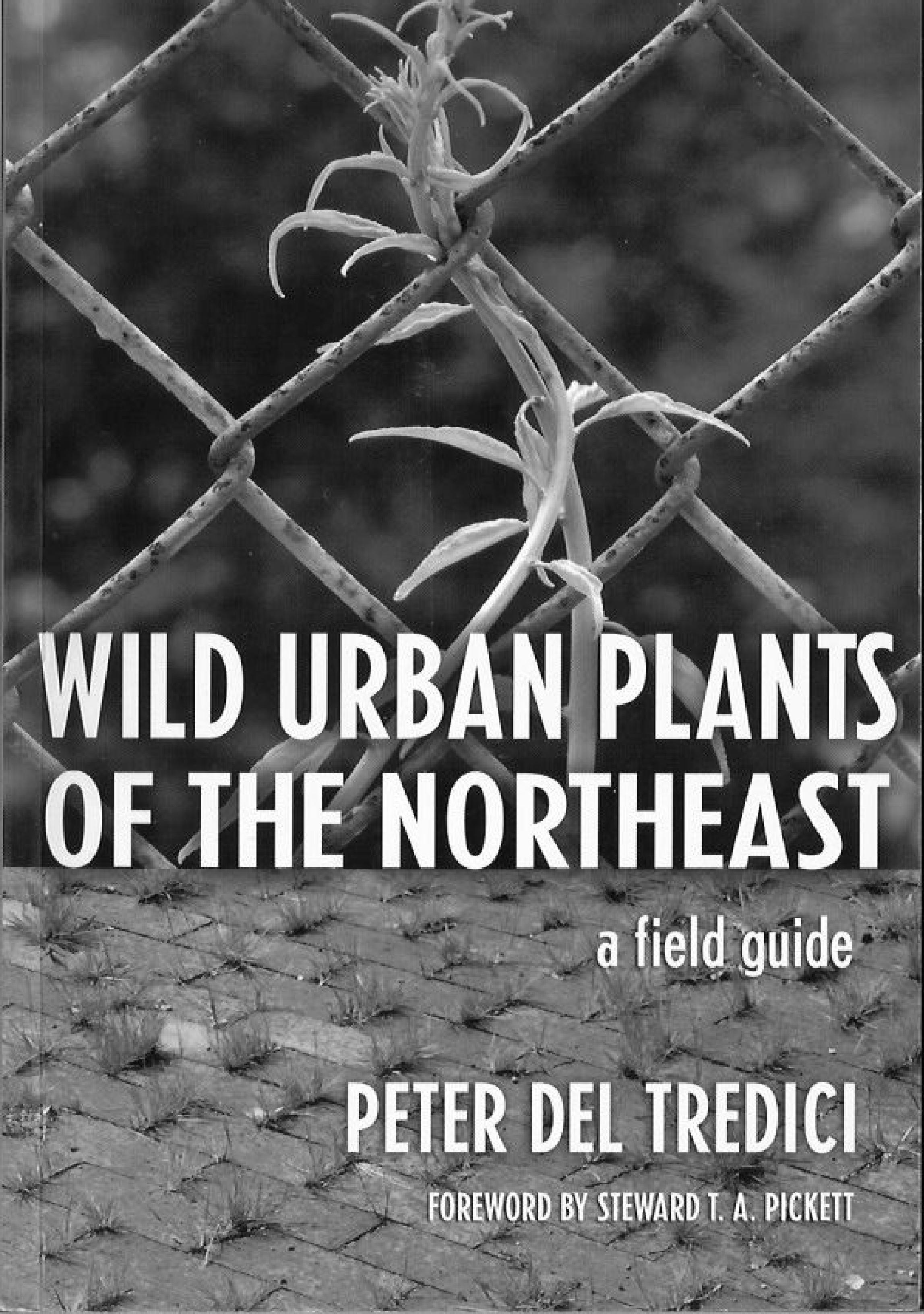

WILD URBAN PLANTS OF THE NORTHEAST

a field guide

PETER DEL TREDICI

FOREWORD BY STEWARD T. A. PICKETT

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Peter Del Tredici

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A FIELD GUIDE

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To my grandchildren
for whom the ordinary
is extraordinary

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FOREWORD

Steward T. A. Pickett

You hold in your hands an important book. It makes up for a long-standing neglect of the wild plants that inhabit America's cities and suburbs, filling in the untended, unnoticed, and perhaps unvalued nooks, vacant lots, ditches, and edges of industrial properties that suffuse our metropolises. These plants get around on their own; struggle unaided for light, nutrients, and water; and thrive without our direct intervention. The biological and ecological stories they represent and the benefits they contribute to our local ecosystems are often untold, but are both fascinating and important. This book is a key to a natural history that is almost invisible to most people, even though it is right before our eyes.

More than 50% of the world's people now live in or near cities. In the United States and other wealthy countries, more than 80% of the people live in cities and suburbs, and urban life is becoming the norm even in countries that have not benefited from the profits and products of the industrial revolution. While cities and suburbs have become the dominant habitat of humankind around the globe, however, too often the wild plants that grow in these areas and the unmanaged ground they inhabit are ignored. People fail to realize that were it not for the volunteer wild vegetation in our cities, suburbs, and towns we would be ecologically less well off. This ignorance is unfortunate because these plants offer urban inhabitants easy access to nature and its lessons and benefits. Once they are better understood, our urban ecosystems can help us live healthier, more rewarding, better integrated, and less consumptive lives. All that is needed is a tool to help us see them and understand what kind of ecological work they contribute in places where we have so actively pushed aside nature and the natural. This book is that tool.

Urban places are complex mixes of the human, the built, the cultivated, and the wild. It is important to approach them as a complex whole whose components are seen to contribute to sustainability, health, beauty, and function. Yet, American ecological science has been focused on nonurban places, emphasizing floras beyond the municipal limits. It is perhaps natural for people to be fascinated by the unfamiliar and the exotic, but this biological wanderlust has left us with little appreciation for the untended green that is a real and important part of our complex urban ecosystems.

My nearly two decades of work on urban ecosystems have made it clear to me that cities provide previews of global change. The climate shifts predicted for the world at large are already the reality in major cities and metropolitan areas. Elevated temperatures and carbon dioxide levels, dry soils, and concentrations of contaminants are the norm in cities. The plants that inhabit the wild spots in cities are well adapted to these stressed and disrupted habitats; indeed, it is doubtful that the plants that characterize nonurban places would be able to do as well.

If it is to fulfill its potential, the urban wild flora must be better understood and better used. In other words, its functions, not just its categories—native, exotic, invasive, naturalized—must be appreciated by professionals and citizens alike. Understanding should come before judgment when urban wild plants are concerned. This book provides a refreshingly unprejudiced look at urban wild flora and ultimately invites us all to look for better ways to appreciate wild plants and to use them in our efforts to improve the ecology and the human life of the city.

PREFACE

The genesis of this book goes back to the spring of 2004 when I was on a field trip with my landscape architecture students from the Harvard Graduate School of Design. We were visiting Spectacle Island, a capped landfill in the middle of Boston Harbor, studying the multitude of plants that were growing there. At some point, as I was explaining how to identify a particular specimen growing alongside the pathway, I casually mentioned how unfortunate it was that we lacked the class time to learn about the weedy plants that are so abundant in the urban environment. The ecology course covered the native species, but no class covered the weeds that were all around us. One of the students, Leah Broder, immediately suggested we set up a website for the class that would help students learn to identify these plants on their own time. We speculated that we could do it in a year, in time for next spring's class, by using my slides with a bit of added text.

Back at the Design School I quickly put together a grant proposal that was funded by the Harvard Center for Innovative Teaching Technologies. With this money and a lot of help from Kevin Lau in the Media Department I was able to hire Leah and another of my students, Ken Francis, to create the EVUE (*Emergent Vegetation of the Urban Environment*) website, which, remarkably, was operational by August 2005. With a continuation of the grant for a second year and additional help from two more of my students, Sharon Komarow and Addie Pierce McManamon, I was able to expand the fledgling website to about a hundred species and add new digital images. At this point, in September 2006, the money ran out, leaving the website frozen in time. It was then that I began thinking of putting all the information and photos together into book form and doubling the number of species covered. This second phase of the project took an additional four years to complete, and this book is the final result. While I have taken precautions to ensure that the information in this book is accurate, there will inevitably be some mistakes, for which I take sole responsibility.

ACKNOWLEDGMENTS

In addition to the students mentioned above I would like to acknowledge the encouragement and assistance provided by my professional colleagues, including Randy Prostak of the University of Massachusetts, who reviewed the manuscript and photos for accuracy; Les Mehrhoff of the University of Connecticut, who helped me with the identification of several problematic species; and Alan Berger, Richard Forman, Robert France, Niall Kirkwood, Christian Werthmann, and Paula Meijerink of the Harvard Graduate School of Design, who provided important comments and ideas during the early stages of writing the book. I also want to thank Roxana and Ledlie Laughlin of Cornwall, Connecticut, for generously allowing me to use their beautiful cabin in the woods to complete the manuscript during the summer of 2008; Izabela Riano, who put the finishing touches on several of the photographs, Cynthia Silvey and Melissa Guerrero who put together the data on the city of Somerville, Massachusetts (Figure 2), and my editor at Cornell University Press, Heidi Lovette. Finally, I especially want to thank my two children, Sonya and Luke, who for years uncomplainingly put up with innumerable travel delays while I stopped to take yet another "weed" picture; and my wife, Susan Klaw, whose support during the six long years of writing this book has been unwavering.

WILD URBAN PLANTS OF THE NORTHEAST

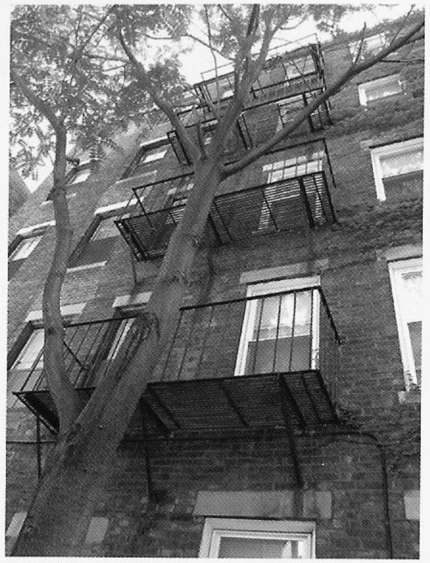
INTRODUCTION

> The flora of today surely differs from that of five hundred or more years ago, due largely to the influence of an increasingly complicated civilization; may it not be of interest to record in detail the ruderals and escapes of to-day as a prophesy of the flora of the not distant future?
>
> —Edgar Anderson and Robert Woodson
> *The Species of Tradescantia*, 1935

The basic goal of *Wild Urban Plants* is to help the general reader identify the plants that grow spontaneously in the urban environment and develop an appreciation for the role they play in making our cities more livable. The 222 plants featured in this book are the ones that fill the vacant spaces between our roads, our homes, and our businesses; take over neglected landscapes; and line the shores of streams, rivers, lakes, and oceans. Some of the plants are native to the region and were present before humans drastically altered the land; some were brought intentionally or unintentionally by people; and some arrived on their own, dispersed by wind, water, or wild animals. They grow and reproduce in the city without being planted or cared for. They are everywhere and yet they are invisible to most people.

Given that cities are human creations and that the original vegetation that once grew there has long since disappeared, one could argue that spontaneous plants have become the de facto native vegetation of the city. Indeed, a basic premise of this book is that the ecology of the city is defined not only by the cultivated plants that require ongoing maintenance and the native species that are restricted to protected natural areas, but also by the plants that dominate the neglected interstices of the urban environment. This "wasteland" flora occupies a significant percentage of the open space in many American cities, especially those with faltering economies. Recent research indicates that if such vegetation is left undisturbed long enough to develop into woodlands, it can provide cities with important social and ecological services at very little cost to taxpayers (Zipperer et al. 1997; Kowarik and Körner 2005; Weiss et al. 2005; Mauratet 2007).

Perhaps the most well-known example of a "spontaneous" plant is *Ailanthus altissima*, or tree-of-heaven, introduced from China. Widely planted in the Northeast in the first half of the nineteenth century, *Ailanthus* was later rejected by urban tree



Spontaneous trees, such as this tree-of-heaven (*Ailanthus altissima*), can become significant components of the urban forest.

planters as uncouth and weedy. Despite concerted efforts at eradication, the tree managed to persist by sprouting from its roots and spread by scattering its wind-dispersed seeds. Its urban niche was famously described by Betty Smith in her 1943 novel, *A Tree Grows in Brooklyn*: "There's a tree that grows in Brooklyn. Some people call it the Tree of Heaven. No matter where its seed falls, it makes a tree which struggles to reach the sky. It grows in boarded-up lots and out of neglected rubbish heaps. It grows up out of cellar gratings. It is the only tree that grows out of cement. It grows lushly . . . survives without sun, water, and seemingly without earth. It should be considered beautiful except that there are too many of it."

Although it is ubiquitous in the urban landscape, *Ailanthus* is never counted in street tree inventories because no one planted it—and consequently its contribution to making the city a more livable place goes completely unrecognized. When the mayor of New York City promised in 2007 to plant a million trees to fight global warming, he failed to realize is that if the *Ailanthus* trees already growing throughout the city were counted he would be halfway toward his goal without doing anything. And that, of course, is the larger purpose of this book: to open people's eyes to the ecological reality of our cities and appreciate it for what it is without passing judgment on it. *Ailanthus* is just as good at sequestering carbon and creating shade as our beloved native species or showy horticultural selections. Indeed, if one were to ask whether our cities would be better or worse without *Ailanthus*, the answer would clearly be the latter, given that the tree typically grows where few other plants can survive.

There is no denying the fact that many—if not most—of the plants covered in this book suffer from image problems associated with the label "weeds"—or, to use a more recent term, "invasive species." From the plant's perspective, invasiveness is just another word for successful reproduction—the ultimate goal of all organisms, including humans. From a utilitarian perspective, a weed is any plant that grows by itself in a place where people do not want it to grow. The term is a value judgment that humans apply to plants we do not like, not a biological characteristic. Calling a plant a weed gives us license to eradicate it. In a similar vein, calling a plant invasive allows us to blame it for ruining the environment when really it is humans who are actually to blame. From the biological perspective, weeds are plants that are adapted to disturbance in all its myriad forms, from bulldozers to acid rain.

Their pervasiveness in the urban environment is simply a reflection of the continual disruption that characterizes this habitat. Weeds are the symptoms of environmental degradation, not its cause, and as such they are poised to become increasingly abundant within our lifetimes.

This book was written for the ordinary urban resident who has some curiosity about the plants and animals that live in the city—the type of person who notices and admires tenacious weeds growing in the sidewalk cracks or trees growing out of building foundations. The extensive use of photographs coupled with a minimal use of botanical jargon is intended to facilitate plant identification for people without formal botanical knowledge or training. Essentially this book is a beginner's guide to urban plants that can also serve as a primer on urban vegetation for students of all levels who are studying environmental science.

What Is a Weed?

I consulted innumerable written and electronic publications about weeds and invasive species in the process of writing this book. Most focused on plants that are considered to be problems in either an agricultural context, where the issue of competition with economic crops is the primary concern, or a residential context, where an unsightly plant is growing in a place where people are trying to cultivate something else. The term *invasive species* is used to describe a plant that displaces native vegetation in natural areas in a suburban or rural context. When it comes to *spontaneous urban plants,* people's complaints are usually aesthetic (the plants are perceived as ugly signs of blight and neglect) or security related (they shield illicit human activity or provide habitat for vermin). Indeed, the context in which a plant is growing not only determines the label that we put on it but also the positive or negative value that we assign to it.

Although there is considerable overlap among the three categories of plants listed above, they can be readily distinguished by the types of landscapes in which they grow—the constructed, the agricultural, and the ecological. In general, urban habitats have an abundance of pavement, problematic soil conditions, and frequent physical disturbance; agricultural habitats combine extreme soil disturbance with high nutrient levels; and ecological habitats are characterized by relatively low levels of soil disturbance and introduced nutrients. While disturbance is clearly an integral part of the ecology of all three types of habitats, they differ from one another in the frequency with which the disturbance reorders the environment and resets the so-called successional clock.

Succession—the change in the composition of biological communities over time—is typically driven by disturbance events. The initial stages of the process are referred to as *early succession* and are dominated by rapidly growing species that do best in full sun. Over time, these plants give way to shade-tolerant *late succession* species, which persist on the site until the next round of disturbance.

Disturbance of vacant urban land tends to be periodic. Structures are built, used, abandoned, torn down, and so on. Such disturbance is often tied to governmental

Common reed dominates this "loading dock wetland" in an abandoned Detroit factory.

approval processes that typically take 5 to 20 years for implementation. For agricultural land, the typical disturbance cycle occurs on an annual basis and begins every time the ground is plowed. The disturbance cycle for woodland landscapes is on the order of 50 to 100 years, depending on a combination of unpredictable climatic, biological, and economic factors.

The duration of the "disturbance return" cycle determines the composition of the plant communities that grow in each of the three habitat types. The vegetation of urban land, with its intermediate disturbance cycle, is composed of more or less equal numbers of annuals, herbaceous perennials, and woody plants. Annual and biennial species dominate agricultural landscapes; and long-lived woody plants dominate forested landscapes (Muratet et al. 2007).

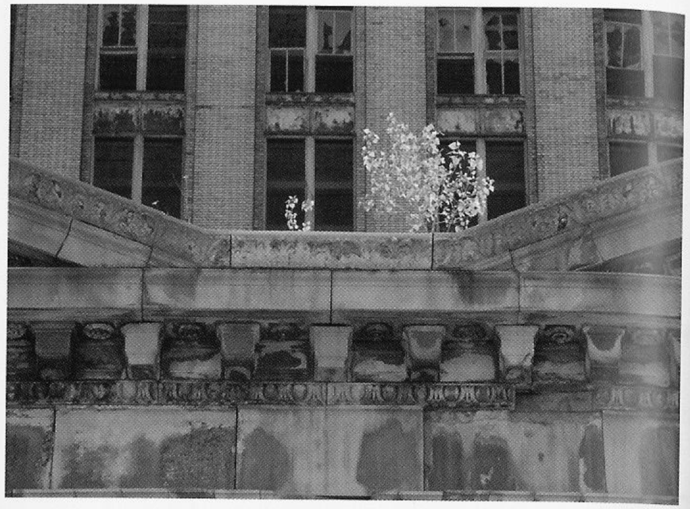
Criteria for Developing the List of Wild Urban Plants

Developing the list of plants covered in this book was a lengthy process that required me to develop a biologically relevant definition of the term *urban*, which as I use it, refers to any part of a city or town where more of the land is covered with pavement and buildings than not, and all traces of original native habitats have disappeared. The urban environment is also characterized by high levels of disturbance associated with pedestrian and vehicular traffic, infrastructure maintenance, and new construction. Plants that can survive and reproduce under such conditions are referred to as spontaneous urban vegetation. From a plant's perspective, it is the abundance of paving and disturbance rather than the density of the human population that defines the urban environment. In other words, a sidewalk crack is a sidewalk crack whether it is in a city or a suburb. For the purposes of this book, the term *urban* does not include minimally disturbed, usually protected, natural areas found within the boundaries of the city and the species list does not include

Figure 1. Urban areas of northeastern North America showing census blocks with a population density of at least 1,000 people per square mile and surrounding census blocks with an overall density of at least 500 people per square mile. U.S. data are from the 2000 census; Canada data are primarily from the mid-1990s (Government of Canada). Illustration courtesy of Alan Berger and Case Brown of the Project for Reclamation Excellence (P-REX).

plants that are confined to such remnant habitats, although it does include native species that have moved out of such natural areas and into the city. Nor does the list include cultivated species characteristic of managed landscapes within the urban environment unless they have "escaped" and become naturalized in the surrounding unmanaged areas.

The plants covered in this book are commonly found growing spontaneously in the cities of the Northeast—both large and small—from Montreal, Quebec, in the north, to Boston, Massachusetts, in the east, to Washington, D.C., in the south, and to Detroit, Michigan, in the west, with the core coverage area extending along the eastern seaboard from Boston to Philadelphia. My categorization of a plant as common is based on a review of the relevant literature on spontaneous vegetation



Quaking aspen colonizing the roof of the abandoned Central Train Depot in Detroit.

as well as my personal observations over a number of years in numerous northeastern cities. The decision to exclude certain plants was ultimately a subjective one on my part, motivated partly by space limitations and partly by the book's focus on species that are ubiquitous in the urban environment. As one moves south and west of the core coverage area, one is more likely to find spontaneous species not covered in this book. From the ecological perspective almost all of the plants included in this book are disturbance-adapted, early successional species (Appendix 3). Excluded from the book are many familiar ground covers such as the common orange daylily, periwinkle, and lily-of-the-valley which can spread aggressively once planted in gardens but are typically not capable of moving into new areas without the help of people.

Where Do Urban Plants Come From?

Of the 163 herbaceous angiosperms (128 dicots and 35 monocots) treated in this book, 59% came to North America from Europe (including adjacent parts of Asia and North Africa), 26% are native only to North America (including Central America), 10% are native to both North America and Eurasia, and 5% originated in Eastern Asia. Remarkably, only 1 plant—bermudagrass (*Cynodon dactylon*)—appears to be native exclusively to Africa. In contrast, the 54 woody angiosperms covered here are mainly native to temperate North America (51%) and Asia (32%), with only 17% coming from Europe (Table 1). The different geographical origins of the herbaceous species and the woody species reflect the deeper evolutionary patterns that underlie the modern distribution of urban plants (Grime 2001).

The origin and global dispersal of spontaneous urban vegetation is as much a cultural as a biological phenomenon. European ecologists have traditionally had a stronger interest in the subject than their American counterparts because Europe

TABLE 1. Geographical Origin of the Plants Described in This Book

	North & Central America	Europe & Central Asia	Eastern Asia	Eurasia & North America	Africa	Totals
Ferns & Horsetails	2	—	—	2	—	4 (1.5%)
Conifers	—	—	1	—	—	1 (0.5%)
Woody Dicots	27	9	18	—	—	54 (24.5%)
Herbaceous Dicots	34	79	6	9	—	128 (58%)
Monocots	9	17	2	6	1	35 (15.5%)
Totals	72 (32.5%)	105 (47.5%)	27 (12%)	17 (7.5%)	1 (0.5%)	222

has a much longer history of urbanization. By combining sophisticated archaeological work with modern ecological research they have been able to reconstruct the complex history of their continent's urban flora. As part of this process they subdivided the category of alien plants into *archaeophytes*, which were introduced with agriculture into a given area from other parts of Europe prior to 1500, and *neophytes*, which were introduced after 1500, mainly from Asia and North and South America (Pyšek 1998; Wittig 2004). This distinction is of little relevance to American botanists, who tend to lump all European plants together as "aliens."

The dichotomy represented by these two terms reflects the long history—going back thousands of years—of moving both food and medicinal plants around *within* the Mediterranean basin (between southern Europe, North Africa, Turkey, and the Middle East); from central Asia *into* the Mediterranean basin; and from the Mediterranean region *into* central, eastern, and northern Europe. When one realizes that twenty-two of the plants covered in this book were described almost 2000 years ago by the Greek physician Dioscorides in *De Materia Medica*—a five-volume work about medicinal plants that remained in usage into the 1600s—one begins to get an inkling for just how ancient the relationship between archaeophytes and humans is (Appendix 1). The fact that we no longer use these plants to treat diseases does not diminish the significance of the role they played in the development of human culture.

The movement of plants from Europe into North America that began in the 1600s with the founding of Plymouth colony and continued through the 1800s is part of the larger story of human migration. The earliest North American settlers from Europe brought their entire lifestyle along with them—not only their own personal belongings and food for the first year, but also seeds of their crop plants, livestock and the fodder to feed them, and medicinal plants. In addition to these intentionally cultivated plants, the colonists inadvertently brought weed seeds embedded in the hay they brought for their animals and mixed in with the grains they sowed on the land they cleared. Essentially, the weeds came to North America along with the crops. In his classic book *New-England's Rarities Discovered* (1672), John Josselyn documented the presence of dozens of European weeds growing spontaneously in New England under the category "Of such plants as have sprung up since the English planted and kept cattle in New England" (Appendix 2). Clearly Europeans' invasion of North America was biological as well as cultural.

English-speaking people dominated the initial settlement of North America, but immigrants from other western European countries were quick to follow, driven by difficult economic conditions in their homelands. And just as the members of each group came with their own language and culture, they also brought their own crops and agricultural practices. Indeed, of the 150 nonnative species covered in this book, at least half were intentionally cultivated prior to their escape from the farm or garden (Rehder 1946; Mack 2000, 2003; Mack and Ernberg 2002).

This flood of European plants into North America dramatically and permanently altered the North American landscape. In contrast, only a few North American species have become naturalized in Europe, most notably black locust, black cherry, pokeweed, and box elder, along with a number of goldenrods, asters, and evening primroses; all are native to disturbed, early successional habitats (Marks 1983; Wittig 2004). This asymmetry in the biological exchange between the two continents is undoubtedly a reflection of the lob-sided nature of the cultural exchange.

After Japan was forcibly opened to the West in 1853, new plants from Asia—most notably woody plants—began pouring into North America through ports on the U.S. West Coast. At first only wealthy estate owners and commercial nurseries could afford to import these exotic species. However, with time and U.S. government support for plant exploration in China, large numbers of Asian plants were introduced into our horticultural and agricultural landscapes. Many of these species—including kudzu, multiflora rose, Japanese barberry, and various honeysuckles—were widely planted from the 1930s through the 1970s when using plants to control (a legacy of the Great Depression) was considered ecologically and economically responsible.

At the same time that exotic plants were being introduced from Europe and Asia, native American species were being shuffled around as settlers moved inland from the Atlantic Coast. Perhaps the best example of this kind of movement is the black locust, *Robinia pseudoacacia,* which originally had a distribution limited to the Appalachian and Ozark mountain ranges and now grows spontaneously throughout North America—to such an extent that many states now classify it as an invasive species. Mühlenbach's (1979) monograph on the "synantropic" flora of St. Louis documents the significant role played by railroads in moving both native and introduced plants around the country during the nineteenth and twentieth centuries, to say nothing of the fact that the railroad bed itself provided an ideal corridor for the migration of disturbance-adapted species.

At the local level, the movement of plants into cities was facilitated when soil from the countryside—usually loaded with seeds and rhizomes—was used to fill in

Spontaneous vegetation dominates this front yard where a privet hedge (*Ligustrum vulgare*) once grew.

coastal and freshwater wetlands for urban development. The most extreme example of such wholesale translocation of soil and its included seeds resulted from the imbalance of trade between Europe and North America in the nineteenth century when European ships coming to the United States typically arrived filled with rocks and soil as ballast. This ballast was then discarded on shore before loading up with cargo for the return trip—creating extensive "ballast grounds" in many American port cities. Needless to say, the novel assemblage of plants that showed up on these piles attracted the attention of observant botanists, who carefully documented the arrival and spread of the stowaways (Mehrhoff 2000).

These eighteenth- and nineteenth-century manifestations of globalization pale in comparison with what has taken place during the twentieth century as formerly independent economies have become totally interdependent. People and commercial goods now flow seamlessly around the globe, accompanied by a host of weeds, pests, and pathogens (Kareiva et al. 2007). A recent example of this kind of unintentional exchange is the Asian longhorned beetle, which entered North America in the 1990s embedded in wooden shipping pallets and now threatens maple trees growing in several metropolitan areas in the Northeast.

In much the same way that globalization has destabilized long-standing local economic institutions, it has also destabilized well-established ecological associations and led to the establishment of new ones. In essence, the plants that grow in our cities are a cosmopolitan array of species that reflect the natural and cultural histories of the area. Every type of land use seems to leave behind as a legacy a few species able to make the transition to the new type of land use. For cities, this sequence starts with native species adapted to ecological conditions before the city was built. These are followed, in succession, by species adapted to agriculture and pasturage, to pavement and compacted soil, to lawns and landscapes, to infrastructure and pollution, and ultimately to rubble and abandonment.

What Makes a Successful Urban Plant?

The plants that grow and survive in derelict urban wastelands are famous (or infamous) for their ability to grow under extremely harsh conditions. There are many reasons why some plants can survive on these sites while others die, but in essence, the plants that can survive and reproduce on their own in the urban environment are among the toughest on the planet. Through a quirk of evolutionary fate, they developed traits in their native habitats such as the formation of a taproot, that seem to have "preadapted" them to flourish in urban sidewalk cracks (Larson et al. 2004). One study concluded that many successful urban plants are native to exposed cliffs or dry, open grasslands, both of which are characterized by soils with a relatively high pH (Lundholm and Marlin 2006). Cities, with their tall, granite-faced buildings and concrete foundations, are in a sense the equivalent of the natural limestone cliff habitats where many of these species originated. Similarly, the increased use of deicing salts on our roads and highways has resulted in the development of microhabitats along their margins that are typically colonized by calcium-loving grassland species adapted to limestone soils as well as salt-loving plants from coastal habitats.

Plant biologists have identified a number of characteristics that seem to preadapt species to succeed in highly disturbed agricultural or urban environments. In Table 2, I have adapted H. G. Baker's 1974 list of "ideal weed characteristics" to fit spontaneous urban vegetation. In general, the successful urban plant needs to be *flexible* in all aspects of its life history from seed germination through flowering and fruiting, *opportunistic* in its ability to take advantage of locally abundant resources that may be available for only a short time, and *tolerant* of the stressful growing conditions caused by an abundance of pavement and a paucity of soil.

TABLE 2. General Characteristics of Spontaneous Urban Plants

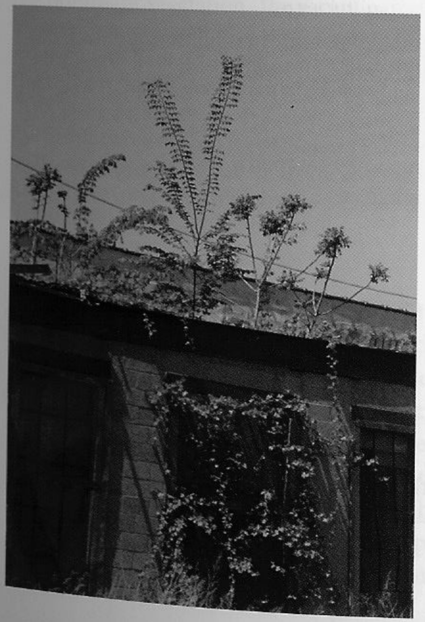
- Their seeds can germinate under a wide variety temperature and light conditions.
- Their seeds have great longevity and can germinate after long periods of burial.
- Their seeds are widely dispersed by wind or animals.
- Their flowers are self-pollinating or pollinated by wind or generalist insects.
- They are adaptable in their growth requirements and can tolerate a wide range of nutrient, light, moisture, and temperature conditions.
- They can readily colonize disturbed soils in full sun.
- They can tolerate problematic soils characterized by any or all of the following: low levels of organic matter, high levels of chemical contamination, relatively high pH, and high levels of compaction.
- They can tolerate drought induced by the abundance of impervious pavement.
- Annual species begin flowering at an early age and produce seed over a long period of time.
- Annuals and herbaceous perennial species display a high degree of "phenotypic plasticity": when growing conditions are good they are large and produce abundant seed crops, and when conditions are poor they are stunted with limited seed production.
- Many herbaceous species display a prostrate growth habit with a strong taproot and are tolerant of trampling or mowing.
- Many perennial species have low winter chilling requirements and begin growing early in spring, as soon as weather permits. This tendency is accentuated in the city relative to the country because of the warmer winter temperatures.
- Many woody species can sprout vigorously from specialized underground structures or cut stems following traumatic damage or extreme drought.

Source: Modified from H. G. Baker, "The Evolution of Weeds," *Annual Review of Ecology and Systematics* 5 (1974): 1–24.

Urban Ecology

At first glance, the term *urban ecology* might seem an oxymoron. Nevertheless, cities do have their own distinctive ecology, dominated by the needs of people and driven by socioeconomic rather than biological factors. People welcome other organisms into cities to the extent that they contribute to making the environment a more attractive, more livable, or more profitable place to be; and they vilify as weeds those organisms that flourish without their approval or assistance. Regardless of humans' preferences, an enormous variety of nonhuman life has managed to crowd into cities to form a cosmopolitan collection of organisms that is every bit as diverse as the human population itself.

The complex cultural, geological, and biological histories of most American cities have made them a patchwork of ecological habitats, each characterized by a distinctive suite of plants and animals. From a strictly functional perspective, ecologists generally classify urban land into three categories: remnant, or leftover, native landscapes; intentionally planted or managed landscapes; and ruderal, or abandoned, landscapes (Whitney 1985; Zipperer et al. 1997). The details of this classification scheme are presented in Table 3.



A spontaneous "green roof" on an abandoned Detroit factory featuring tree-of-heaven, Siberian elm, and riverbank grape.

TABLE 3. Generalized Taxonomy of Urban Landscapes in the Northeast

NATIVE (REMNANT) LANDSCAPES: Patches of natural woodlands and wetlands persisting from times of early settlement; they are dominated by **native plants** growing on relatively undisturbed soils and require low levels of maintenance.

- Freshwater wetlands
- River and stream corridors
- Saltwater marshes
- Woodlands
- Cliffs and rock outcrops

MANAGED (CONSTRUCTED) LANDSCAPES: Intentionally designed planting areas that serve specific public functions; they are dominated by **cultivated plants** growing on relatively rich soil (often imported or manufactured) and require moderate to intensive maintenance to preserve their integrity.

- Lawns and ball fields
- Public parks and cemeteries with horticultural plantings
- Residential and commercial landscapes
- Developed river and stream corridors
- Street trees, infrastructure plantings, and parking lots

RUDERAL (ADAPTIVE) LANDSCAPES: Abandoned or neglected land and urban infrastructure dominated by **spontaneous plants** growing on disturbed or compacted soils and require zero maintenance.

Abandoned or Degraded Open Space

- Trampled lawns and ball fields
- Neglected ornamental landscapes (residential, commercial, and public)
- Emergent woodlands and thickets on abandoned land
- Vacant lots in various states of succession
- Freshwater wetlands, ponds, and streams
- Channelized riverbanks (negatively impacted by roadways)
- Saltwater marshes with impeded drainage
- Exposed rock outcrops

Urban Infrastructure

- Small pavement openings (tree pits), edges, and cracks
- Chain-link fence lines
- Stone and masonry walls
- Alleyways (in perpetual shade)
- Compacted dirt walkways
- Roadway and highway banks, edges, and median strips
- Railroad beds and rights-of-way (with gravel substrate)

Figure 2. This map of Somerville, Massachusetts, shows vacant residential, commercial, and industrial lots (red) and railroad right-of-ways (yellow) where spontaneous plants are the dominant vegetation. The vacant parcels of land were identified on the basis of parcel-level tax assessments, and they were mapped using ESRI's ArcMap 9.2 software based on existing GIS data provided by MassGIS and the City of Somerville. The average widths of the rail corridors were calculated based on a 40-foot (12.2 m) buffer from the centerlines of existing railroads, both active and inactive. Based on the overlay of these data, the minimum area of the city of Somerville dominated by spontaneous vegetation is calculated to be roughly 9.7% of the total land area of the city (0.4 of 4.1 square miles [1.03 km^2 of 10.6 km^2]). Map prepared by Cynthia Silvey and Melissa Guerrero with assistance from Ellen Schneider of the City of Somerville.

Essentially, remnant landscapes are left over from the time before the city spread out to embrace them. They include everything from freshwater wetlands and woodlands to salt marshes near the coast. They are residual parts of the original landscape dominated by native species growing on relatively undisturbed soils. Managed or functional urban landscapes are created specifically for human use and enjoyment. They are dominated by horticultural plants growing on relatively good soil and require a consistent input of human energy (i.e., maintenance) in order to survive. Abandoned urban landscapes receive no maintenance and are dominated by spontaneous vegetation growing mainly on compacted or fill soils. These neglected wastelands typically experience high levels of disturbance and can be as inconspicuous as a sidewalk crack or as prominent as an abandoned rail yard or vacant lot (Kastner 1993; Stalter 2004).

Disturbance Ecology

It is not a big step for a disturbance-adapted wild plant to become first an agricultural weed and then an urban weed, but neither is it a given. In the first place, the agricultural niche is much richer in terms of the availability of light, nutrients, and water than the urban environment, which is characterized by an abundance of drought-inducing pavement and compacted soil. Second, the disturbance-driven succession cycle in the city is unpredictable and depends on socioeconomic rather than seasonal factors. To borrow a term from ecology, the urban environment is *patchy* compared with the agricultural habitat. As everyone who lives in the city knows, it is always under construction: old buildings are being razed, new buildings are being erected, infrastructure is being replaced, roadways are being repaved or put underground, and, most destructive of all, open land is being cleared for commercial expansion. At any given time a significant portion of the urban fabric is in the process of being torn up and rebuilt.

Such periodic, unpredictable disturbance combined with the continual introduction of new species into the urban environment from outside sources—including nursery plants with their associated weeds, lawn-seed mixes, construction fill, and seeds carried by wind and migrating animals—provide all the components necessary to produce the typical arrested succession cycle of the urban environment. Disturbance and immigration interact on a continuous basis in the urban environment to create a constantly shifting mosaic of plant associations dominated by stress-tolerant, early successional species (Figure 3). By way of analogy, this situation is not all that different from the dynamism that characterizes the human population of the city as one ethnic group replaces another when the socioeconomic status of a given neighborhood shifts either upward or downward.

As many scientists have pointed out, modern climate change can be viewed as a massive, uncontrolled experiment on the impact of increased atmospheric carbon dioxide concentrations on the earth's ecosystem. Most people now realize that after nearly 200 years of burning fossil fuels these impacts are both wide ranging —they have affected every corner of the globe—and, at the local level, unpredictable. And this is where the cities come in.

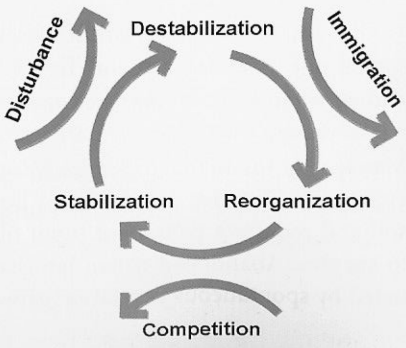


Figure 3. The drivers of the succession cycle in urban habitats.

This sea of urban blacktop looks like a volcanic lava flow, and the plants that grow here, including mullein (*Verbascum thapsus*), chicory (*Cichorium intybus*), New England hawkweed (*Hieracium saubadum*), and frost aster (*Symphyotrichum pilosum*) are extremely drought tolerant.

TABLE 4. **Common Stress Factors for Urban Plants**

- **Paving** reflects heat and light, and leads to higher temperatures in both summer and winter; its impervious nature inhibits the movement of water and air into the soil and leads to drought problems.
- **De-icing salts** used along roads and walkways elevate the soil pH and can lead to "osmotic drought."
- **Drainage problems** are often caused by the construction of buildings and roadways, which inhibit the flow of water across a site.
- **Soil compaction** is a by-product of all construction activities and heavy foot traffic; it results in poorly drained, chronically dry soils.
- **Air pollution** from the burning of fossil fuels (especially ozone and sulfur dioxide) can injure plants and reduce soil pH.
- All of these factors, acting singly or in concert, weaken plants and make them more susceptible to damage **by insects and pathogens.**

Because all the impervious paving and buildings absorb and retain heat, and all the cars, air conditioners, and electrical equipment generate heat, the annual mean temperatures of large urban areas (i.e., with populations in excess of a million people) can be up to 5.4° F (3° C) warmer than the surrounding nonurban areas; on extreme occasions the temperature differences between the city and the countryside can be as high as 21.6° F (12° C) (Sieghardt et al. 2005; George et al. 2007). This "heat island effect" means that the core areas of many of our larger cities have already warmed up to the levels predicted for the surrounding countryside 20 to 50 years from now. Urban areas are the prefect place to study how climate change will affect the environment because they have already arrived at the future.

While increased temperature is probably the most ecologically significant factor that distinguishes the city from the surrounding countryside, several other features

A robust urban forest has developed on this vacant lot in Detroit.

associated with urban areas have profound impacts (both negative and positive) on the growth of plants as well, including greater air pollution, higher concentrations of carbon dioxide, altered solar radiation regimens, altered wind patterns, altered hydrology, and decreased humidity (Gregg et al. 2003; Sukopp 2004; George et al. 2009). In addition, the soils found in urban environments—especially those that are heavily compacted or derived from construction rubble—display numerous characteristics that distinguish them from less disturbed soils (Table 4) (Byrne 2007; Godefroud et al. 2007).

Brave New Ecology

The notion that every city has a native flora that can be restored is an idea with little credibility in light of the facts that (1) most urban land has been totally transformed from what it once was; (2) the climate conditions that the original flora was adapted to no longer exist; and (3) most urban habitats are strictly human creations with no natural analogs and no indigenous flora. A native flora once grew where the city now stands, but the idea that this vegetation can somehow be restored to the site is both ecologically and evolutionarily impossible (Gould 1998). Certainly we can plant native species in the city and they will grow—but only if we provide them with the right kind of soil and maintain them the way we would any other intentionally cultivated plant. In an urban context, the concept of restoration is really just gardening dressed up to look like ecology (Janzen 1998; Del Tredici 2007). In the absence of ongoing maintenance, the default vegetation of the cities of the

Northeast is the cosmopolitan collection of plants described in this book. These are the species that establish themselves on their own and thrive without the input of human energy. In general, they are preadapted to the early successional conditions that humans create in the urban environment, and as such they can legitimately be considered its natural vegetation (Larson et al. 2004) (see Appendix 3).

In addition to the form or composition of spontaneous urban vegetation, it is also important to consider its ecological function. In minimally disturbed native habitats, the form and function of the flora and fauna are closely linked (Tallamy 2007). In the urban environment, however, form and function can be decoupled so that reasonable ecological functionality is possible with a cosmopolitan assemblage of species. A long-term study of the Baltimore ecosystem (Pickett et al. 2008) produced some unexpected conclusions in this regard:

- The urban biota is diverse.
- Urban wetlands are not nitrate sinks.
- Nitrate water pollution is higher in suburbs than in the city.
- Urban soils are not uniformly disturbed.
- Urban areas can contribute to carbon balance.
- Lawns can have beneficial social and biogeochemical functions.

The researchers conclude that "both exotic and native species have functional value in urban systems." Needless to say, conservation activists seldom—if ever—acknowledge the ecological contributions of nonnative, spontaneous urban vegetation. Indeed, the response of many regulatory agencies to these plants is to label them invasive and, in a few states, to ban their propagation and distribution. Such well-meaning attempts to control ecology are based on the assumptions that exotic species are the cause of environmental degradation and that replacing them with native species will result in a more "natural" ecological balance. While this is theoretically possible, the reality is that in the absence of intensive horticultural maintenance (i.e., planting, weeding, mowing, and watering), spontaneous vegetation will eventually come to dominate most urban landscapes. In fact, the amount of spontaneous vegetation in a given city always seems to be inversely proportional to its economic prosperity. In New York City, for example, Manhattan—with its sky-high property values—has relatively little spontaneous vegetation while Brooklyn and the Bronx are filled with it. Similarly, Detroit has become an epicenter of spontaneous vegetation as a result of the long, slow decline of the automobile industry.

Edgar Anderson noted in 1952 that many of the so-called weeds that populate North American cities were originally "dump heap" plants from Europe that gained a competitive edge by taking advantage of the nutrient-rich waste that people left behind; in ecological terms, they were exploiting an "open niche." By virtue of their long association with human culture, these "camp followers" developed traits that made them more tolerant of human-generated pollution than the native vegetation that existed on the site before it was disturbed. Casting such plants in the role of "thugs" makes it virtually impossible to recognize the positive contributions they are making to the ecology of cities. By way of analogy, people's attitudes about

Two "pollarded" American elms (*Ulmus americana*) have adapted to this chain-link fence niche in Hartford, Connecticut.

invasive species mirror the political debate about undocumented aliens. Many people complain about the problems caused by people who are in the country illegally but fail to recognize the positive contributions such people make to the economy and the society at large.

In an effort to turn this dynamic on its head, I have chosen to describe in positive terms the ecological functions of all the plants treated in this book. Clearly the longer-lived woody plants and herbaceous perennials have the capacity to perform more of these functions than short-lived annuals and biennials, which mainly serve to absorb pollutants and stabilize disturbed ground. Under the heading Ecological Function I have created the following list of possible "ecosystem services" for each entry in this book:

- temperature reduction
- food and/or habitat for wildlife
- erosion control on slopes and disturbed ground
- stream and river bank stabilization
- nutrient absorption (mainly nitrogen and phosphorus) in wetlands
- soil building on degraded land
- tolerance of pollution or contaminated soil
- disturbance-adapted colonizer of bare ground

I do not include carbon storage and the production of oxygen in my list of ecosystem services because all plants do those things regardless of where they come from or where they are growing. It is important to keep in mind, however, that because they grow on marginal sites and require no maintenance, urban plants are probably providing a greater return in terms of carbon sequestration than many intentionally cultivated species.

I also do not treat biodiversity per se as an ecological function. An exhaustive literature review of the vegetation of 54 Central European cities determined that they contained between 20% and 60% nonnative species, with a mean value of 40.3%. This figure is 13.7% higher than the ratio of nonnative to native plants in the surrounding region, which is indicative of a "remarkable concentration of aliens in urban areas" (Pyšek 1998). Other vegetation surveys of European cities indicate that the ratio of nonnative to native species as well as the ratio of neophytes to archaeophytes increase as one gets closer to the more highly disturbed parts of the city (Kovarik 1990; Pyšek et al. 2004).

The unexpectedly high species richness of the inner city is the product of a number of factors, including habitat heterogeneity, changing climatic conditions, horticultural activity by humans, and the establishment opportunities disturbance provides for new immigrants (Zerbe et al. 2003; Sukopp 2004). A number of European researchers have even proposed that certain types of inner-city landscapes should be conserved because of the role they play in promoting and maintaining urban biodiversity (Maurer et al. 2000; Kowarik and Körner 2005; Muratet et al. 2007).

One potentially important function of spontaneous urban vegetation that people have only recently begun to study is *phytoremediation* or the ability of some plants to clean up contaminated sites by selectively absorbing and storing high concentrations of heavy metals such as cadmium, lead, copper, zinc, chromium, and nickel in their tissues (Porębska and Ostrowska 1999). Several common urban species—most notably prickly lettuce (*Lactuca serriola*), lambsquarters *Chenopodium album*), and mugwort (*Artemisia vulgaris*)—possess this ability and are helping to "detoxify" the land by taking some of the heavy metals out of circulation.

As every sufferer of hay fever knows all too well, plants do not always enhance the quality of life for the human inhabitants of cities. Indeed, if recent research is any guide, climate change could well make some of these negative interactions between plants and people worse than they currently are. Controlled experiments with two infamous native plants—ragweed (*Ambrosia artemisiifolia*) and poison ivy (*Toxicodendron radicans*)—have shown that elevated levels of carbon dioxide induce the former to produce significantly more of its highly allergenic pollen and cause the latter to produce higher concentrations of its rash-producing toxins (Ziska 2003; Mohen et al. 2006). While the remarkable ability of these two species to adapt to changing environmental conditions does not bode well for human health in a carbon dioxide–rich future, such examples do provide an important reminder of the innate capacity of "weeds" to capitalize on the mess we have made of the planet.

It is a foregone conclusion that the environment will continue to deteriorate over the next few decades as people continue to pump more heat-trapping carbon dioxide into the atmosphere and more acid rain falls back to earth to pollute the water and the soil. The worldwide migration of people from the countryside into cities is also contributing to environmental degradation because land that was once covered with vegetation is being covered instead by buildings and pavement that generate and retain heat (Grimm et al. 2008). The confluence of climate change and urbanization—acting in concert with the global spread of invasive species—has set the stage for spontaneous vegetation to play a major ecological role in the human-dominated landscapes of the future (Ziska et al. 2004; Christopher 2008; George et al. 2009). Regardless of how humans feel about this brave new ecology, the plants described in this book are well adapted to the world we have created and, as such, are neither good nor bad—they are us.

Landscaping with Spontaneous Urban Vegetation

Most people tend to interpret the presence of spontaneous urban vegetation in their neighborhood as a visible manifestation of dereliction and neglect while viewing the same plants growing in a suburban or rural context as "wildflowers" (think about the beautiful combination of chicory and Queen Anne's lace along the roadside in July and August). Clearly, the context in which a plant exists has everything to do with how people feel about it. The very same species that people despise as invasive in North America are often cherished natives in Europe. The common reed, for example, is widely distributed in river deltas throughout Europe and serves as a major bulwark against costal erosion. The fact that the plant is dying throughout much of its native European range is viewed as an ecological crisis. The same species growing in the same type of habitat in eastern North America, however, is widely seen as a noxious weed that should be eradicated.

This relativity is explained by the fact that people are looking at the same plant through the subjective lens of a cultural value judgment which places a higher value on the form or nativity of a given plant association than on its function. While this dichotomy may be appropriate and necessary for preserving wilderness areas or rare habitats, it does not work so well in the urban context, where ecological functionality should be recognized as being of equal value to ecological form (Sagoff 2005). Unfortunately, the aesthetics of ecologically functional, spontaneous urban landscapes often leave something to be desired, which raises the question of whether

In August, Queen Anne's lace (*Daucus carota*) and chicory (*Cichorium intybus*) make a stunning combination along roads in the Northeast.

A typical spontaneous urban meadow in which purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), chicory (*Cichorium intybus*), mullein (*Verbascum thapsus*), evening primrose (*Oenothera biennis*), quackgrass (*Elymus repens*), and Queen Anne's lace (*Daucus carota*) are clearly identifiable.

or not there is a way to harmonize such spontaneous ecological functionality with people's desire to live in a neat and tidy environment.

As is the case with urban ecology in general, the Europeans have been hard at work on this question for the past 20 to 30 years. *The Dynamic Landscape*, edited by Nigel Dunnett and James Hitchmough introduces North American readers to years of European work on ways to manipulate the aesthetic characteristics of spontaneous vegetation through the judicious addition or deletion of species. The book is unique in combining solid ecological research on natural grasslands and agricultural meadows with the horticultural goal of creating aesthetically pleasing, low-maintenance landscapes. Indeed, landscapes that include spontaneous vegetation fit the technical definition of *sustainable* in the sense that they are adapted to the site, require minimal maintenance, and are ecologically functional (Kühn 2006).

Using the work of various European authors as a guide, I have developed the concept of the "cosmopolitan urban meadow" as a way of capitalizing on the aesthetic and ecological opportunities presented by some of the herbaceous species covered in this book. The plants chosen for inclusion in this novel landscape form (Appendix 4) were selected on the basis of their ability to meet the following criteria:

- They should be long-lived and capable of spreading vegetatively (**erosion control value**).
- They should be tolerant of full sun, drought, soil compaction, road salt, and high or low soil pH (**stress tolerance**).
- They should not be too tall or weedy looking and should have some obvious ornamental characteristics (**aesthetic value**).
- They should be attractive to pollinating and herbivorous invertebrates and seed-eating animals (**wildlife value**).
- They should be commercially available as seed (**economic value**).

The basic idea behind the cosmopolitan urban meadow is to select an assemblage of plants that will grow well on typical urban soil, create an aesthetically pleasing urban meadow on vacant land, and remain in place until a more permanent use for the land is developed. Some minimal soil preparation would be required to get the meadow established, but much less than it would take to start a lawn from seed. There would also have to be some selective weeding to keep out unsightly plants such as ragweed and mugwort, especially in the early stages of growth. An annual mowing in late summer or fall would maintain the composition of the meadow and keep woody plants from taking over.

The question of aesthetics is more complicated for landscapes dominated by spontaneous woody plants, which have longer life spans and less conspicuous ornamental attributes than herbaceous species. Nevertheless, the appearance of an urban woodland can often be enhanced by removing trees or shrubs that are unsightly, in poor health, or too crowded. Such landscape "editing," if done by a trained horticulturist, can dramatically improve both the appearance and the recreation potential of a spontaneous urban woodland (Kowarik and Langer 2005). The foundation for this approach to vegetation management was laid out in 1966 by Frank Egler in *The Wild Gardener in the Wild Landscape,* a remarkable book that he wrote under the pseudonym Warren G. Kenfield. Egler was light-years ahead of his time in advocating the use of herbicides to remove unwanted trees in order to arrest or suspend forest succession at the shrub or grassland stage of development. He called this process "intaglio," after the engraving technique that creates an image by removing unwanted material from the surface of a blank plate.

Another landscape concept that utilizes spontaneous vegetation is the "freedom lawn" introduced in the landmark book *Redesigning the American Lawn* (Bormann, Balomori, and Geballe 1993). The freedom lawn, as the authors define it, is a collection of low-growing, spontaneous plants that "results from an interaction of naturally occurring processes and the selective effects of lawn mowing." The book goes on to contrast the freedom lawn with the "industrial lawn," which requires the constant input of chemical fertilizers, weed killers, and water in order to maintain a uniform monoculture of grass. The beauty of the freedom lawn concept is that it has the potential to transform a wasteful sink of petroleum products into a sustainable source of ecological benefits.

A stand of Norway maples (*Acer platanoides*) dominates a typical highway slope in Watertown, Massachusetts.

And finally there is the concept of the "spontaneous roof," a modification of the increasingly popular "green roof." Most current designs for the so-called extensive green roof involve the use of various types of succulent stonecrops in the genus *Sedum* growing in a lightweight medium consisting of a high percentage of expanded slate or shale on top of several layers of waterproofing. Sedums are low growing and colorful, and once established require very little maintenance. The only problem is that they grow very slowly and sometimes have a difficult time holding the ground against other, more aggressive species. An alternative strategy is the "brown roof" described in *Planting Green Roofs and Living Walls* (Dunnett and Kingsbury 2004). According to the authors, brown roofs "have been covered with substrate or loose material but have not been purposefully planted. . . . Brown roofs are created primarily for biodiversity purposes and aim to recreate typical brownfield conditions through the use of by-products of the development of urban sites: brick rubble, crushed concrete, and subsoils. Such roofs may colonize spontaneously with vegetation but the unvegetated loose substrates can also provide habitat for a range of invertebrates and birds." If one tweaks this definition by adding a somewhat richer substrate and managing the vegetation by selectively removing woody plants and tall-growing or toxic herbaceous perennials, the brown roof concept can be transformed into what I call a spontaneous roof. Indeed, in the absence of ongoing maintenance, it seems likely that many of the extensive green roofs being built today are destined to become tomorrow's spontaneous roofs.

How to Use This Book

Following the format of *Weeds of the Northeast*, also published by Cornell University Press, I have arranged the plants in this book according to major botanical categories. The highest level is the Taxonomic Group, which for the purposes of this book includes *ferns, horsetails, conifers, woody dicots, herbaceous dicots*, and *monocots* (see Glossary for definitions). Within each of these groupings are the plant families, which are arranged alphabetically; within each family the individual species are listed alphabetically. Appendix 5 describes the key characteristics of 12 common plant families that account for 64% of the species covered in this book. Being able to recognize the higher-order characteristics of a given plant family is a critical step not only in determining the identity of a specific species but also in getting a handle on the daunting diversity of the plant kingdom.

While determining the correct Scientific Name of a plant may seem to be a straightforward process, it is anything but that. Modern molecular technology has led to a revolution in plant taxonomy, which in turn has led to a host of new

FORMAT USED FOR THE PLANT ENTRIES*

Scientific Name and Author   Common Name

SYNONYMS: older scientific names and alternative common names

LIFE FORM: annual, biennial, herbaceous perennial, or woody (including shrubs, trees, and vines), and the typical height in urban conditions

PLACE OF ORIGIN: where the plant grows as a native species

VEGETATIVE CHARACTERISTICS: a description of the vegetative features of the mature plant (leaves, stems, branches, trunk, bark, and root system)

FLOWERS AND FRUIT: a description of the flowers, fruit, and seeds, as well as the timing of these events

GERMINATION AND REGENERATION: the conditions required to stimulate seed germination and, for perennials, the mode of vegetative sprouting from underground structures or woody stems

HABITAT PREFERENCES: the types of urban habitats where the plant is most likely to be found

ECOLOGICAL FUNCTIONS: the "ecological services" the plant contributes to the urban environment

CULTURAL SIGNIFICANCE: the various uses—both ancient and modern—of the plant and a few details about the history of its introduction into the Northeast

RELATED SPECIES: names and brief descriptions of closely related plants that are typically not as common as the primary entry

SIMILAR SPECIES: how to distinguish the primary species from other species treated in the book

HIGHER TAXONOMIC GROUP: *ferns, horsetails, conifers, woody dicots, herbaceous dicots, or monocots* followed by the **Plant Family**

* Plant entries may not include all categories.

names for species whose names had remained unchanged for a hundred years. It is a certainty that some of the names of the species treated in this book will have been changed during the interval between when the manuscript for this book was finalized for publication and when it was printed. Equally problematic is the issue of a plant's COMMON NAME, which frequently varies regionally. To help resolve this potentially confusing situation I used the standardized weed names—both scientific and common—published in April 2007 on the website of the Weed Science Society of America (http://www.wssa.net/Weeds/ID/WeedNames/namesearch.php). For plants not treated in this source I used the Plants Database of the U.S. Department of Agriculture (http://plants.usda.gov/). Each species account lists SYNONYMS—for

both scientific and common names—that have been used for the plant over the past hundred years or so.

The PLACE OF ORIGIN of a given species is not always easy to pin down, either, especially for plants with a long history of association with humans. I have had to rely on a number of different sources, the most important of which are the *Manual of Vascular Plants of Northeastern United States and Adjacent Canada* (2nd edition, 1991) by H. A. Gleason and A. Cronquist, and *Weeds of Lawn and Garden* by John Fogg Jr. (first published in 1945). I particularly admire the latter book not only for its comprehensive treatment of species and accessible text but also for the beautiful and informative line drawings by Léonie Hagerty.

I have tried to keep the technical descriptions of the plants' physical characteristics simple and jargon-free, a goal that is possible only because of the many photographs that accompany the text. The Glossary defines all the technical terms used in the text. Under the subheads HABITAT PREFERENCES, ECOLOGICAL FUNCTIONS, and CULTURAL SIGNIFICANCE I explain where the plant grows, the ecological functions it serves in the urban environment, and its relationship with humans.

I have not included information on how to kill the described plant. Virtually every other book on weeds and invasive species already provides more than enough information on this topic. Indeed, these books' authors seem to assume that the main reason for learning to identify weeds is to be able to kill them more effectively. My decision is in keeping with this book's two primary goals: to teach people how to identify the plants that are growing in urban areas, and to counter the widespread perception that these plants are ecologically harmful or useless and should be eliminated from the landscape. This is not to say that I think these species should be actively cultivated, but I do hope that people will develop a sense of respect and appreciation for what these plants are contributing—free of charge—to the quality of urban life.

A Note on the Photographs

Except where noted in the captions, all photographs in the book were taken outdoors by the author with a digital camera (either an Olympus 8080 or a Canon Digital Rebel XTi with a 60 mm macro lens). The photos were selected for their ability to capture the essence of the plant growing in its natural habitat, with an emphasis on important macroscopic features that can be used to identify the plant at various stages in its life cycle. The extensive use of photographs has allowed me to keep technical descriptions to an absolute minimum and allows an untrained observer confronted with an unknown plant to ignore the formal classification system and simply "go fishing" through the pictures for a match.

APPENDIX 1. Plants Treated in This Book That Are Included in Dioscorides' *De Materia Medica*

The Greek physician Pedanius Dioscorides (AD 40–90) practiced medicine in Rome under the emperor Nero and wrote the five-volume *De Materia Medica*, a compendium of medicinal plants that remained in active use into the 1600s. Modern research has demonstrated that many of the plants Dioscorides mentioned contain medically active compounds and were effective herbal remedies in their day. Among the plants mentioned in the earliest known edition of this book, from the fifth century (Gunther, 1959), are the following:

Achillea millefolium	Yarrow
Arctium minus	Burdock
Calystegia sepium	Hedge Bindweed
Capsella bursa-pastoris	Shepherd's Purse
Chelidonium majus	Greater Celandine
Cynanchum rossicum	Pale Swallowwort
Daucus carota	Wild Carrot
Glechoma hederacea	Ground Ivy
Hypericum perforatum	Common St. Johnswort
Iris pseudacorus	Yellow Flag Iris
Leonurus cardiaca	Motherwort
Medicago sativa	Alfalfa
Polygonum persicaria	Ladysthumb
Populus alba	White Poplar
Portulaca oleracea	Purslane
Rhamnus cathartica	Common Buckthorn
Saponaria officinalis	Bouncing Bet
Solanum nigrum	Black Nightshade
Sonchus oleraceus	Annual Sowthistle
Tussilago farfara	Coltsfoot
Urtica dioica	Stinging Nettle
Verbascum thapsus	Common Mullein

APPENDIX 2. European Plants Listed by Josselyn as Growing Spontaneously in New England in the Seventeenth Century

Plants listed under the category "Of such plants as have sprung up since the English planted and kept cattle in New England":

Capsella bursa-pastoris	Shepherd's Purse
Malva neglecta	Common Mallow
Plantago major	Broadleaf Plantain
Polygonium aviculare	Prostrate Knotweed
Rumex crispus	Curly Dock
Senecio vulgaris	Groundsel
Solanum nigrum	Black Nightshade
Sonchus oleraceus	Annual Sowthistle
Stellaria media	Chickweed
Taraxicum officinale	Dandelion
Urtica dioica	Stinging Nettle

Josselyn mistakenly listed the following plants as native to both England and New England

Arctium minus	Common Burdock
Chelidonium majus	Greater Celandine
Chenopodium album	Lambsquarters
Glechoma hederacea	Ground Ivy
Hypericum perforatum	St. Johnswort
Linaria vulgaris	Yellow Toadflax
Polygonum persicaria	Ladysthumb
Portulaca oleracea	Purslane
Tanacetum vulgare	Common Tansy
Veronica arvensis	Corn Speedwell

Source: From *New-England's Rarities* (1672) by John Josselyn with modern identifications provided by Tuckerman (1865).

APPENDIX 3. Shade-Tolerance Ratings of the 32 Trees Covered in This Book

Sun loving

Shade-intolerant species (59.4%)

Acer negundo	Box Elder
*Acer pseudoplatanus**	Sycamore Maple
Acer saccharinum	Silver Maple
Ailanthus altissima	Tree-of-Heaven
*Albizia julibrissin**	Silktree
Alnus glutinosa	Black Alder
Betula nigra	River Birch
Betula populifolia	Gray Birch
Catalpa speciosa	Northern Catalpa
Gleditsia triacanthos	Honey Locust
Morus alba	White Mulberry
*Paulownia tomentosa**	Princess Tree
Populus alba	White Poplar
Populus deltoides	Eastern Cottonwood
Populus tremuloides	Quaking Aspen
Quercus palustris	Pin Oak
Rhus glabra	Smooth Sumac
Rhus typhina	Staghorn Sumac
Robinia pseudoacacia	Black Locust

Moderately shade-tolerant species (25%) Moderate shade

Acer rubrum	Red Maple
Celtis occidentalis	Hackberry
Malus pumila	Common Apple
Prunus serotina	Black Cherry
Prunus virginiana	Choke Cherry
Quercus rubra	Red Oak
Ulmus americana	American Elm
Ulmus pumila	Siberian Elm

Very shade-tolerant species (15.6%)

Acer platanoides	Norway Maple
Frangula alnus	Glossy Buckthorn
*Phellodendron amurense**	Amur Corktree
Rhamnus cathartica	Common Buckthorn
*Taxus cuspidata**	Japanese Yew

Source: Based on data listed in *Michigan Trees* by B. V. Barnes and W. H. Wagner, University of Michigan Press, 2004.

* species not listed in *Michigan Trees*

APPENDIX 4. Species Suitable for a Cosmopolitan Urban Meadow

The three plant families that make up this list—the grasses, the legumes, and the composites—often grow together in typical meadow conditions. The grasses have fibrous roots that bind the soil and quickly generate organic matter; the legumes have ropy roots with nitrogen-fixing bacteria that enrich the soil; the composites have a strong taproot that is well adapted to penetrating compacted soil. Growing together, they represent a long-term solution to problematic urban soils that typically cannot support ornamental landscapes.

Species	Common Name	Family
Achillea millefolium	Yarrow	Asteraceae
Cichorium intybus	Chicory	Asteraceae
Leucanthemum vulgare	Oxeye Daisy	Asteraceae
Symphyotrichum pilosum	White Heath Aster	Asteraceae
Tanacetum vulgare	Tansy	Asteraceae
Coronilla varia	Crownvetch	Fabaceae
Lotus corniculatus	Birdsfoot Trefoil	Fabaceae
Trifolium hybridum	Alsike Clover	Fabaceae
Trifolium repens	White Clover	Fabaceae
Eragrostis spectabilis	Purple Lovegrass	Poaceae
Festuca rubra	Red Fescue	Poaceae
Lolium arundinacea	Tall Fescue	Poaceae
Poa compressa	Canada Bluegrass	Poaceae

APPENDIX 5. Key Characteristics of Important Plant Families

Aceraceae (recently merged into the Sapindaceae): Maple Family

- Opposite leaves with lobed margins; they may be simple or compound.
- Flowers are wind-pollinated and typically, but not always, unisexual.
- Winged seeds (samaras) are produced in pairs.

Asteraceae (Compositae): Sunflower Family

- Many individual flowers (florets) are combined on a common receptacle to form a composite inflorescence.
- Two basic types of flowers make up the composite heads: ray or ligulate florets with strap-shaped, petal-like appendages, often infertile; tube-shaped disk florets that lack petal-like appendages and are usually fertile (i.e., seed producing).
- Some, such as the oxeye daisy, have both ray and disk florets.
- Some, such as dandelion, chicory, and prickly lettuce, have only ray florets with conspicuous "petals" and have milky sap.
- Some, such as burdock, groundsel, and pineapple weed, have only disk florets without conspicuous "petals" and have clear sap.
- Flowers pollinated by insects or self-pollinated.

Brassicaceae (Cruciferae): Mustard Family

- Herbaceous plants, often producing basal rosettes.
- Simple, alternate leaves are often divided, cleft, or lobed.
- Flowers have 4 petals forming a cross (mainly yellow or white).
- Flowers pollinated by insects or self-pollinated.
- Seedpod is a 2-chambered capsule that is either long and narrow (silique) or more or less rounded (silicle). The seedpods often explode at maturity, leaving only a clear membrane (the placenta) behind. The sap contains pungent oils.

Caryophyllaceae: Pink Family

- Leaves are opposite, entire, and joined together at the base of the stem to form swollen nodes.
- Flowers have 5 petals, often notched at the tip.
- Sepals are often united to form an inflated tube.
- Flowers pollinated by insects or self-pollinated.
- Fruits consist of a dry capsule filled with small seeds.

Euphorbiaceae: Spurge Family

- Flowers often have colored bracts that look like petals.
- Flowers pollinated by wind or by insects.
- Plants always exude milky sap (rich in latex) when broken.
- Leaves and branching are alternate.
- Plants are often, but not always, toxic to humans.

Fabaceae (Leguminosae): Pea or Bean Family

- Consists of three subfamilies: the Mimosadae, with "powder-puff" flowers; the Caesalpinoideae with separate, more or less equal petals; and the Papalinoideae, with the typical pea-type flower consisting of 5 petals: one is upright (the banner), 2 are lateral on the sides (the wings), and 2 are fused and project outward (the keel).
- Flowers pollinated by bees and other insects.
- All subfamilies produce a fruit that is a pealike pod (a legume) containing one or more seeds and that splits open on two sides.
- Alternate leaves are often pinnately compound.
- Most members of the subfamily Papalinoideae have root nodules that fix nitrogen.

Lamiaceae (Labiatae): Mint Family

- Stems are square and foliage is aromatic.
- Opposite, simple leaves have toothed margins.
- Flowers have 5 fused petals that form 2 prominent lips: an upper one with 2 lobes and a lower one with 3 lobes.
- Flowers typically pollinated by insects.

Poaceae (Graminae): Grass Family

- Stems are round with distinct nodes and hollow internodes.
- Leaves are alternate and often arranged in a single plane.
- Leaves consist of a blade that projects out from the stem and a sheath that wraps around the stem; the blades have parallel venation.
- Flowers are subtended by bracts and aggregated into clusters known as spikelets.
- Flower spikelets lack distinctive petals and sepals and are wind-pollinated.
- New shoots arise from rhizomes or stolons.

Polygonaceae: Smartweed Family

- Stem is swollen at the leaf nodes, forming distinct "knots."
- Leaves are alternate, simple, without teeth along their edges.
- Membranaceous stipules (ochrea) encircle the stem at the nodes.
- Flowers are small with reddish sepals and without petals.
- Flowers pollinated by wind or by insects.
- One-seeded fruits (achenes) usually have 3 distinct wings to facilitate wind or water dispersal.

Rosaceae: Rose Family

- Flowers with 5 petals, 5 sepals, and numerous stamens.
- Flowers typically insect-pollinated.
- Leaves are alternate, can be simple or compound.
- Leaves and/or leaflets are often oval with serrated margins and leaflike stipules at their base.

Scrophulariaceae: Figwort Family

- Flowers typically have 5 petals, which are usually united to form a corolla tube with 2 prominent lips: an upper one with 2 lobes and a lower one with 3 lobes.
- Stamens are attached to the inside of the corolla.
- Flowers typically insect-pollinated.
- Fruit is typically a dry capsule filled with small seeds.

Vitaceae: Grape Family

- Climbing vines with tendrils that coil or produce adhesive disks at their tips.
- Leaves are alternate, deeply lobed or compound.
- Tendrils and flower clusters are produced opposite the leaves.
- Flowers typically insect-pollinated.
- Clusters of fleshy berries contain relatively few seeds.

GLOSSARY*

Achene A single-seeded, dry fruit that remains closed at maturity (e.g., the "seeds" of buttercups and cinquefoils).

Actinobacteria A type of filamentous, gram-positive bacteria. The genus *Frankia* forms nitrogen-fixing root nodules in symbiosis with a variety of dicotyledons (e.g., alder, autumn olive). *Contrast* Rhizobium

Adventitious bud or shoot A bud or shoot that arises from any region of the plant other than the leaf axil, as from a root or a leaf.

Adventitious root A root that originates from stem or leaf tissue rather than from another root.

Adventive Refers to an introduced or nonnative species with only a limited or temporary distribution in a given area; not widespread. *Contrast* Invasive; Naturalized

Allelopathy Release of a chemical compound by one plant that inhibits the growth of another plant.

Alternate Refers to leaves or other organs arranged singly at a node. *Contrast* Opposite; Whorled

Angiosperm A plant that produces flowers with ovules enclosed in an ovary. *Contrast* Gymnosperm

Annual A plant that completes its life cycle in 1 year, including germination, flowering, seed set, and death. *See* Summer annual; Winter annual

Anther The enlarged, terminal portion of the stamen that produces pollen.

Apical Located at the tip of an organ such as a leaf, root, or shoot. *Contrast* Basal; Lateral

* Definitions are based on a number of sources, the most significant are H. A. Gleason and A. Cronquist, *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd ed. (Bronx, N.Y.: New York Botanical Garden, 1991); R. H. Uva, J. C. Neal, and J. M. DiTomaso, *Weeds of the Northeast* (Ithaca, N.Y.: Cornell University Press, 1997); M. Hickey and C. King, *The Cambridge Illustrated Glossary of Botanical Terms* (Cambridge: Cambridge University Press, 2000); and J. M. DiTomaso and E. A. Healy, *Weeds of California and Other Western States* (Berkeley: University of California Press, 2007).

Apomixis The production of seeds without fertilization; a form of asexual reproduction.

Archaeophyte A plant introduced into European agriculture prior to AD 1500. *Contrast* Neophyte

Aril A fleshy, often brightly colored covering on some seeds (e.g., those of the yew tree).

Asexual reproduction *See* Vegetative reproduction

Auricle In grasses, a small, projecting lobe or earlike appendage located where the blade meets the sheath; in broadleaf plants, an earlike lobe that protrudes from the base of the leaf blade.

Awn The slender bristle on a grass floret.

Axil The angle formed by the upper side of a leaf and the stem. The position on a stem above the point of attachment of a leaf where a bud is located is the "leaf axil." *See* Subtend

Basal Located at the base of an organ such as a stem, leaf, or flower. *Contrast* Apical; Lateral

Berry A fleshy, indehiscent fruit with 1 or more seeds embedded in pulp.

Biennial A plant that requires 2 years to complete its life cycle. During the first season the seed germinates and produces a rosette of leaves; the following year it flowers, sets seed, and dies. *Contrast* Annual

Bipinnate Refers to leaves that are branched twice, with leaflets on the second-order branches. *See* Compound leaf; *Contrast* Pinnate

Bisexual A flower having both male and female parts. *See* Perfect flower; *Contrast* Unisexual

Blade The expanded, flattened portion of a leaf; located above the petiole in broadleaf plants and above the sheath in grasses.

Bloom A waxy powder that covers the surface of a leaf or fruit, making it appear bluish or whitish. *See* Glaucous

Bolt To produce erect, flowering stems from a basal rosette of leaves; typically associated with annual or biennial species.

Bract A reduced, leaflike structure located below a flower or inflorescence.

Bud A young shoot protected by scale leaves from which flowers or leaves develop; typically located in the axil of a leaf or bract.

Bulb A short underground shoot with leaves modified to act as food storage organs.

Bur A fruiting structure covered with spines or prickles, typically dispersed as a unit.

Calyx Collectively, the sepals of a flower. *Contrast* Corolla

Capsule A dry fruit that splits open at maturity to release its seeds.

Carbohydrate An organic compound composed of carbon, hydrogen, and oxygen, such as a sugar or starch; one of the products of photosynthesis.

Carpel The female organ at the center of a flower, consisting of an ovary, a style, and a stigma. *See* Pistil

Catkin A pendulous, spikelike inflorescence of unisexual flowers that lack petals; found in the Betulaceae.

Circumboreal Occurring all the way around the North Pole, encompassing the northern parts of Europe, Asia, and North America.

Clasping Refers to the base of a leaf blade that surrounds the stem to which it is attached.

Cleistogamous flower A self-pollinating flower that produces seeds without opening, as in violets and jewelweed.

Clone In plants, a group of genetically identical individuals produced by means of vegetative reproduction from a single parent.

Collar The outer side of a grass leaf located at the junction of the blade and sheath; also the base of a tree or shrub where new shoots originate. *See* Crown

Colonizer *See* Pioneer

Composite flower head The dense inflorescence of the Asteraceae composed of individual florets carried on a receptacle subtended by bracts.

Compound leaf A leaf composed of 2 or more leaflets. Once-compound leaves have leaflets arranged along an unbranched petiole or rachis; twice-compound leaves have leaflets arranged along a branched petiole or rachis. *See* Bipinnate; Palmate; Pinnate

Cone The organ of sexual reproduction in gymnosperms; woody female cones produce seeds and transitory male cones produce pollen. *Contrast* Flower

Conical Cone shaped.

Conifer A seed-bearing plant that produces cones; part of the gymnosperm group.

Cordate Heart shaped.

Corolla The collective term for the petals of a flower, either separate or fused. *Contrast* Calyx

Corymb An inflorescence with branches arising at different points on a stem but reaching more or less the same height at maturity, producing a flat-topped appearance. *Contrast* Umbel

Cotyledon The first leaf (monocotyledon) or pair of leaves (dicotyledon) produced by a seedling.

Crown The base of a perennial plant, located at or just below ground level, where new shoots originate. *See* Collar; Stump sprout

Culm A jointed stem, especially the flowering stem of grasses.

Cultivar A individual perennial plant or strain of annual plant that has been selected and propagated for its unique characteristics. The word is a contraction of the phrase "cultivated variety."

Deciduous Dropped at senescence, as leaves in autumn or petals after flowering.

Dehiscent Splitting open at maturity, as a pod releasing its seeds.

Deltoid Shaped more or less like an equilateral triangle.

Dicot Short term for dicotyledon.

Dicotyledon A broadleaf flowering plant (i.e., an angiosperm) that is characterized by seedlings with 2 cotyledons (along with a number of other features). *Contrast* Monocotyledon

Dimorphic Producing two different forms of the same organ, as the leaves of perennial vines.

Dioecious Producing male and female flowers on different plants of the same species. *Contrast* Monoecious

Disk floret The central, tubular flower of some members of the Asteraceae with both male and female organs. *Contrast* Ray floret

Dissected Divided into many slender, irregular segments but not compound; typically used to describe leaves or petals.

Dormant Resting or inactive; used to describe seeds or buds that will sprout only after experiencing a period of chilling.

Drupe A fleshy fruit containing a single seed enclosed in a hardened ovary wall (e.g., a cherry or plum).

Elliptical Football shaped; used to describe a leaf that is widest in the middle and narrowing equally toward the ends.

Endemic A plant with a natural distribution restricted to a particular country or region.

Endophyte A bacterium or fungus that lives within a plant for at least part of its life cycle without causing a disease.

Entire The unbroken edge of a leaf or petal with a continuous, untoothed margin.

Escape Any cultivated plant that, under its own power, has spread outside the garden or field in which it was originally planted. *Contrast* Naturalized; Spontaneous; Volunteer

Exotic Nonnative; originating in a foreign country or region. *Contrast* Native

Fastigiate Refers to the growth habit of a tree in which the branches are all more or less erect or ascending, as a Lombardy poplar. *Contrast* Weeping

Fertilization In plants, the fusion of an ovule with a pollen cell to produce a viable seed.

Filament The stalk of a stamen.

Floret A little flower; an individual flower in a flower cluster, as in a grass spikelet or the composite flower head in the Asteraceae.

Flower The organ of sexual reproduction in angiosperms; typically composed of sepals, petals, stamens, and carpels. *Contrast* Cone

Flower head *See* Composite flower head

Frond The leaf of a fern.

Fruit A mature ovary of a plant including the enclosed seeds.

Gametophyte The sexual stage in the life cycle of a plant in which the cells have half the usual number of chromosomes.

Genotype The genetic makeup of an individual organism. *Contrast* Phenotype

Germination The sprouting of a seed to produce a seedling; the production of a pollen tube by a pollen grain.

Glabrous Smooth, without hairs. *Contrast* Pubescent

Glaucous Covered with a waxy, bluish green coating; used to describe leaves or fruits.

Gymnosperm A group of seed plants whose ovules are "naked," i.e., not enclosed in an ovary. *Contrast* Angiosperm

Habitat The environmental conditions in which a plant grows.

Herb A plant with stems that die to the ground at the end of the growing season.

Herbaceous Refers to a plant composed entirely of soft, nonwoody tissue that dies to the ground each year.

Hybrid A plant produced by the sexual crossing of parents belonging to two genetically distinct taxonomic groups.

Hypocotyl On a seedling, the region of the stem between the cotyledons and the primary root.

Indehiscent Refers to a fruit that remains closed at maturity.

Indigenous *See* Native

Inflorescence The grouping or arrangement of flowers on a stem; a cluster of flowers.

Internode The section of a stem between two adjacent nodes.

Invasive Refers to a nonnative species with the capacity to proliferate and spread aggressively into natural habitats or minimally managed landscapes, often displacing native species and reducing biodiversity. *Contrast* Adventive; Naturalized

Lanceolate More or less lance shaped; that is, much longer than wide with a rounded base and a pointed tip.

Lateral Located on the side of an organ; typically used to describe the position of branches, roots, or flowers. *Contrast* Apical; Basal

Leaf A lateral outgrowth from the stem, typically consisting of a petiole and a blade.

Leaflet The leaflike subunit of a compound leaf lacking an associated bud.

Legume A simple, dry fruit that opens lengthwise along two seams and is characteristic of the family Fabaceae, e.g., a string bean or a pea pod.

Lenticle A small pore or opening in the bark that allows gases to pass in and out.

Ligulate floret Refers to a flower type in the Asteraceae with a long, petal-like corolla. *See* Ray floret

Ligule The thin, dry membrane that projects from the top of the leaf sheath in grasses and sedges.

Lobe A rounded segment of a leaf or flower part that is larger than a tooth, typically with the adjoining sinuses extending less than halfway to the midrib; leaf or petal margins are often described as "lobed."

Margin The outer edge of a leaf or petal. *See* Entire; Lobe; Serrate

Membranous Thin, flexible, and transparent.

Monocot Short term for monocotyledon.

Monocotyledon A grasslike flowering plant (i.e., angiosperm) that is characterized by seedlings with 1 cotyledon (along with a number of other features). *Contrast* Dicotyledon

Monoecious Producing separate male and female flowers on the same plant. *Contrast* Dioecious

Mycorrhizae A mutually beneficial, symbiotic association between various fungi and the roots of plants that involves the exchange of minerals and carbohydrates.

Native Occurring naturally in a given region; not introduced into an area as a result of human activity; indigenous. *Contrast* Exotic

Naturalized Refers to an introduced or nonnative species that reproduces on its own and is well established in a region. *Contrast* Adventive; Invasive; Volunteer

Nectary An organ, usually located on a flower but sometimes found on leaves, that produces nectar to attract animals.

Neophyte A plant introduced into European agriculture—mainly from Asia and the Americas—after AD 1500. *Contrast* Archaeophyte

Nitrogen fixation A biochemical process carried out by bacteria in which nitrogen gas in the air is converted into ammonium that is then used to produce amino acids and proteins. *See* Root nodule; Symbiosis

Node The place on a stem where a leaf and its associated bud are attached. *See* Internode

Oblong Much longer than wide, with parallel sides and a more or less rectangular shape.

Ocrea A papery sheath that encloses the stem at the nodes formed by the fusion of 2 stipules; found in members of the Polygonaceae.

Opposite Refers to leaves or other organs arranged directly across from each other at the same node. *Contrast* Alternate; Whorled

Ovary The part of the female flower in angiosperms that contains ovules and develops into a fruit.

Ovate Shaped like a chicken egg, with the larger end closer to the base than the tip.

Ovule A structure within the ovary that, after fertilization, develops into a seed.

Palmate Divided to the base into separate leaflets, all of which arise from the same point at the end of the petiole.

Panicle An inflorescence with a main axis and secondary branches; usually broadest at the base and tapering upward.

Pappus In the family Asteraceae, the tuft of hairs or dry scales on a seed that facilitate wind or animal dispersal.

Pedicel The stalk of a single flower within an inflorescence.

Peduncle The stalk of an inflorescence or a single flower.

Perennial Refers to a plant that lives for more than 2 years. Contrast Annual

Perfect flower A flower with both male and female organs. *See* Bisexual

Petal An individual part of the corolla, usually colored.

Petiole The stalk of a leaf.

Pith The spongy tissue that occupies the central portion of a twig or stem.

pH The scale used to measure the acidity (pH < 7) or alkalinity (pH > 7) of a solution.

Phenotype An observable characteristic or trait of an organism; it can be the product of either genetic or environmental factors or their interaction. *Contrast* Genotype

Photosynthesis The process whereby a green plant converts carbon dioxide and water into sugars and oxygen in the presence of sunlight.

Phytoremediation The use of plants to clean up land contaminated by a variety of human-generated waste products such as heavy metals, petroleum products, acid mine drainage, and excessive amounts of dissolved nitrogen and phosphorus.

Pinnate Refers to a compound leaf with leaflets arranged along both sides of a petiole; they may be odd-pinnate with a single terminal leaflet or even-pinnate with a terminal pair of leaflets. *Contrast* Bipinnate

Pioneer A plant that colonizes bare ground; an early successional species. *Contrast* Invasive; Weed

Pistil The female organ of a flower, consisting of an ovary, style, and stigma. *See* Carpel

Pistillate Refers to flowers having only female organs.

Pith The central, spongy tissue in a stem or root that is surrounded by a cylinder of woody tissue.

Pollen The powdery substance shed from anthers of a flower that contains the male reproductive cells.

Pollination The transfer of pollen from an anther to a stigma.

Pre-adaptation An anatomical or physiological trait that evolved under one set of ecological conditions and, by chance, proves advantageous under a completely different set of circumstances.

Prostrate Lying flat on the ground; used to describe the growth habit of low-growing plants.

Pubescent Covered with short hairs; typically used to describe leaves and stems. *Contrast* Glabrous

Raceme An elongated inflorescence with stalked flowers on an unbranched central axis; flowers develop from the bottom up. *Contrast* Spike

Rachis The central axis of a pinnately compound leaf.

Ray floret One of the outer, irregular flowers in the flower heads of some plants in the Asteraceae that produce a single, straplike "petal." *Contrast* Disk floret

Receptacle The basal part of a flower to which the other flower parts are attached; it is sometimes enlarged and fleshy, as in a strawberry or blackberry.

Recurved Bent or curved downward or backward.

Rhizobium Rod-shaped bacteria that are capable of nitrogen fixation in symbiosis with plants in the family Fabaceae. *Contrast* Actinobacteria

Rhizome A creeping, underground stem that produces new shoots and adventitious roots. *Contrast* Stolon

Root The lower portion of the plant's axis that anchors it in the soil and absorbs nutrients and water. The primary root develops from the embryo, and secondary roots are branches off the primary root.

Root nodule An outgrowth on the roots of certain plants that contains *Rhizobium* or *Frankia* bacteria and is the sites of symbiotic nitrogen fixation.

Root sucker A shoot that arises from an adventitious bud on a root.

Rosette In herbaceous plants, a circular cluster of leaves located at ground level. The stem is compressed and the leaves are separated by very short internodes.

Ruderal Refers to a plant that grows in waste places or requires soil disturbance to become established. From Latin *rudera*, "ruins" or "rubbish," plural of *rudus*, "broken stone." In botanical parlance, a disturbance-adapted species.

Runner *See* Stolon

Samara A dry, indehiscent winged fruit, as maple or ash seeds.

Scale A reduced or rudimentary leaf; usually surrounding a dormant bud.

Scion In grafting, a young shoot with special characteristics that is spliced or grafted onto a rooted understock.

Seed A ripened ovule consisting of a protective coat enclosing an embryo and food reserves; the product of sexual reproduction.

Seed bank The totality of viable seeds that lie buried in the soil at any point in time; they typically germinate following some disturbance of the soil surface.

Seed head An inflorescence bearing mature fruit; especially in the Asteraceae.

Seed leaf *See* Cotyledon

Sepal In a flower, the outermost whorl of leaflike, usually green appendages below the petals. *See* Calyx

Serrate Refers to the margin of a leaf with sharp, forward-pointing teeth. *Contrast* Entire; Lobe

Sessile Attached directly by the base, as a leaf without a petiole or a flower without a pedicel.

Sexual reproduction The production of a plant from seed. *Contrast* Vegetative reproduction

Sheath In grasses, the lower part of a leaf that encloses the stem and the emerging new leaves.

Shoot A young green stem with leaves, flowers, or both.

Simple leaf A leaf blade that consists of a single piece but may be deeply lobed or divided. *Contrast* Compound leaf

Sinuses The indentations between the teeth or lobes on the margin of a leaf.

Species A population of individuals sharing common morphological features and evolutionary history; the basic unit of classification in the nomenclatural hierarchy.

Spike An elongated inflorescence with sessile flowers on an unbranched central axis. *Contrast* Raceme

Spikelet In grasses and sedges, an inflorescence consisting of 1 to many flowers subtended by minute bracts.

Spontaneous Refers to a plant that grows in an area without being cultivated by humans; it may be either a native or introduced species. *Contrast* Escape; Naturalized

Spore The tiny, dustlike reproductive unit of ferns and horsetails.

Sporophyte The mature stage in the life cycle of ferns and horsetails that produces spores.

Stamen The male organ of a flower, consisting of a stalk (filament) and a pollen-producing organ (anther).

Staminate Flowers that have only male organs.

Stigma The apex of the style, usually enlarged and sticky, on which the pollen grains land and germinate. *See* Carpel; Pistil

Stipule A small, leafy outgrowth at the base of a petiole; typically found in pairs.

Stolon A stem that grows horizontally along the surface of the ground, producing roots at its nodes and new plants from its buds. *Contrast* Rhizome

Strobilus The conelike reproductive structure of horsetails.

Stump sprout A shoot that emerges from the base of a tree or shrub, usually after some form of traumatic injury such as logging; a basal sprout. *See* Crown

Style The elongated portion of a carpel, above the ovary, with the stigma at its tip.

Subtend To be located beneath a given structure, as a leaf at the base of a bud. *See* Axil

Succession Changes in the composition of a plant association over time, typically initiated by some form of disturbance. **Early succession** refers to the beginning stages of the process, immediately following a disturbance event; **late succession**

refers to the latter stages of the process when the composition of the vegetation has stabilized.

Summer annual A plant that germinates in late spring or summer and completes its life cycle before winter. *Contrast* Winter annual

Symbiosis A long-lasting association between 2 species of organisms that may or may not be mutually beneficial; literally the word means "living together."

Taproot A thick, downward-growing root with few side branches; adapted to penetrating heavy soils and storing carbohydrates.

Tendril A twining, threadlike structure produced by the stem or leaf of a climbing plant that enables it to cling to an object.

Terminal Located at the tip or apex (e.g., a terminal inflorescence). *Contrast* Lateral

Tiller A lateral shoot that emerges from the base of a grass or other monocot.

Trifoliate A compound leaf consisting of 3 leaflets, as in clover and poison ivy.

Tuber The swollen tip of an underground stem or rhizome; an underground food storage organ that sprouts when growing conditions are favorable (e.g., a potato).

Tubular floret *See* Disk floret

Umbel A cluster of flowers—typically flat topped—with numerous pedicels arising from a common point.

Understock In grafting, the rooted plant (usually a seedling) to which the scion is spliced or grafted.

Undulate Having a wavy, up-and-down margin; used to describe leaves or petals.

Unisexual A flower having organs of only 1 sex. *Contrast* Bisexual

Variegated Having 2 or more colors.

Vegetative reproduction Asexual reproduction by any means other than from seed, including bulbs, rhizomes, stump sprouts, root suckers, and leaves. *See* Clone; *Contrast* Sexual reproduction

Vein An externally visible strand of vascular tissue in a leaf or other flat organ.

Volunteer *See* Spontaneous

Weed A plant that grows rapidly and abundantly in a place where it is not wanted; a plant that aggressively colonizes disturbed habitats. *Contrast* Invasive

Weeping With branches bending over or hanging down, as a weeping willow. *Contrast* Fastigiate

Whorled Having a ring of 3 or more leaves or other organs radiating from a node. *Contrast* Alternate; Opposite

Wing A thin, flat extension or projection from the side of a stem or leaf.

Winter annual A plant that germinates in fall or winter and completes its life cycle the following spring. Winter annuals are tolerant of cold weather, overwinter as rosettes, and grow best in cool, moist conditions. *Contrast* Summer annual

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