came from noble families who owned dehesas. While the lower reaches of the Guadalquivir River provided the origins of Mexican-Spanish livestock ranching culture that transferred Spanish practices to the Americas, today many of the traditions common to modern-day Californian range culture derive from those early migrations from Andalucía and Extremadura (Doolittle 1987; Jordan 1989; Butzer 1988; Starrs 1997; Starrs and Huntsinger 1998; Sluyter 1996).

The closest equivalent to Spain’s wooded dehesa is described as oak woodland in California, and covers 3.4 million ha (Gaman and Firman 2006), about two-thirds of which is grazed by livestock as part of ranching activity (Huntsinger et al. 2010). Five of the state’s oak species—blue oaks, coast live oaks (*Q. agrifolia*), interior live oaks (*Q. wislizenii*), valley oaks (*Q. lobata*) and Englemann oak (*Q. engelmannii*)—are the dominant overstory oaks across most of the state’s grazed woodlands (Pavlik et al. 1991). Tree canopy and density vary throughout the region (Fig. 1.6). California’s oak-dominated landscapes occur mainly in Mediterranean climate zones in the Coast Ranges, Transverse Ranges, and western

foothills of the Sierra-Cascade Range (CDF-FRAP 2003). More than 350 vertebrate species inhabit them (CIWTG 2005), and they provide some of California's richest wildlife habitat (Chap. 8).

Table 1.2 provides a general comparison of dehesa and ranch characteristics. About 85 % of the dehesa regions are private properties. They are frequently larger than 350 ha and rearing livestock and the periodic harvest of cork are the primary commercial activities (Parsons 1962a, b; Campos 1984).

More than 80 % of California's oak woodlands are in private ownership (CDF-FRAP 2003), and despite the rapid land use and demographic change of recent decades, most of those areas are still managed as oak woodland ranches (Hunt-singer et al. 2010). The quantity and quality of understory grazing forage varies seasonally with the climate and life cycles of hundreds of plant species, including several dozen varieties of native and introduced grasses (Stromberg et al. 2007) (Chap. 6).

1.4 Broader Themes: Chapters in this Volume

The chapters included in this volume are on topics as specific as acorn crop fluctuations linked to climate, and as overarching as a comparative history of landownership and use. Because this book attempts to address a broad spectrum of woodland uses and incorporates diverse analytic approaches, numerous authors and professional specialties are involved. With the goal of enabling an in-depth appreciation of the two systems, we have focused on California and Spain (Figs. 1.7, 1.8 and 1.9), although other Mediterranean oak woodlands are scattered about the world. Research has been conducted on Portuguese montados, cork oak woodlands in Tunisia, oak woodlands in Morocco, and Mediterranean forests in France and Italy. However, the vast amount of research devoted to Spanish dehesas and California oak woodland ranches is unique, and makes possible a detailed comparison between these ecologically significant working landscapes.

1.4.1 *History and Recent Trends*

Appropriately, this volume begins with a story: a comparative history of the woodlands. Contemporary ranchlands set in oak woodlands and the dehesas of Spain result from dissimilar histories involving centuries of human use. What are now recognized as dehesas began forming during Roman rule, developed in Arab-dominated Iberia, and by the fifteenth century at the time of the Christian reconquest were subject to diversified management involving grazing, hunting, farming, and non-timber forest products such as firewood, charcoal, and even the harvest of palm fronds from stock driveways that cut through the dehesa (Fig. 1.10). California woodlands were modified by thousands of years of Native

Table 1.2 Characteristics of Spanish dehesas and Californian oak woodland ranches landowners

Characteristics	Oak ranches in California	Spanish dehesa
Extent	1.9 million ha owned by ranchers out of 3.4 million ha total (Gaman and Firman 2006)	3.6 million ha (MARM 2008, 43)
Typical range of property sizes	600–1,000 ha (Huntsinger et al. 2010) (see also Chap. 10)	100–1,000 ha (MARM 2008); 465 ha on average in Andalucía (RECAMAN project, ^a unpublished data)
Most common oak	Blue oak (<i>Q. douglasii</i>)	Holm oak (<i>Q. ilex</i>)
Land use	66 % grazed by livestock (Huntsinger et al. 2010)	82 % grazed by livestock (RECAMAN project, unpublished data)
Commodity products	Beef, lamb, wool, firewood, game/hunting, grazing	Beef, Iberian pigs, lamb, acorns, firewood, charcoal, hay, cereals, grazing, wool, goat meat and milk, game, truffles, cheese, fodder, honey, cork.
Ownership	80 % in private ownership; mean ownership 39 years, 3 % corporate; 17 % in trust. (Huntsinger et al. 2010)	85 % in private ownership; mean ownership 25 years in 2010; 79 % in family ownership, 8 % corporate; 13 % in other private ownership (RECAMAN project, unpublished data)
Management	80 % are resident managers/owners; caretakers may manage larger properties. (Huntsinger et al. 2010)	83 % of landowners are involved in dehesa management (RECAMAN project, unpublished data). 9 % are resident owners. 71 % have a residential house in the dehesa for weekends and vacation.
Age of principal landowner	62 years (Huntsinger et al. 2010)	58 years (RECAMAN project, unpublished data)
Education	60 % with a university degree in 2004; for 1985, 50 % (Huntsinger et al. 2010)	41 % have some university education in 2010
Contribution to household economy	14 % earn majority of income from woodlands; more on larger properties. (Huntsinger et al. 2010)	Dehesa management is the main job for one-third of the landowners (MARM 2008).
Labor	Mostly resident landowners; some hired labor.	20 % employ family; 60 % hire ≥ 1 non-family member (MARM 2008); 10–15 h of labor per ha are required to manage property.

^a The RECAMAN project (*Valoración de la Renta y el Capital de los Montes de Andalucía*) of the Junta de Andalucía is ongoing and applies the Agroforestry Accounting System at the regional scale to measure total income and capital from the montes of Andalucía in Spain.



Fig. 1.7 A tour of Spanish researchers to California helped kick off the collaboration. Here a group of Spanish and Californian researchers pose beneath an old cork oak at Mission San Juan Bautista in the central coast of California in 2004. (Photograph by P. Gil)



Fig. 1.8 A visit by Californian researchers to Spain sealed the deal, in the Montes de Jerez in the Sierra de Cádiz (Andalucía) in 2003. (Photograph unattributed)



Fig. 1.9 Learning from a pair of landowners in Spain in 2011. (Photograph by A. Caparrós)



Fig. 1.10 The diverse uses of the dehesa, and a complicated landscape history, is reflected in this view from the Montes de Toledo (Castilla-La Mancha). An abandoned and unroofed building, with chimneys still evident, is surrounded by repopulating oaks, and adjoining the ruins is a field recently harvested for grain production—something less common now than it once was in the dehesa. (Photograph by M. Díaz)

American use, including widespread burning. In the eighteenth century Spanish settlers brought livestock into California, along with new plants that replaced the oak woodland understory. [Chapter 2](#) takes us through periods of over-exploitation that, in some forms, are still ongoing. There is in Spain, for example, deep concern about a lack of oak regeneration, causing some to refer to cork production as the mining of “brown gold” from a putatively renewable resource that is failing to be renewed. In California, the woodlands are considered prime real estate for exurban development, and are being fragmented, converted, and developed, although this is currently slowed by the economic recession that began in 2008. The chapter moves us to the present, with an embedding of oak ranchlands and dehesas in the global economy, and to the shared concern of both countries and hemispheric powers for the future of the woodlands.

1.4.2 Environmental Setting

We then move into the environmental setting, exploring first the climate in [Chap. 3](#) and then soil and water dynamics in [Chap. 4](#). Climate constrains the presence and specific characteristics of California oak woodlands and Spanish dehesas. The authors summarize studies conducted in the two regions, using different methodologies to investigate the influence of climatic factors on the distribution of oak species (Fig. 1.11). Climate strongly influences oak distribution in California. Soil characteristics and socioeconomic issues are more important factors than climate for the creation and maintenance of dehesa in Spain.

Climate conditions, terrain morphology and parent material, but also land use and management, play a crucial role in the functioning of oak woodland ranches and dehesas. The authors review research results to gain understanding of human influences on soil and water through land-use and management practices. Soils in the Spanish dehesa have been subject to many centuries of agricultural use. Erosion by runoff and rivers resulting in the reduction of organic matter and physical degradation are the most important phenomena. For California, the authors present results from studies on water quality and the effects of vegetation conversion on water yield, soil stability, and erosion.

1.4.3 Vegetation

Vegetation is the focus of the next several chapters, examining the critical question of whether or not the oaks are reproducing adequately. Oak woodland area in both regions was greatly reduced in the twentieth century. Scientists and the public are deeply concerned about the sustainability of the remaining woodlands, and a baseline requirement for that is whether or not there is enough seedling survival to replace aging trees. [Chapter 5](#) is about oak regeneration, examining both what we



Fig. 1.11 The massive and often solitary valley oak (*Q. lobata*) is a long-time fixture of the fertile bottomlands and alluvial soils of the valleys and riparian areas in the Central Valley and the coast ranges. However, today most of its range has been converted to field crops. (Photograph by F. Bruno Navarro)

know about the ecology of oak reproduction, and how to restore oak woodlands that have lost oaks. In [Chap. 6](#), the relationship between oaks and their understory is discussed. Although California oak woodlands and the Spanish dehesa may often look very much alike, the dynamics of the understory vegetation are quite different. Shrubs are swift invaders into dehesa and are excluded vigorously by managers ([Fig. 1.12](#)), yet they facilitate oak regeneration by protecting seedlings from summer drought and by maintaining populations of acorn dispersers that move acorns outside of oak canopies. In California woodlands, shrub invasion happens more slowly if at all, but with fire suppression is becoming more common.

Acorns, once the staff of life and still of cultural significance for Native Californians, are important livestock feed in Spain and offer wildlife forage in both places. Acorn production is highly variable from year to year, and researchers are working to explore what factors explain this variability, including ongoing—and changing—dehesa management practices. [Chapter 7](#) explores this body of research, and the potential differences in dynamics between Spain and California and between dehesas and nearby oak forests in Spain.



Fig. 1.12 When shrubs and brush are cleared from hillsides, left in the open are often holm oaks, which by Spanish law are under moderate protection regimes. The dehesa is more readily invaded by shrubs than California's oak ranchlands, and requires regular maintenance. Nonetheless, there is high biodiversity and productivity in the mosaic of vegetation patterns seen in both environments, and a great deal of habitat for game and non-game species as well as livestock enterprises can be sustained. (Photograph by M. Díaz)

1.4.4 Management, Uses, and Ecosystem Response

[Chapters 8, 9, 10, and 11](#) examine the interaction of economic enterprises and the ecosystems of working landscapes. We begin with a look at biological diversity in dehesa and oak woodland ranches, and how management benefits from it and influences it, in [Chap. 8](#). Intensive land use, long-term abandonment of livestock enterprises and active management, and development into housing certainly threatens habitat mosaics that foster both high biodiversity and oak woodland functioning at multiple spatial and temporal scales. The chapter reviews how different management practices can affect the provision of this biodiversity.

In [Chap. 9](#), silvopastoral management models are used to analyze how dehesa and Californian oak woodlands support the production of multiple goods and services. Management scenarios for supporting oak regeneration in dehesa are reviewed and compared to outcomes without such management. Silvopastoral models for California woodlands illustrate the importance of reflecting actual landowner behavior in policy analysis to accurately represent the trajectory of future oak woodland status, whereas Spanish models emphasize the need for public short-term support to landowners to achieve higher longer-term economic and environmental benefits.



Fig. 1.13 With a rough mixture of oaks behind them, including the pointed and sharp leaves of *Q. coccifera*, which in its shrub form is a particularly difficult form of oak to travel through, these hunters are working their way toward assigned posts, part of a *montería* in the Sierra Norte de Sevilla (Andalucía). Such activities, which used to attract mainly wealthy landowners, are now accessible (for a fee) to hunting enthusiasts. The leather chaps are trappings carried over from earlier times when hunters derived as much enjoyment from pushing dogs after game in the oak understory as they did from shooting; a rarity in this day and age when dog handlers are mostly hired and travel from hunt to hunt with their packs of dogs. (Photograph by P.F. Starrs)

Extensive livestock production in dehesa and oak woodland is examined in [Chap. 10](#). In both countries, cattle, sheep, and goats are all found in the woodlands, though cattle are overwhelmingly the most common in California. In Spain, the Iberian pig is fattened on acorns in the oak woodland to produce high quality *jamón* (air-dried ham). In California, acorns are mostly used by wildlife, including wild pigs, an import to California from Europe.

[Chapter 11](#) presents hunting as a source of income for landowners in the woodlands, but also as a product enjoyed by the owner and shared with friends ([Fig. 1.13](#)). Distinct cultural and legal histories governing property rights over wildlife and land tenure have created dissimilar hunting systems in Spain and California with differences that are manifest in the methods of hunting, the economic return to landowners, the actions taken to manage game species, and the accompanying environmental effects.

1.4.5 Oak Woodland Economics

The term ecosystem services was coined in the 1980s to describe the valuation of a full range of human benefits from ecosystems, including provisioning services, regulation and maintenance functions, and cultural services. In [Chap. 12](#), authors

explore efforts to identify oak woodland ecosystem services that may be difficult to quantify and value economically, and which therefore are often undervalued in policy decision-making processes that draw on such analysis. The chapter reviews several studies that attempt to incorporate non-market values of ecosystem services into economic assessments.

In [Chap. 13](#), the authors use case studies of oak woodland ranches and dehesas to reveal how landowners on the ground use their woodlands and profit from them, with tabulations that include the value owners derive from enjoying the amenities that come from owning and managing the land ([Fig. 1.14](#)). A complete Agroforestry Accounting System is applied to enumerate operating income and capital gains or losses. The studies reveal important vulnerabilities in the economic functioning of the enterprises that support the management of these woodlands. Oak woodlands in ranches and dehesas provide multiple public goods, and society and landowners alike need to work together and make compromises in order to pass the natural capital of the woodlands on to future generations ([Fig. 1.15](#)).



Fig. 1.14 Field research investigating dehesas in Spain and oak woodland ranches in California invariably requires ongoing contact with landowners who rightly see themselves as linchpins in the management and maintenance of a complex system of products and benefits that derive from a healthy and thriving ecosystem. In both environments, owners make decisions that reflect their goals and motivations. (Photograph by S. García)



Fig. 1.15 An oak woodland ranch in the Gold Rush country of the Sierra Nevada foothills in California. (Photograph by Lynn Huntsinger)

1.4.6 Dehesa and Oak Woodland Ranch Landscapes

[Chapter 14](#) extends a Geographic Information System (GIS) and remote sensing based model for looking at landscape change in Spain and California, exploring our ability to use the techniques of landscape ecology to understand the drivers of pattern and change in oak woodlands.

We conclude with recommendations for conservation in California and Spain, and our findings of issues that need to be addressed, in [Chap. 15](#). There, the takeaway points from this study are laid out, along with a discussion of the salient advantages of a comparative analytical approach to working landscapes.

References

- Braudel F (1975) *The Mediterranean and the Mediterranean World in the Age of Philip II*, vol 1. Harper and Row, New York (orig. published 1949 in French)
- Butzer KW (1988) Cattle and Sheep from old to New Spain: historical antecedents. *Annals Assoc Am Geog* 78:29–56
- Campos P (1984) *Economía y energía en la dehesa extremeña*. MAPA, Madrid

- CDF-FRAP [California Department of Forestry and Fire Protection-Fire and Resource Assessment Program, CalFire] (2003) Changing California: forest and range 2003 assessment. Sacramento, CA: State of California Resources Agency. <http://www.frap.cdf.ca.gov/assessment2003>. Accessed June 2012
- CIWTG [California Interagency Wildlife Task Group] (2005) California WILDLIFE HABITAT RELATIONSHIPS (CWHR) System version 8.1, personal computer program. California Department of Fish and Game, Sacramento. <http://www.dfg.ca.gov/biogeodata/cwhr/>. Accessed Aug 2012
- Doolittle WE (1987) Las Marismas to Pánuco to Texas: the transfer of open range cattle ranching from Iberia through Northeastern Mexico. Yearbook, Conf Lat Americanist Geog 23:3–11
- Gaman T, Firman J (2006) Oaks 2040: The status and future of oaks in California. California oak foundation, Oakland http://www.forestdata.com/Oaks2040_long_version_web.pdf. Accessed Sept 2012
- Huntsinger L, Johnson M, Stafford M, Fried J (2010) California hardwood rangeland landowners 1985 to 2004: ecosystem services, production, and permanence. Rangel Ecol Mgmt 63:325–334
- Jordan TG (1989) An Iberian lowland/highland model for Latin American cattle ranching. J Hist Geog 15:111–125
- MARM [Ministerio de Medio Ambiente y Medio Rural y Marino] (2008) Diagnóstico de las Dehesa Ibéricas Mediterráneas. Tomo I. Available at: http://www.magrama.gob.es/es/biodiversidad/temas/montes-y-politica-forestal/anexo_3_4_coruche_2010_tcm7-23749.pdf. Accessed Aug 2012
- Parsons JJ (1962a) The Acorn-Hog Economy of the oak-woodlands of Southwestern Spain. Geogr Rev 52:211–235
- Parsons JJ (1962b) The cork oak forests and the evolution of the cork industry in Southern Spain and Portugal. Econ Geog 38:195–214
- Pavlik BM, Muick PC, Johnson SG, Marjorie Popper (1991) Oaks of California. Cachuma Press, Los Olivos
- Sluyter A (1996) Ecological origins and consequences of cattle ranching in sixteenth-century New Spain. Geogr Rev 86:161–177
- Starrs PF (1997) Let the cowboy ride: cattle ranching in the American West. Johns Hopkins University Press, Baltimore
- Starrs PF, Huntsinger L (1998) The cowboy & buckaroo in American ranch hand styles. Rangel 20:36–40
- Stromberg MR, Corbin JD, D'Antonio CM (eds) (2007) California grasslands: ecology and management. University of California Press, Berkeley and Los Angeles