chapter 1

The Ecology of Planting Design

The common thread that links the environments we design as landscape architects is plant materials. The common philosophy that guides the selection of plants for these environments is planting design ecology.

Our repertoire of trees, shrubs, ground covers, and grasses provides the extensive and complex base of ingredients we use to manipulate the spaces around us. We improve living conditions for humans, protect and balance the habitats of wildlife, and prevent the deterioration of the aesthetic environment with the proper selection and placement of plant materials. It is important, therefore, to begin a study of the elements of planting design with the processes of plants as they occur in natural spaces.

Just as planting design is an element of landscape architecture, landscape ecology — both natural and ornamental — is the principle component of planting design. Solving intricate design problems with plants requires an understanding of "how plants live, where they live, and why they live where they do" (Dice, 1952). The selection, placement, survival, and design effectiveness of each plant or plant mass in a composition depends upon the external forces that act upon them. As landscape architects, we manipulate these forces to create planted spaces that reconstruct, replenish, or enhance livable environments.

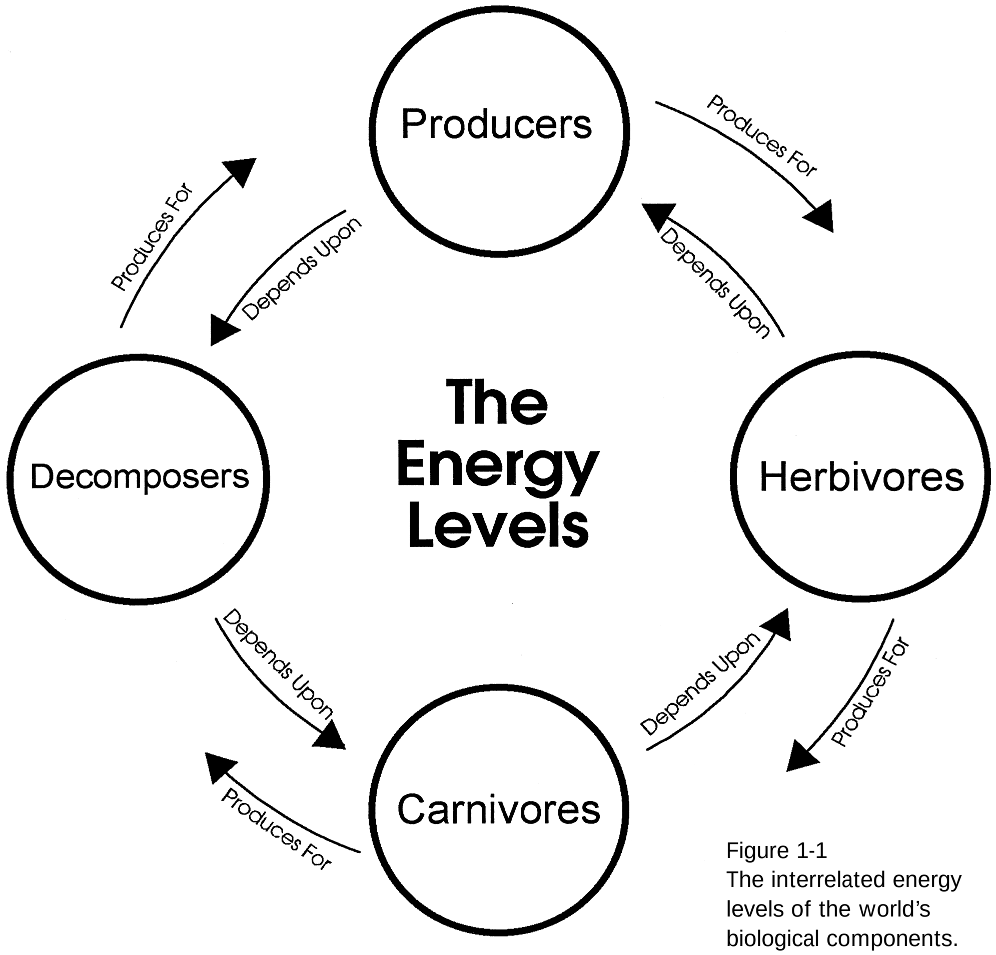


Figure 1-1
The interrelated energy levels of the world's biological components.

The Biological Components

The biological components of the physical world consist of a variety of interrelated energy levels. The first level is green vegetation, the part of the system that collects and stores energy from the sun through photosynthesis, with a corresponding release of oxygen. The rest of the plant and animal communities are dependent upon this level. Green vegetation is thus the producer level for the system. The second level, the herbivores, ranges in size from a parasitic fungus to an elephant and is dependent upon the first level for its energy and food. Levels three and four are both composed of carnivores — animals that eat herbivores. The lower form of carnivores, level three, relies exclusively on level two for energy. Level four, however, the higher form, may also get its energy from consuming members of level three. Level five is made up of bacteria, fungi, and protozoa — the decomposers — which use dead plants and animals for food and energy. This decayed matter in turn becomes an energy and food source for green vegetation, and the chain of elements and events necessary for our existence is completed (Fig. 1.1).

The Basic Communities

The community of green vegetation, known broadly as plants, is divided into four groups or subcommunities known as divisions:

1. *Thallophyta* (thallophytes) are non-chlorophyll-bearing with little or no woody structure, comprising bacteria, lichens, and fungi.
2. *Bryophyta* (mosses and liverworts) are small green plants without flowers (in the popular sense).
3. *Pteridophyta* (ferns and fern families) are green plants with vascular tissue, true roots, and a clear differentiation of leaf (frond) and stem; classes are true ferns, scouring rushes,

club mosses, the tropical genus *Psilotum*, and quillworts.

4. *Spermatophyta* (seed plants) are distinct flowering plants having an embryo that germinates and are considered to be the most highly organized. The most distinct subdivisions are the gymnosperms (plants that produce a naked seed) and the angiosperms (plants that enclose the seed in an ovary).

The Natural Plant Systems

The two basic plant ecological systems a designer must know are the *individual system* and the *population system* (Shelford, 1963).

Within the natural plant community, the individual system is one that is genetically uniform. Leaves, stems, and roots act as a total unit, and under most circumstances none of the parts can live without the others for any extended period. Some species generate vegetative parts (rhizomes or runners) that produce genetically identical plants (clones).

An individual plant in a natural environment is dependent upon and relates to the other plants around it in two ways: genetically to other members of the same species, and ecologically to other plants in the community — forming a plant population system. When a population becomes isolated and begins to inbreed with other plants within the same group, it is called a local population. It is from the local population in a specific environment that we begin to find genetic adaptation to the soil, climate, and water conditions of a site. Certain genes or gene combinations begin to restrict the area in which the plant will grow and thrive. This fundamental relationship is the key to selecting plants for a designed environment as well. An individual plant in a designed environment must depend upon and relate to the other plants in the composition. No individual plant or plant mass should be an independent element, freestanding or without ecological relationships.

The distribution of individual or populations of plants depends upon their success or failure within the particular system to which they are associated. Processes found in each living organism determine not only the continuation of the species but also its use as a design element. A plant must do more than just survive — it must complete the reproductive cycle to become fully adaptable (Shelford, 1963; Spurr, 1964). The three stages in this cycle are *germination*, *vegetative growth*, and *flowering and fruiting*.

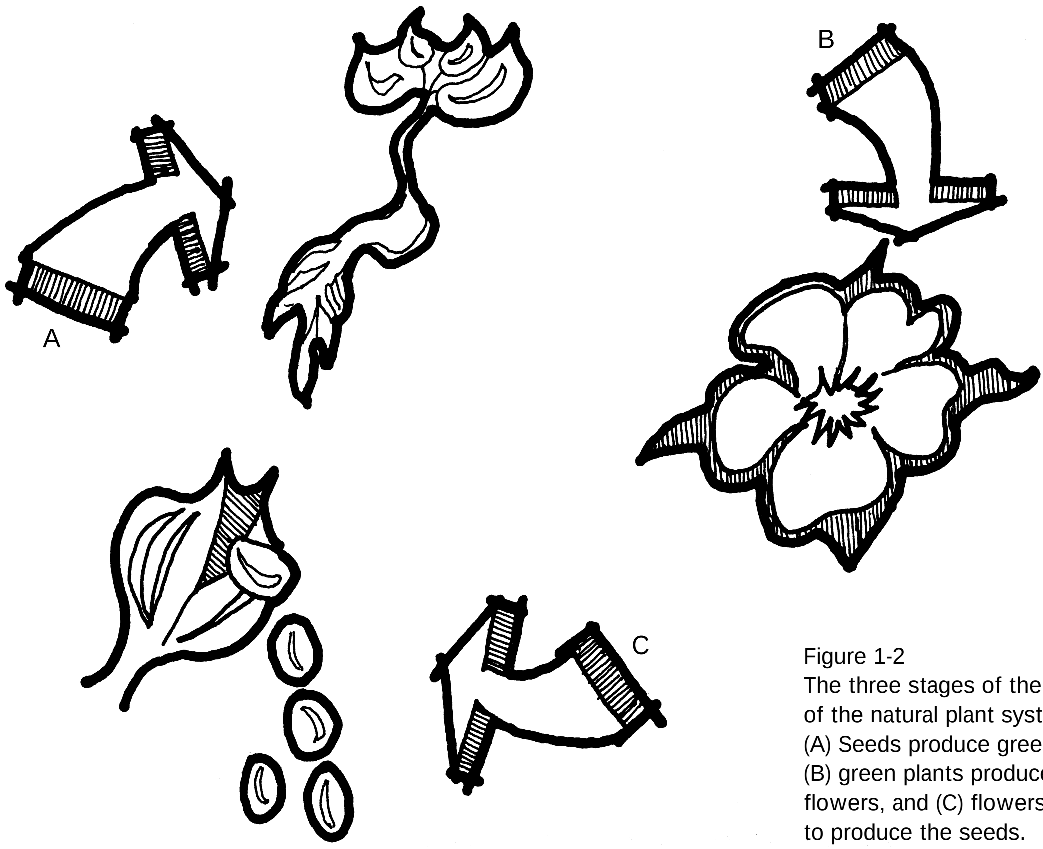


Figure 1-2
The three stages of the cycle of the natural plant systems. (A) Seeds produce green plants, (B) green plants produce the flowers, and (C) flowers pollinate to produce the seeds.

Most plants, with the exception of ferns and mosses, start from seeds. The seed is a self-contained life unit relying upon moisture as the key factor for releasing the plant embryo (Fig. 1-2).

The germination of a seed is followed by vegetative growth — represented by the development of rootlets and sprouts. The roots start downward, following water and providing the anchor system of the plant. The roots will eventually have an outer covering similar to that of bark, with root hairs forming at the ends and near the drip line of the plant to attract moisture.

The stem system in the beginning pushes the seed leaves above the surface of the ground. Eventually it provides the terminal growing points (terminal bud) that concentrate the energy direction for the pant. Side buds (lateral growth) form, and soon the structure of the plant is permanently established. Another function of the stem system is the storage of food during dormancy periods. Some plants with weak aboveground systems (such as sweet potatoes and bulbs) have developed underground stems for storage.

Aboveground development conditions the survival of most plants in the natural environment. The limbs grow and adjust as needed to expose the leaves to sunlight for the production of food. If, however, an environment becomes hostile to a plant's survival, evolutionary capabilities may emerge and allow the structure to adapt to habitat extremes such as severe loss of nutrients needed for a support structure. Good examples of this are groups of plants such as vines and creepers that have adopted a clinging or twining habit for support. Their basic structure is such that other plant features give them their form.

Once the true leaves form, the plant becomes a complete and productive organism. The leaf uses raw materials from the environment, converting and recycling ingredients into other reusable items — maintaining itself as one of the best-designed machines in nature (Fig.1-3).

The last stage in the process is flowering and fruiting. The flowers, regardless of their structural configuration, provide the link of seed fertilization by pollination. From fertilization the seeds develop, disperse, and germinate into a new plant, continuing the species (Fig. 1-4).

The existence and distribution of a plant in an ornamental setting or in a forest or open field is subject to the "approval" of the environment that surrounds it.

There are two basic levels of distribution. *Macrodistribution* is geographic: plant species occur in a general region. *Microdistribution* is ecological, with species occurring only in certain kinds of environmental situations (i.e., north-facing slopes or the edges of streams and lakes).

A few species of plants are found almost everywhere and are referred to as *cosmopolitan species*. Others are found in only one area and are called *endemic species*. Plants restricted to a given region (such as eastern North America) are *broad endemics* and include such plants as the flowering dogwood *(Cornus florida)* and ponderosa pine *(Pinus ponderosa)*. Those restricted to microenvironments in a narrow geographic area are narrow endemics and include the isolated redwoods *(Sequoia sempervirens)* of California.

The presence or absence of winter separates the distribution of plants into three groups. The first, *arctic-alpine* (harsh winter), is made up primarily of perennial herbs occurring as tundra plants. The second, *temperate*, is made up of widely distributed species genetically capable of producing individuals adapted to different climates. The third, *pantropical*, consists of species located throughout the tropics primarily in cultivated areas (Shelford, 1963).

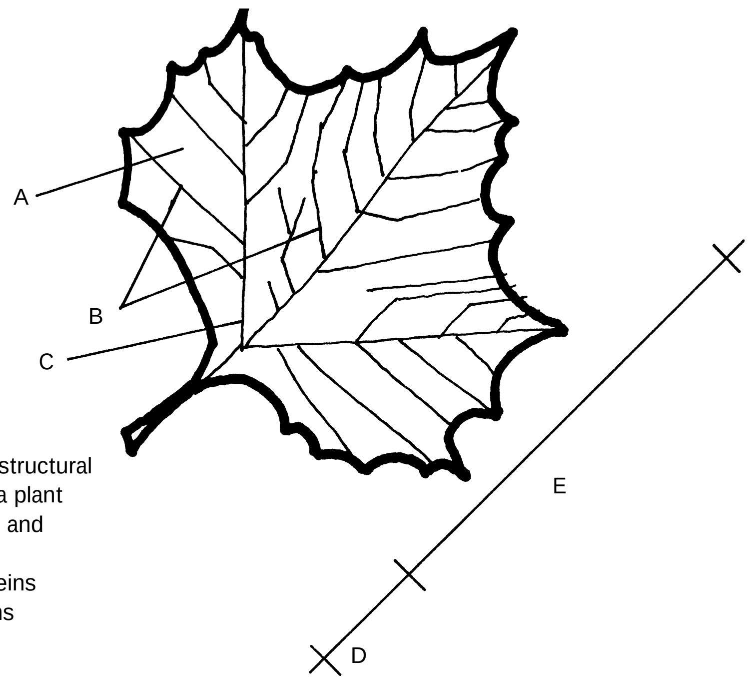


Figure 1-3
True leaves are the structural elements that help a plant become a complete and productive system.
A. Small netted veins
B. Secondary veins
C. Main veins
D. Petiole
E. Blade

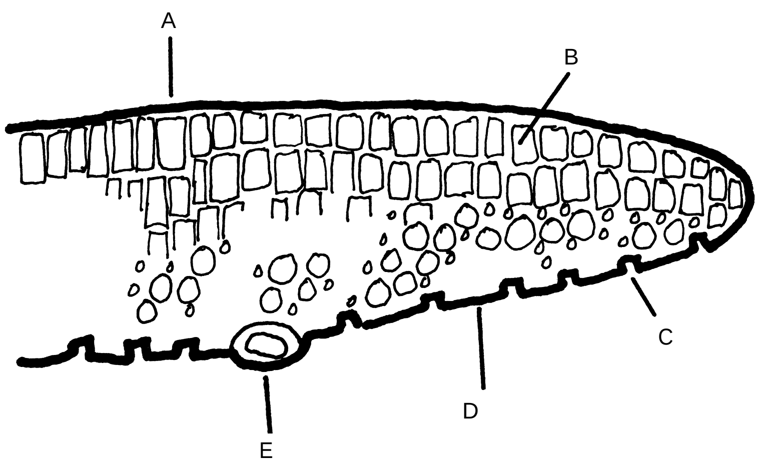


Figure 1-4
The leaf is the center of an extensive plant production system. A designed planting environment should not interrupt the needs of that system.
A. Protective layer (upper epidermis)
B. Cells for food manufacturing (parenchyma)
C. Stomata for breathing
D. Protective layer (lower epidermis)
E. Veins for conduction

The Communities of the Natural Plant Systems

The dynamic relationship between the various plant systems is governed by three principal ecological factors: climate, physiography, and soil. In order to focus attention upon the species used in a project, a careful review of these factors is important. For it is these factors, more than anything else, that will determine the geographic range and possible design functions of a plant or population of plants.

Climate

The ability of an individual plant to fulfill a specific design function is related to its hardiness and adaptability to the climate conditions that will surround it. The climate needs of broadleaf evergreens and narrow-leaf evergreens are a good example. Narrow-leaf plants will generally not survive the harsh summers of the broadleaf range without microclimate modification. Such an alteration of climate conditions may extend a plant's design effectiveness and site adaptability, but it may also increase maintenance costs.

The climate of a plant community includes temperature, precipitation, humidity, light, and wind, which act in unison from day to day and season to season.

Temperature

Temperature determines plant hardiness and growth. Each plant has a minimum and maximum temperature requirement that largely determines adaptability in a particular region or project. Adaptability is generally related to the ability of the plant to enter a dormant or resting stage during which it is able to withstand widely variable temperature extremes. Many plants, especially deciduous woody plants, protect themselves by becoming dormant until temperatures are such that growth can occur again (Fig. 1-5).

The limiting factors of temperature are:

- short growing season
- unfavorably high or low temperatures during growing season

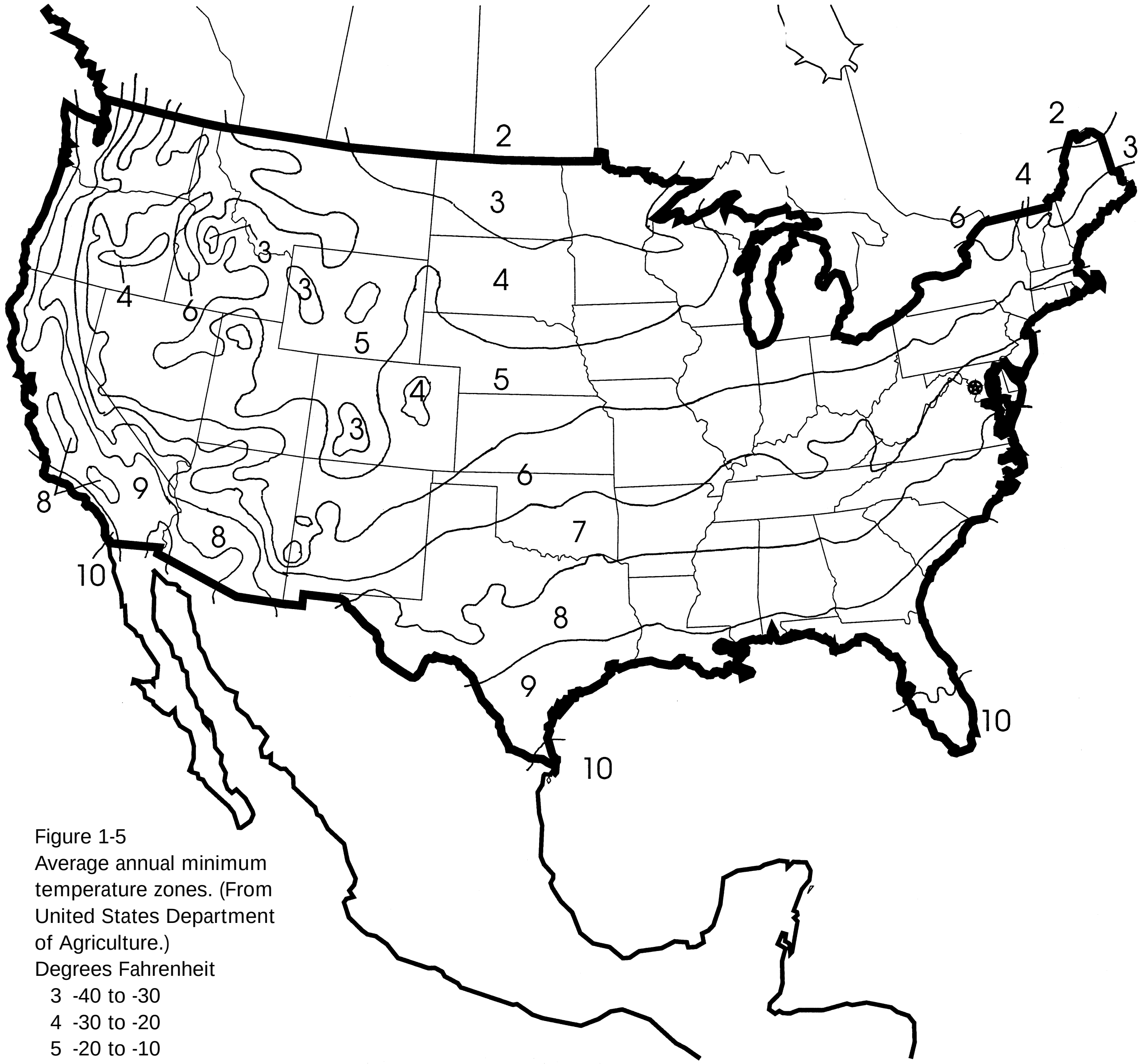


Figure 1-5
Average annual minimum temperature zones. (From United States Department of Agriculture.)
Degrees Fahrenheit

3	-40 to -30
4	-30 to -20
5	-20 to -10
6	-10 to 0
7	0 to 10
8	10 to 20
9	20 to 30
10	30 to 40

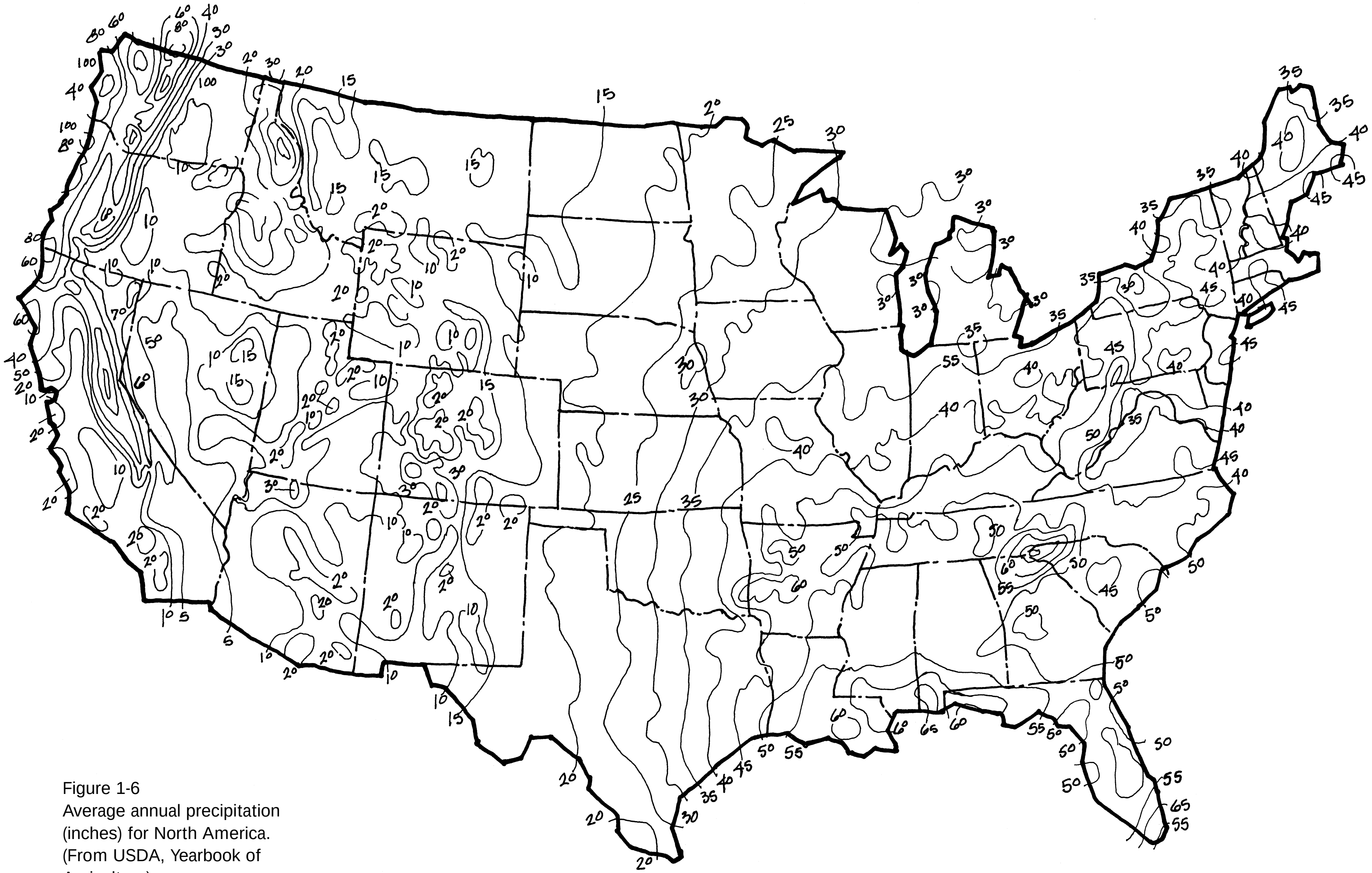


Figure 1-6
Average annual precipitation (inches) for North America. (From USDA, Yearbook of Agriculture)

harsh winter temperatures that injure or kill dormant plants

temperatures favorable to the development of pest problems.

Precipitation

Precipitation, in both natural and supplemental form, ranks next to climate in determining plant adaptability for design. It is usually gauged in inches and hundredths of inches and will largely control the distribution of vegetation. Where rainfall is heavy, a climax community could easily be a dense forest. Where it is scarce, a community may sustain only desert-like growth and will never reach its climax states.

Water may have a greater part to play in adaptability than in hardiness, but it is still important to the latter because plants under water stress may be more subject to low or high temperature injury. Plants are divided into three groups based upon their adaptability to moisture: *hydrophytes*, which are plants that will grow in water or on extremely wet sites; *mesophytes*, plants adapted to medium moisture conditions; and *xerophytes*, plants resistant to drought or extremely dry conditions. The ability of a plant to adapt to water extremes will largely determine its adaptability to a particular climate and design situation (Fig. 1-6).

Humidity

Humidity is the amount of water vapor in the air, with relative humidity corresponding to the percentage of air saturation. Air can hold more water vapor when the temperature rises; thus when air is heated, relative humidity is lowered, and vise versa. When plants cool at night and the adjacent air reaches a relative humidity of 100 percent, excess moisture falls to the ground in the form of dew or frost — depending on the temperature.

Light

Light falls to earth in the form of solar radiation and is essential to the usefulness of plants in a design, especially when color is to be a dominant element. Light is the main ingredient of photosynthesis. Light determines plant growth responses, and in many instances also relates to hardiness and adaptability. Exposure to light and temperature are interrelated, and both directly contribute to the ability of plants to adapt to local design or environmental conditions. Among the most important planting design factors to consider are the placement of plants for exposure to sun or shade (Fig. 1-7).

When dealing with light for specific plants, three aspects must be remembered:

1. *Intensity*, the plant's need for a certain level of brightness. Some plant materials cannot withstand full sunlight while others cannot tolerate shade. The landscape architect responds to this factor by filtering or increasing available light.
2. *Wavelength*, the relationship of the plant to ultraviolet (400 millimicrons) and/or infrared (760 millimicrons) light rays. The fact that a plant receives light does not necessarily mean that its light requirements are being met, as some plants need more ultraviolet (blue light) than others. The heavenly bamboo, *(Nandina domestica)* needs infrared light to produce its attractive yellows and reds and when placed in ultraviolet light remains a cool green. A designer may adjust this element to meet the needs of the materials chosen for composition.
3. *Duration*, the length of time a plant may need to be exposed to light to produce flowers, seeds, or attractive foliage. If a small flowering tree or shrub remains in full sun only a short period of time during a day, it may not receive the light it needs to achieve full aesthetic quality.

Wind

Wind plays an important role in the natural plant community by aiding in the dispersal of pollen, seeds, or insects that are vital for the continuation of basic community characteristics. The exposure of some plants to winds may directly affect their ornamental adaptability by causing the loss of stem or leaf moisture or reducing their ability to reproduce. High winds or sudden wind changes may also cause damage to some plant species or even reduce the amount of water vapor in the air. In some vegetative communities, the direction of growth and even the shape of some plants will be controlled by both seasonal and prevailing winds (Fig. 1-8).

Physiography

The basic physiography of plant communities can be determined by looking at a region's natural environment. The topography will govern the amount of light for plant growth. On level areas where the grade is fairly uniform, the transition of plants may be very broad and indefinite. On mountains and steep slopes, near saline areas, or around water, there may be a very small and well-defined plant community (Spurr, 1964).

On a micro scale, the local environmental conditions of the site must be determined by careful resource inventory. For a macro scale determination, however, the vegetative regions discussed below are presented for preplanning assistance. The United States is made up of 32 general growth regions, which stretch from the North Pacific Coast to the southern tip of Florida. These regions in turn may be divided into various forest and grassland communities (Fig. 1-9).

The North American Deciduous Forest

This forest community occupies North America from the Gulf of Mexico to the Great Lakes. It spreads from the East Coast westward to the Mississippi River and beyond and is dominated by trees with broad leaves that shed each season. Small deciduous trees and shrubs occupy its understory. The beech and sugar maple comprise the climax stand of this area.

The subdivisions of this forest are the northern and upland regions, the southern and lowland regions, and the stream-skirting forest. The natural landscape is characterized by mixed plant materials and lack of a distinctive boundary between regions.

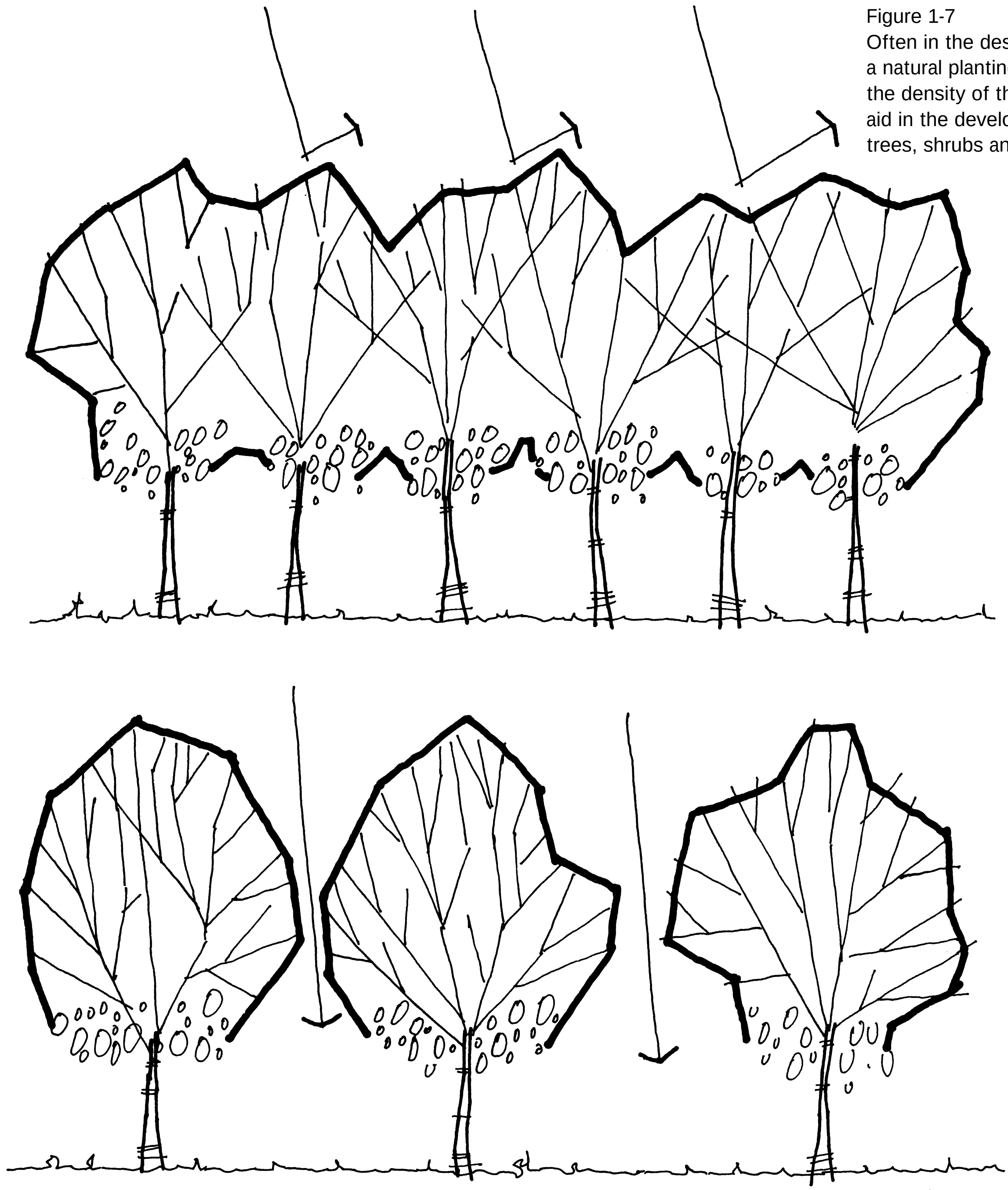


Figure 1-7
Often in the design and development of a natural planting composition reducing the density of the overhead canopy will aid in the development of understory trees, shrubs and ground covers.

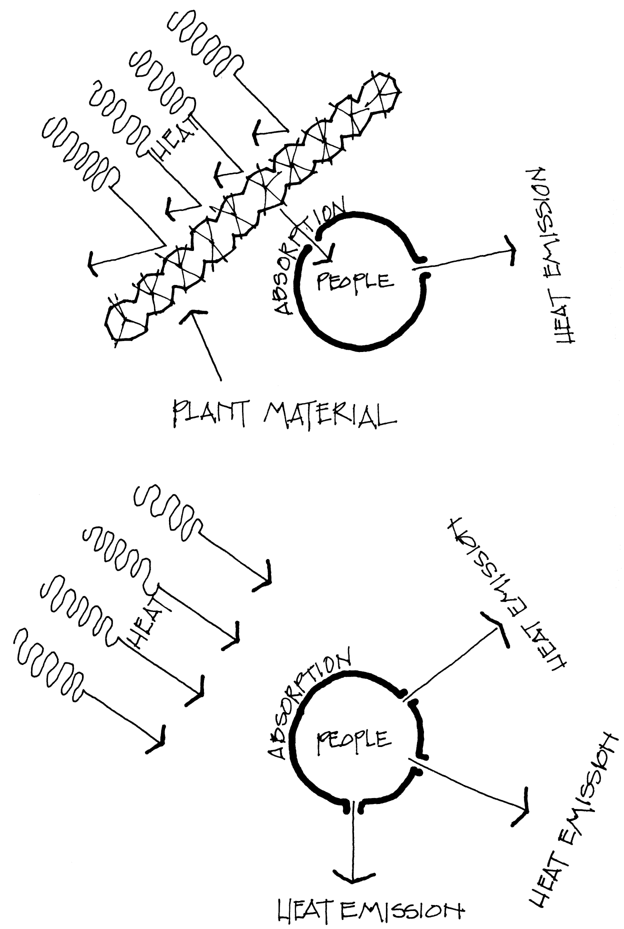


Figure 1-8
Using plants to control the effects of cold winds will help reduce heat emission, increasing the comfort of people in a planted space.

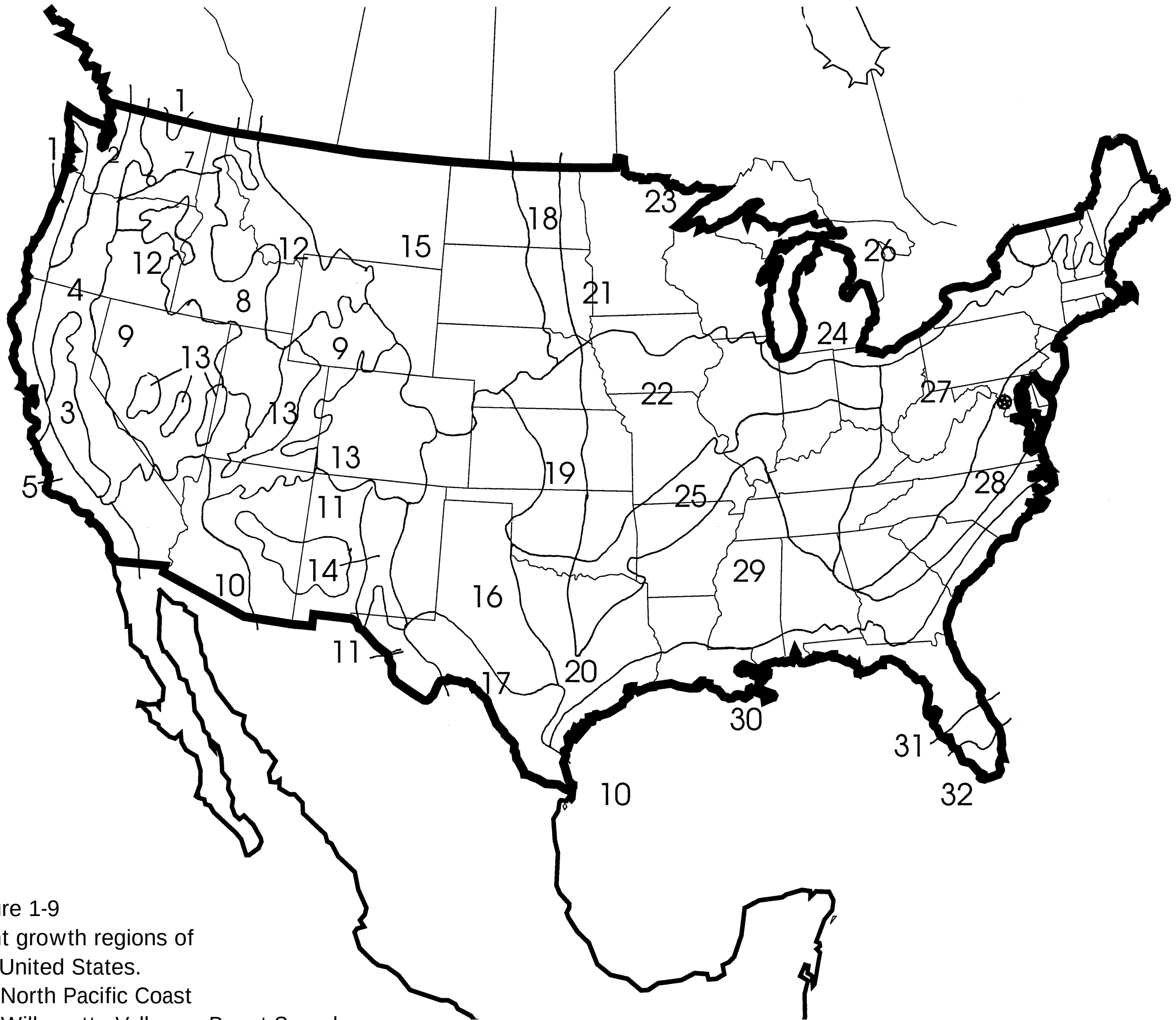


Figure 1-9
Plant growth regions of the United States.

1. North Pacific Coast
2. Willamette Valley — Puget Sound
3. Central California Valleys
4. Cascade–Sierra Nevada
5. Southern California
6. Columbia River Valley
7. Palouse-Bitterroot Valley
8. Snake River Plain — Utah Valley
9. Great Basin — Intermontane
10. Southwestern Desert
11. Southern Plateau
12. Northern Rocky Mountains
13. Central Rocky Mountains
14. Southern Rocky Mountains
15. Northern Great Plains
16. Central Great Plains
17. Southern Plains
18. Northern Black Soils
19. Central Black Soils
20. Southern Black Soils
21. Northern Prairies
22. Central Prairies
23. Western Great Lakes
24. Central Great Lakes
25. Ozark-Ohio-Tennessee River Valleys
26. Northern Great Lakes–St. Lawrence
27. Appalachian
28. Piedmont
29. Upper Coastal Plain
30. Swampy Coastal Plain
31. South-Central Florida
32. Subtropical Florida

The northern and upland region has five subregional areas, which are composed of the following vegetative types (Figs. 1-10 to 1-12):

1. *Tulip-oak*. This part of the forest is most abundant between altitudes of 500 feet (150 m) and 1,000 feet (300 m).
2. *Oak-chestnut*. This area is found from Cape Ann, Massachusetts, to the southern end of the Appalachians at elevations between 1,500 and 2,000 feet.
3. *Maple-basswood-birch*. This forest area is found primarily in the Appalachians at altitudes of 2,500 feet (760 m) to 4,200 feet (1,275 m).
4. *Maple-beech-hemlock*. These are found in southern Michigan, northern Ohio, and Indiana.
5. *Maple-basswood*. These are found in northern Illinois, southern Wisconsin, and parts of eastern Minnesota.

The annual rainfall of this forest area ranges from 28 inches (70 cm) to 40 inches (100 cm). The trees of the forest canopy are 75 feet (23 m) to 100 feet (30 m) in height and 23 inches (58 cm) to 30 inches (76 cm) in caliper. Their branching heights are 32 feet (10 m) to 40 feet (12 m), and they shade about 90 percent of the forest floor.

The canopy layer is made up of the limbs, upper trunk, and leaves of the dominant forest vegetation. The understory is composed of young and suppressed individuals of the larger species, while the main seedling trees (or larger shrubs) are the abundant pawpaw. The spicebush is the dominant material of the shrub layer, and the herb layer is characterized by common nettle and wild ginger.

The southern and lowland forests are subdivided into:

1. *Oak-hickory*. These are found primarily from New Jersey to Alabama and westward to Texas.
2. *Magnolia-maritime*. This begins in the southwest corner of Virginia, extends southward to meet the magnolia forest in South Carolina, and goes along the coast to the southeast corner of Texas.

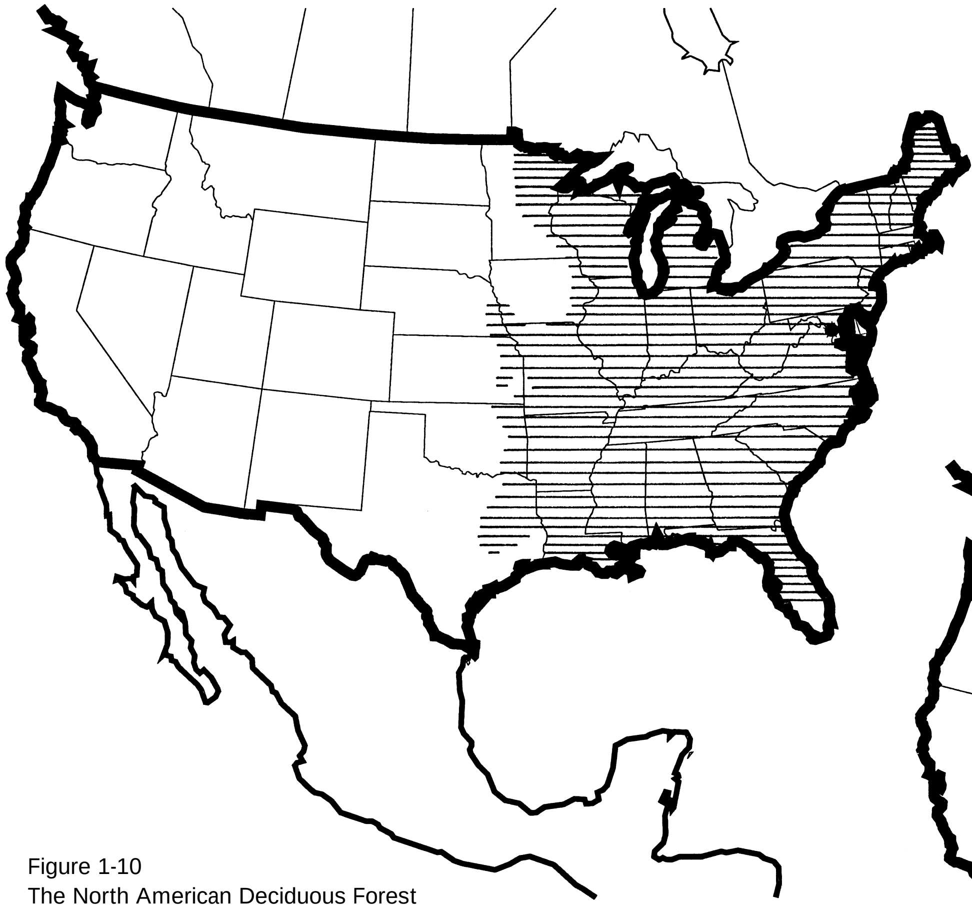


Figure 1-10
The North American Deciduous Forest
Trees with broad leaves that shed annually dominate this plant region. (U.S. Department of the Interior, Bureau of Land Management.)

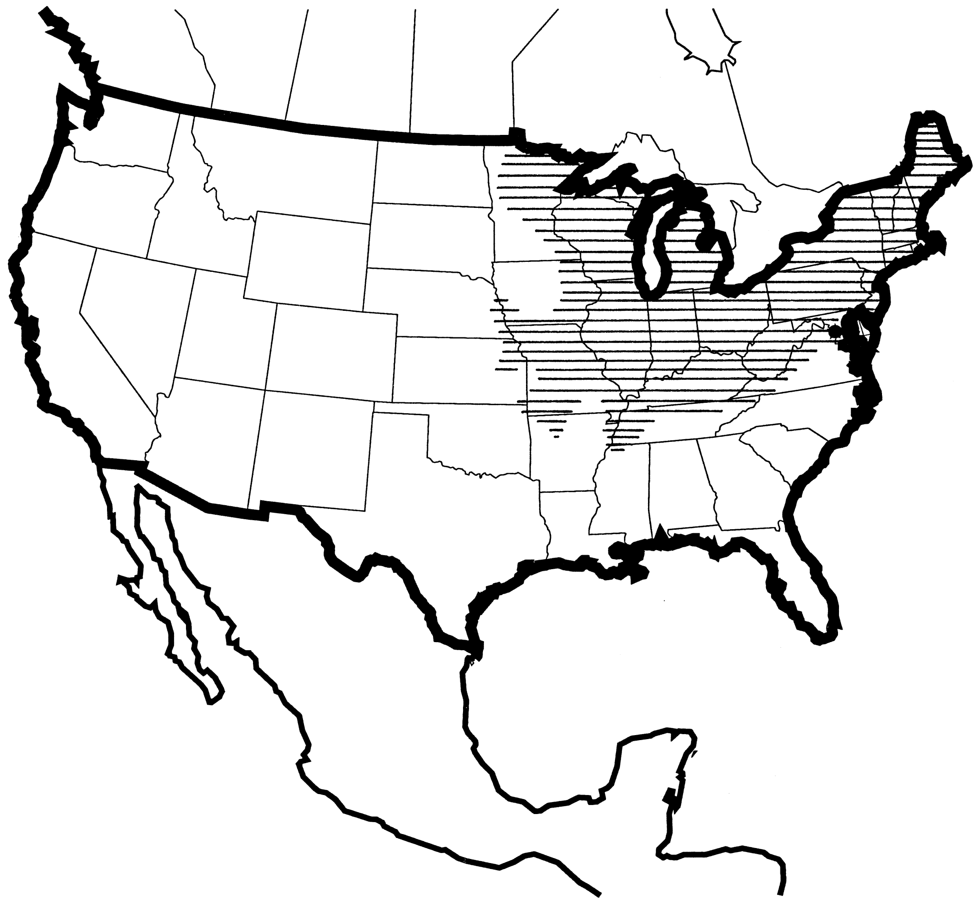


Figure 1-11
The Northern and Upland Plant Region
This plant region is characterized by large overstory vegetation. (U.S. Department of the Interior, Bureau of Land Management.)

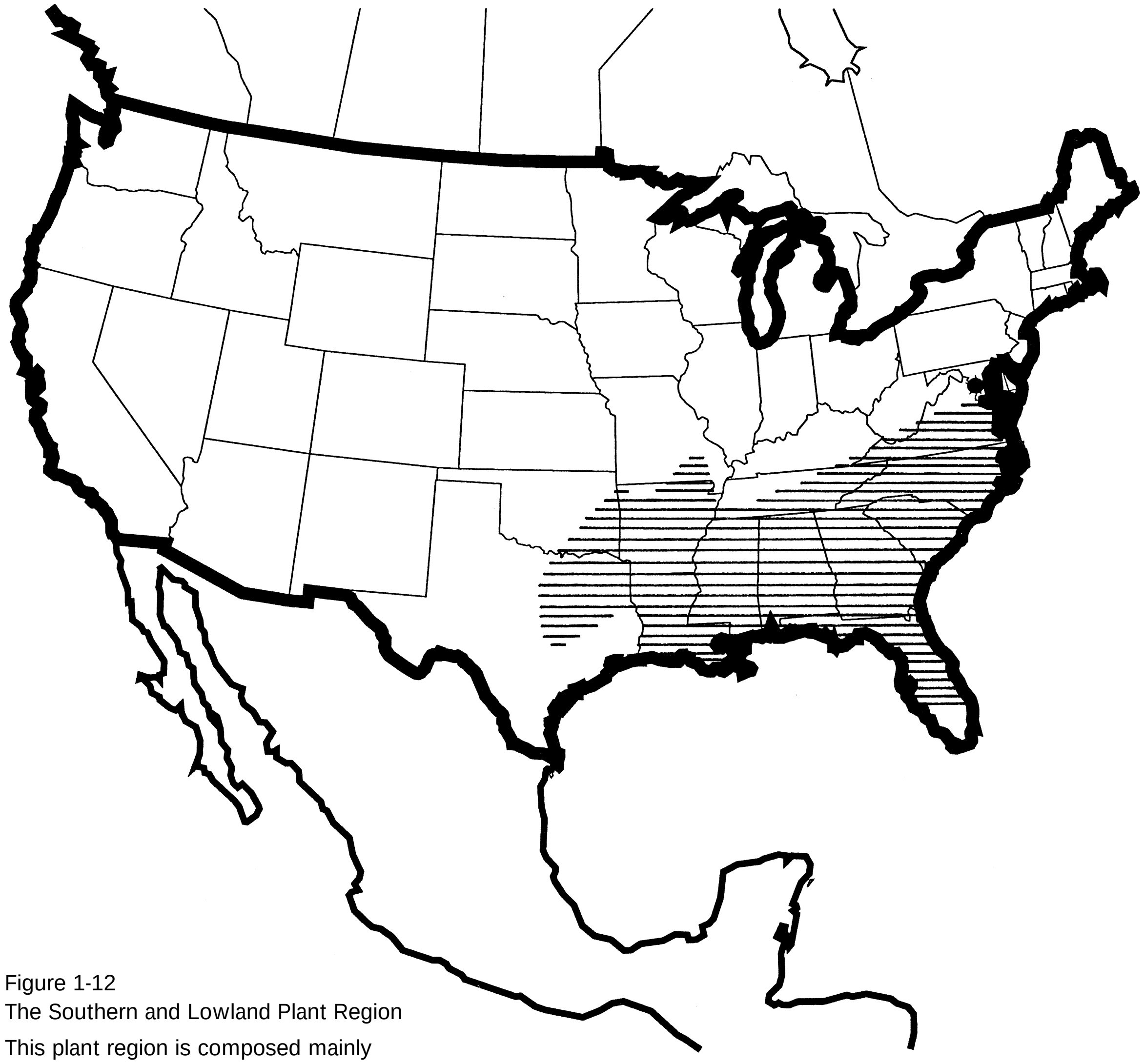


Figure 1-12
The Southern and Lowland Plant Region
This plant region is composed mainly of oak-hickory-magnolia forest. (U.S. Department of the Interior, Bureau of Land Management.)

Rainfall for this region is from 40 inches (100 cm) to 60 inches (150 cm) annually and is greatest in the spring and summer (Spurr, 1964.)

The floodplain forest is mixed with other deciduous forests and grassland areas of North America. Because of constantly changing environmental conditions brought on by shifting channels, islands, and sandbars, vegetation often stops short of the climax stage (Fig. 1-13).

Two types of landscape habitats are characteristic of this area. The first is *terrestrial*, which is dry at low water. Early spring flooding that causes the submergence of vegetation for anywhere from a week to as long as two months is typical of these forest areas. The second is *aquatic*, which is covered with water most of the year.

Small tree thickets are common, especially the sandbar willow, which helps stabilize sands along river channels. These are usually followed immediately by cottonwood seedlings, and then by sugarberry, elm, and sweetgum. Several hundred years may be necessary for an oak forest to appear in areas 40 feet (12 m) to 45 feet (14 m) above the low water level (Shelford, 1963).

The Boreal Coniferous Forest

This forest originally extended from some parts of Indiana and Ohio, to the mouth of the Mackenzie River in Canada, to the Brooks Mountain Range in Alaska. In this area, the climate ranges from cool to cold, and there is precipitation all year, with much coming in the summer. The climax evergreens may be pines, with long needles, or spruce, hemlock, and fir, with short, thick leaves (Fig. 1-14).

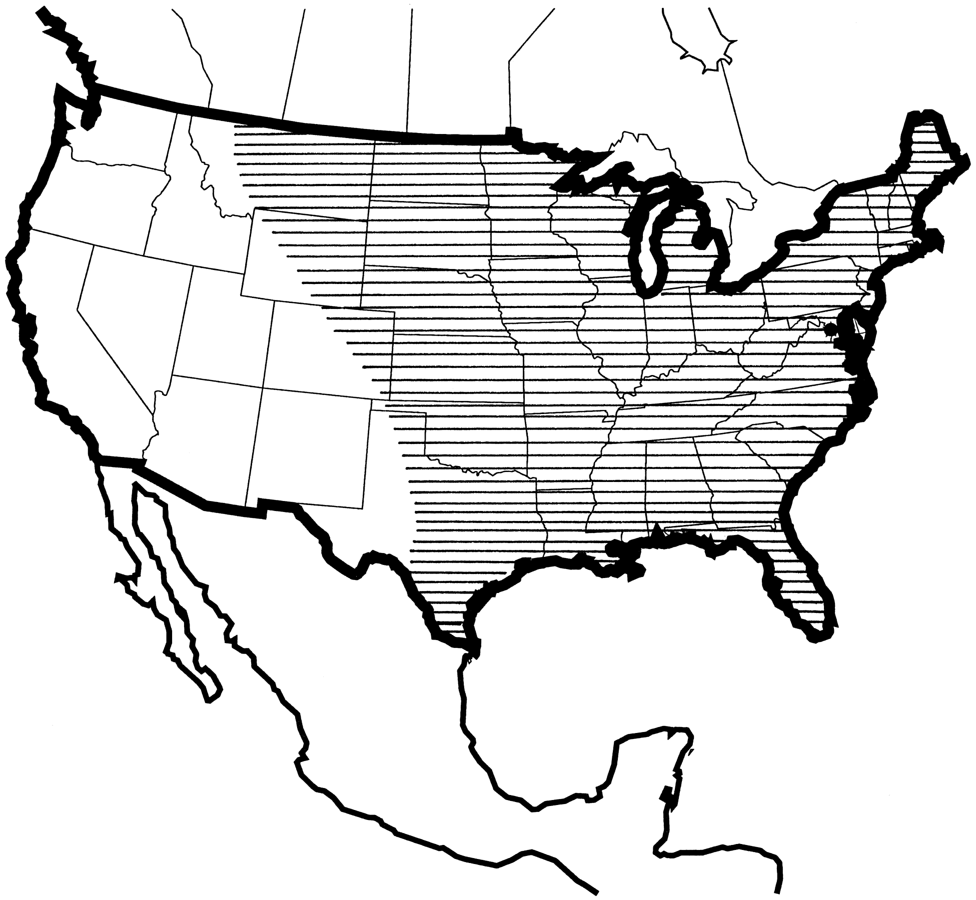
This forest area can be subdivided into the boreal forest east of the Rocky Mountains; the vegetation of the valley areas and lower slopes of the northern Rocky Mountains; and the forests of the Rocky Mountains and the Sierra Nevada (Shelford, 1963).

The Montane Coniferous Forest and Alpine Communities

This region is found from the upper eastern slope of the British Columbia coastal mountains, the Cascade Mountains, and the coast range of northern California.

Figure 1-13
The Floodplain Forest Region

This region is characterized by terrestrial (occasionally flooded) and aquatic (submerged or partly submerged) vegetative types. (U.S. Department of the Interior, Bureau of Land Management.)



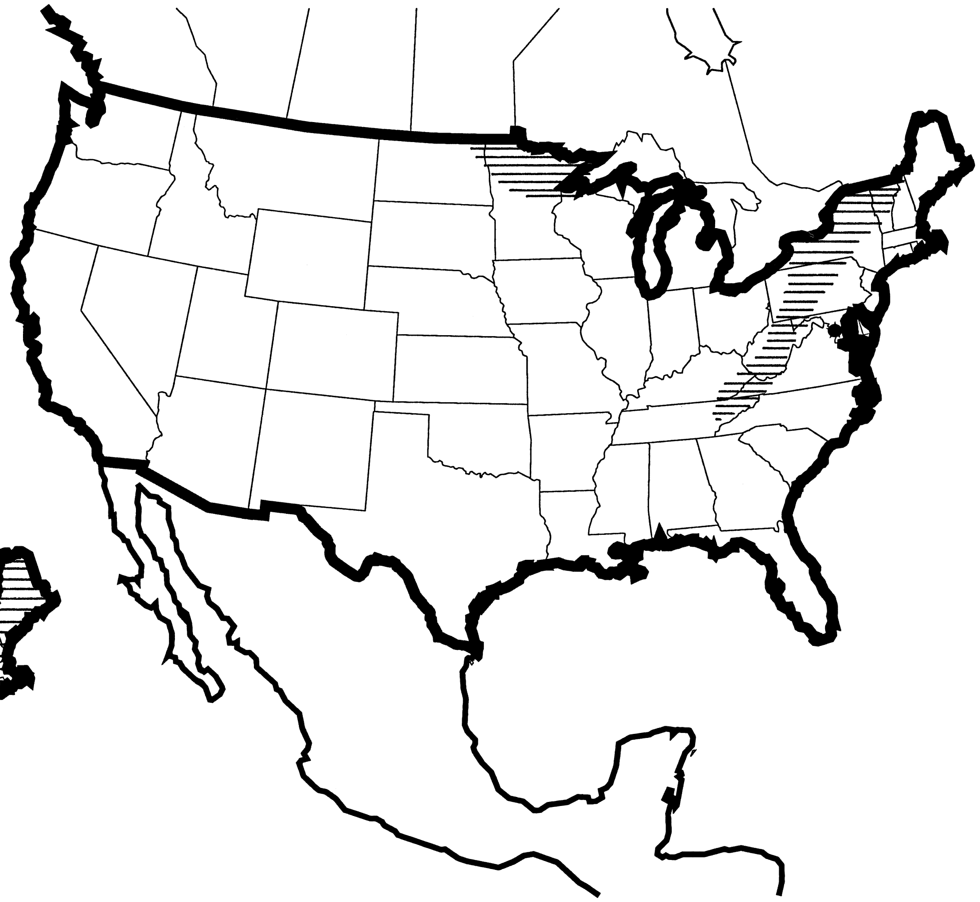


Figure 1-14
The Boreal Coniferous Forest Region

This region is divided into the boreal forest east of the Rocky Mountains in northern Minnesota and in the Appalachian region, and the vegetation of the valley areas of the northern Rocky Mountains of Canada. (U.S. Department of the Interior, Bureau of Land Management.)

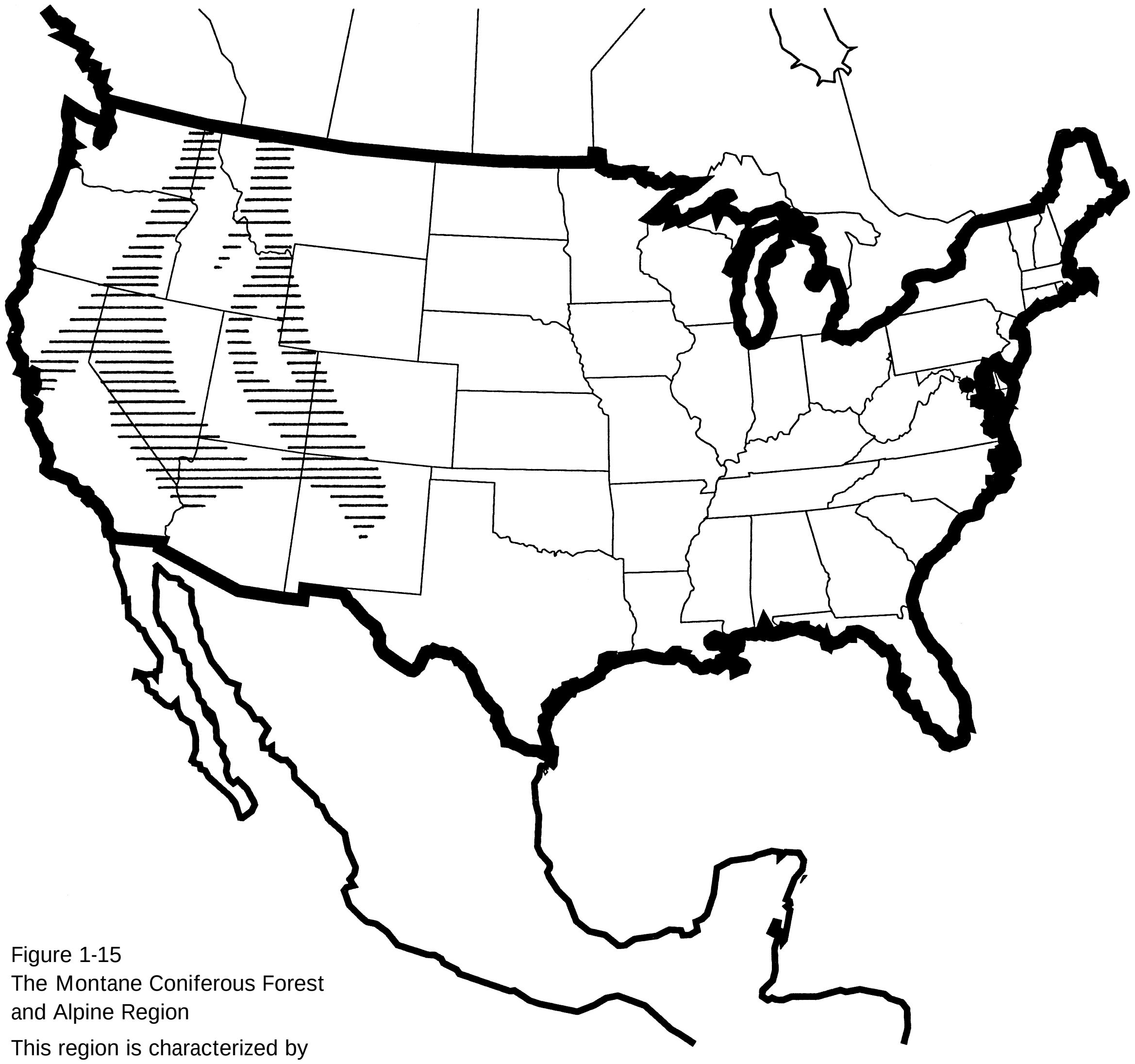


Figure 1-15
The Montane Coniferous Forest and Alpine Region

This region is characterized by alpine meadows, with woodland areas at lower elevations. (U.S. Department of the Interior, Bureau of Land Management.)

Its eastern boundary is the boreal forest in the north and the Great Plains grassland in the south. Alpine meadows occur at higher elevations above the forest's vegetation, while various woodlands occur below at lower elevations (Fig. 1-15) (Shelford, 1963).

The Northern Pacific Coast– Rainy Western Hemlock Forest

This forest area is found adjacent to the Pacific Coast from the middle of California to southern Alaska. The mature, dominant vegetation is very tall — 125 feet (38 m) to 300 feet (90 m) — and up to 20 feet (6 m) wide. Understory trees or shrubs may find it impossible to survive unless openings are provided in the canopy (Fig. 1-16). Shrub and herb layers cannot develop properly in the mature forest and are restricted to a few species. The frost-free period will vary from 120 days to 210 days, with a mean annual temperature range from 40°F (4°C) to 56°F (13°C).

The Broad Sclerophyll– Grizzly Bear Community

This vegetation ranges from central Oregon through California and may be either forest, woodland, or chaparral. Fewer than 20 percent of the dominant species are deciduous.

Annual rainfall in the northern areas ranges from 16 inches (40 cm) to 38 inches (95 cm), whereas the southern chaparral averages 21.6 inches (54 cm) and remains dry June through September.

The sclerophyll vegetation will vary from a large oak forest with a grass ground cover, to a scattered woodland with chaparral or sagebrush undergrowth, to a bush vegetation (Fig. 1-17) (Shelford, 1963).

The Desert and Semidesert Communities

These communities occupy the Great Basin portion of western Utah and a part of Nevada. The vegetation is shrubby and dominated by sagebrush, with some contact with ponderosa pine forests.

Rainfall for most of this area will average below 10 inches. The temperature in January will average between 29°F (-17° C) and 39°F (3.90°C), with July averaging

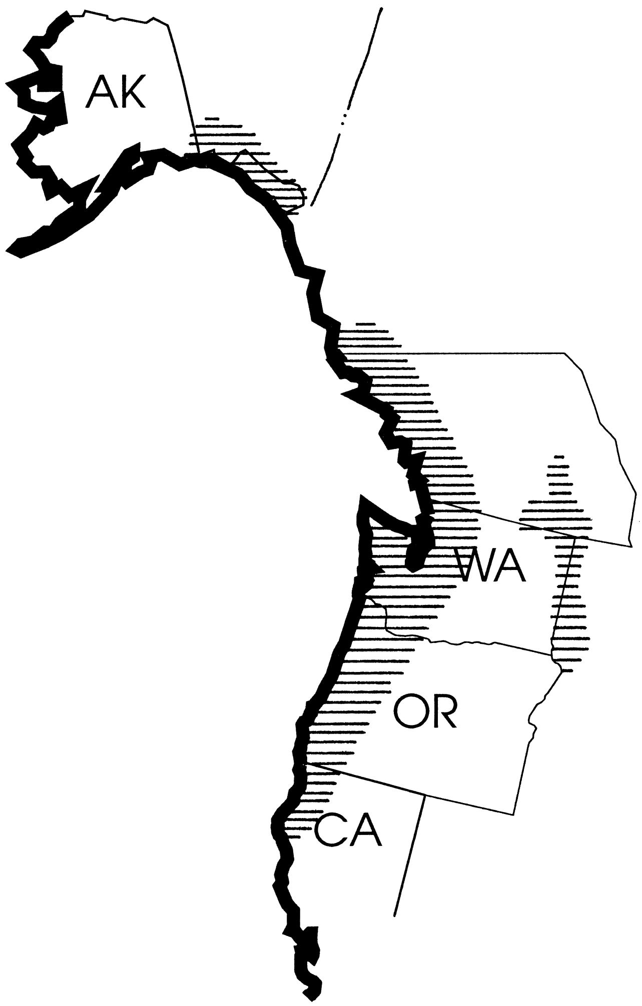


Figure 1-16
The North Pacific Coast–Rainy Western Hemlock Forest

This region has a dominant overstory reaching as high as 300 feet tall. (U.S. Department of the Interior, Bureau of Land Management.)

between 70°F (21°C) and 78°F (26°C). The major plants are deciduous shrubs and dense stands of tall sagebrush (Fig. 1-18) (Shelford, 1963).

The Woodland and Brushland Communities

This vegetation occurs in the foothills of the Rocky Mountains from Montana and Oregon to Mexico. It is characterized by short-trunked trees, a scattered growth of shrubs and herbs, and a dense growth of shrubs thinning into grassland and desert at lower elevations. The annual rainfall is from 12 inches (30.48 cm) to 25 inches (63.5 cm), and the temperature of the seasons is quite variable.

The following specific communities may be recognized: the western juniper-buckbrush region; the pinyon-juniper region; the oak-juniper region; the oak woodland region; and the oak bushland (Fig. 1-19) (Shelford, 1963).

The Northern Grasslands

This vegetative region is characterized by perennial grasses stretching from Alberta to Mexico City, and from the Pacific Coast to western Indiana. The northern part is moist and cool; the southern part is drier. There are four major grassland areas important in this natural landscape (Fig. 1-20) (Shelford, 1963).

The tall-grass prairie

This grass range once extended through what is now the Midwest agricultural region of the United States, from Manitoba to Oklahoma and eastward into Ohio and southern Michigan. It is now extensively plowed and is principally found in Kansas, the northern parts of Oklahoma, Nebraska, and North and South Dakota. The major species of grasses are the bluestems *(Andropogon spp.)*, porcupinegrass *(Stipa spp.)*, switchgrass *(Pancium spp.)*, Indiangrass *(Sorghastrum spp.)*, and wild rye *(Elymus spp.)*. The average height of these grasses is 4 to 5 feet (1.22 to 1.524 m) with a root depth reaching to 8 feet (2.44 m). The coastal prairie occupies the southern extension of this growth region inland from the coastal marches of Texas and Louisiana (Shelford, 1963).

The mixed-grass prairie

This grass region occupies the area between the tall-grass prairie and the foothills of the Rocky Mountains, extending from Canada to Texas, and expands westward from Texas to Arizona. It is often referred to as the short-grass prairie, but has intermediate-height grass species.

The major species include the western wheat-grass *(Agropyron smithii spp.)*, needle-and-thread *(Stipa comata)*, and buffalo grass *(Buchloe dactyloides)* (Shelford, 1963).

The semidesert grassland

This area extends from central and southwestern Texas to northern Arizona and is the driest of the grassland regions. The species within this group have a short, open growth characteristic and are dominated by black gramma *(Bouteloua eriopoda)*, three-awn grasses *(Aristida spp.)*, and curly mesquite *(Hilaria berlangeri)*. Tobosa grass *(Hilaria mutica)* and alkali sacaton *(Sporobolus airoides)* are characteristic to low sites that become flooded on occasion (Shelford, 1963).

The pacific prairie

This grassland prairie once covered an extensive portion of the valleys and foothills of California, Oregon, and Washington; northern Utah and southern Idaho; south-central Montana, southwestern Wyoming, and northern Nevada; and western Alberta.

Important species of this region include wild oats *(Avena spp.)*, ripgut *(Bromus spp.)*, purple needlegrass *(Stipa pulchra)*, wild ryes *(Elymus spp.)*, Idaho fescue *(Festuca idahoensis)*, Sandbag bluegrass *(Poa secunda)*, and prairie Junegrass *(Koeleria spp.)*.

The Hot Desert

The vegetation of this community is adapted to small and irregularly occurring rainfalls, a warm climate, and very hot summers. It consists mostly of brush-covered areas, with a large portion of the soil exposed. The dominant vegetation is creosote.

Western portions stretch from lower California into Arizona; the eastern part reaches from New Mexico into

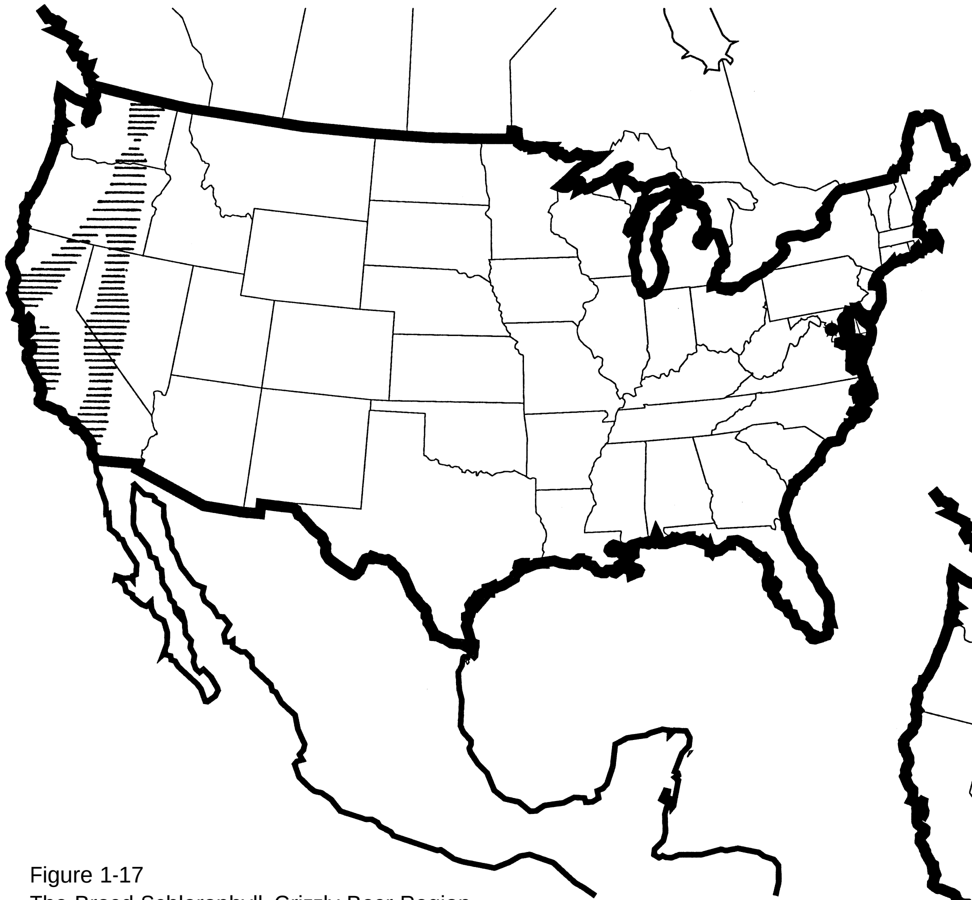


Figure 1-17
The Broad Schlerophyll–Grizzly Bear Region
This region is dominated by evergreen vegetation and has less than 20 percent deciduous plant material.
(U.S. Department of the Interior, Bureau of Land Management.)

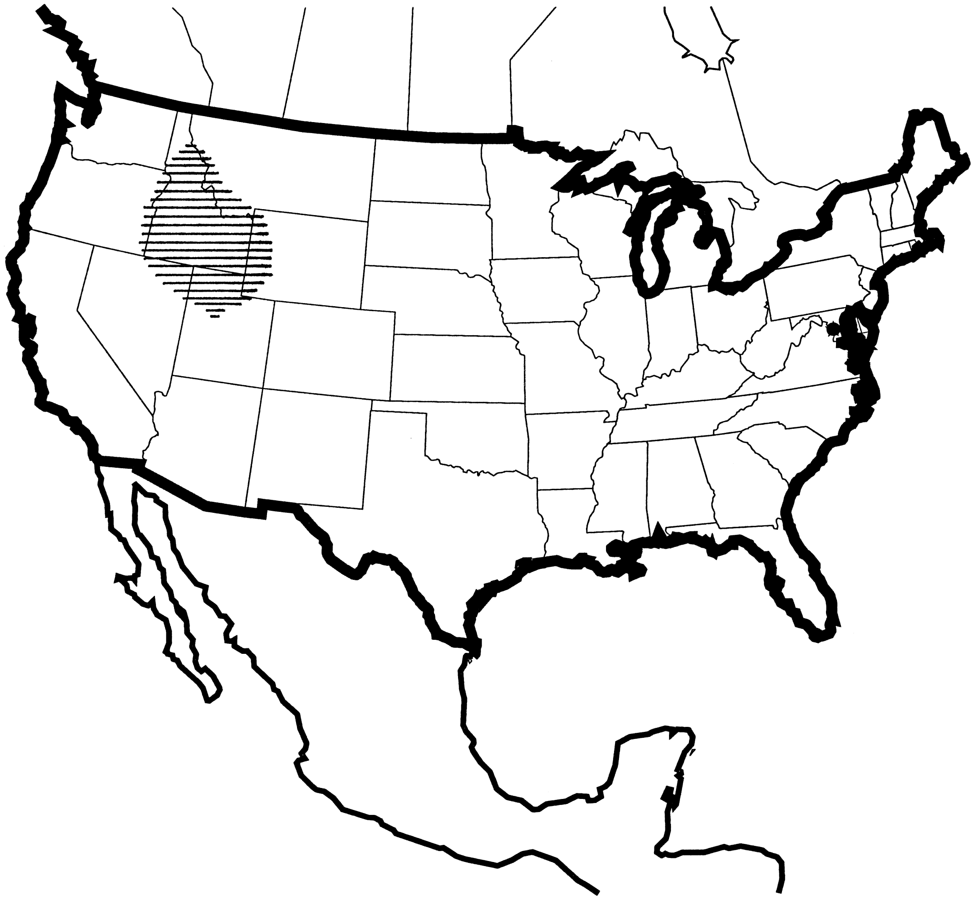


Figure 1-18
The Desert and Semidesert Communities
This region has few trees and is dominated by deciduous shrubs and sagebrush.
(U.S. Department of the Interior, Bureau of Land Management.)

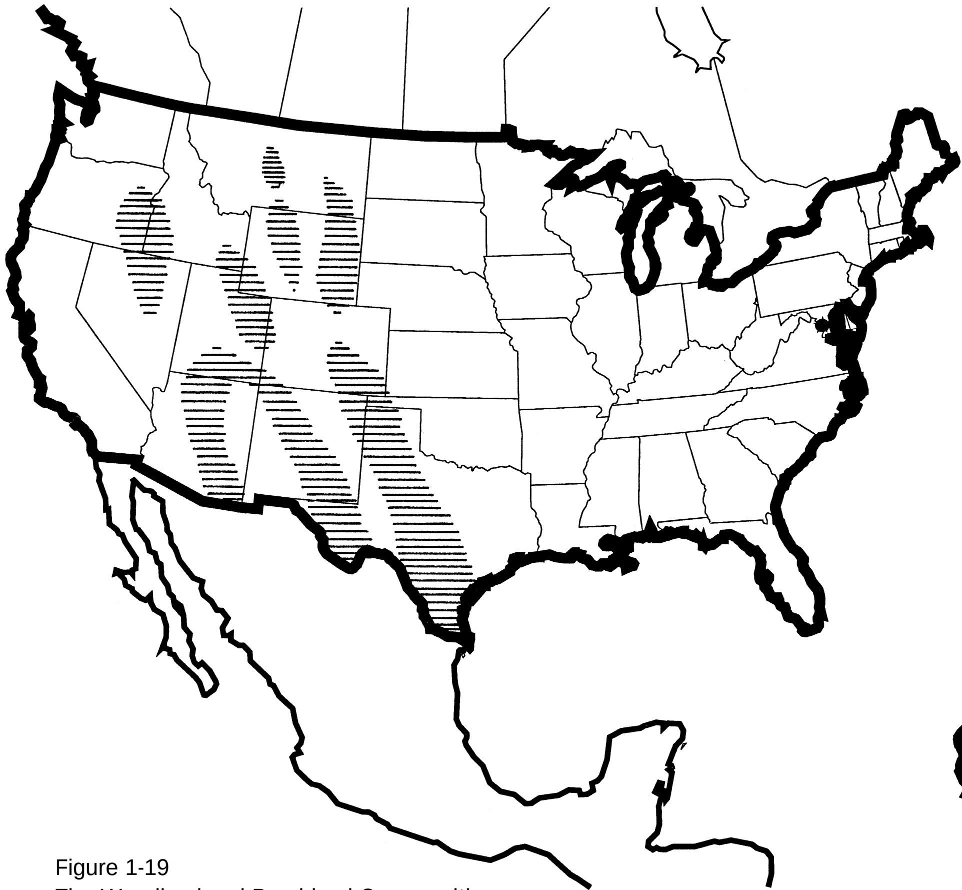


Figure 1-19
The Woodland and Brushland Communities

Short-trunked trees, scattered shrubs and grassland areas characterize this region. (U.S. Department of the Interior, Bureau of Land Management.)

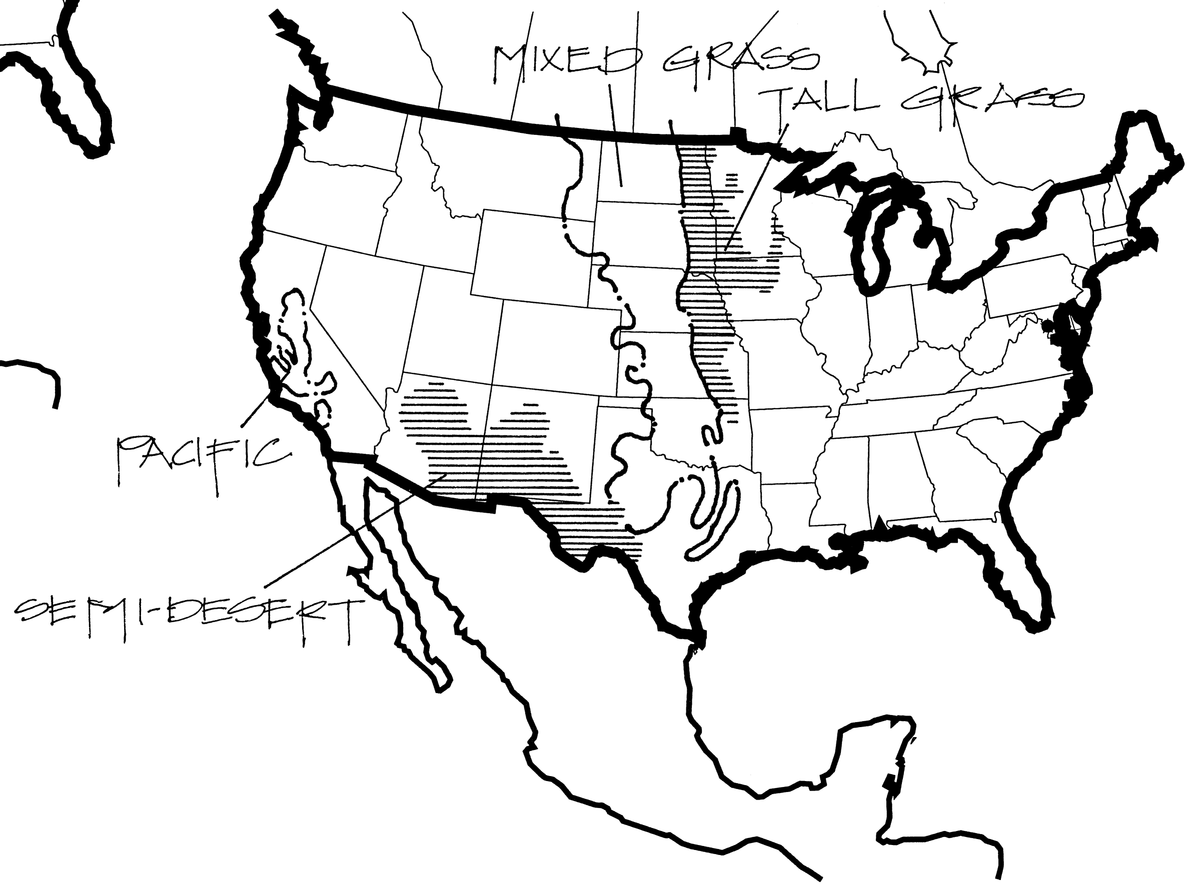


Figure 1-20
The Northern Grasslands

This region is made up of the Tall-grass Prairie and Mixed-grass Prairie, the Semidesert Grassland and the Pacific Prairie. (U.S. Department of the Interior, Bureau of Land Management.)

Texas. Dominant plants are small and rarely exceed 30 feet (9 m) in height; they are widely spaced due to low soil moisture. The diversity of habitat is extensive, with marked differences between slope orientation, sun exposure, and uplands versus lowlands.

The wide variation in habitats causes a complex vegetation distribution and a slow change in site characteristics from one plant type to another. Succession is therefore difficult to distinguish (Fig. 1-21).

Southern Florida

The vegetation of this area is varied and displays three probable climax stages: subtropical hammocks and a mixture of northern plant varieties; tropical hammocks; and dry and scrubby vegetation on the Keys. Rainfall occurs 12 months a year, with an occasional frost. The tropical and subtropical communities are less than 23 feet (7 m) above sea level (Fig. 1-22) (Shelford, 1963).

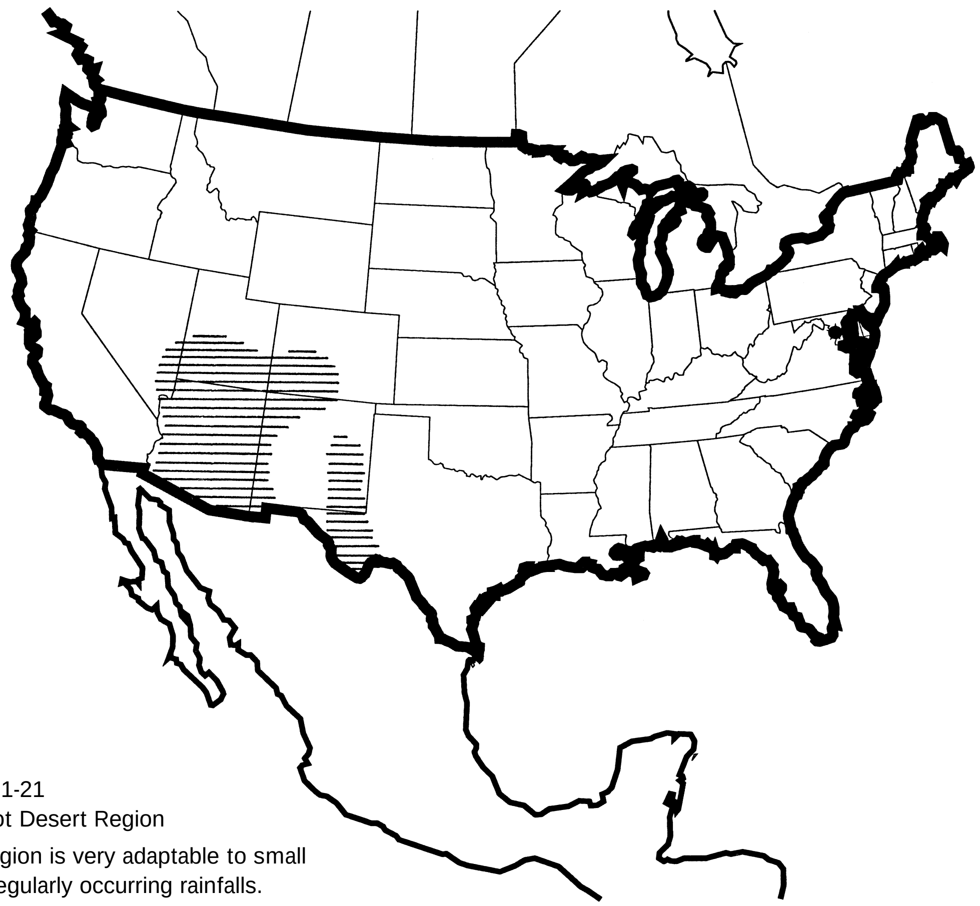


Figure 1-21
The Hot Desert Region

This region is very adaptable to small and irregularly occurring rainfalls. (U.S. Department of the Interior, Bureau of Land Management.)

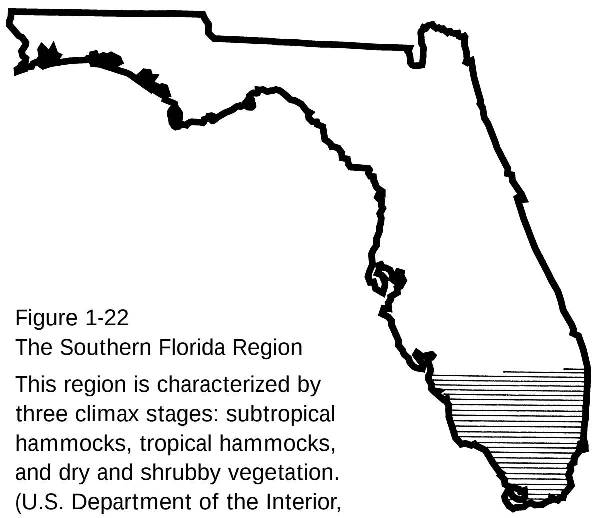


Figure 1-22
The Southern Florida Region

This region is characterized by three climax stages: subtropical hammocks, tropical hammocks, and dry and shrubby vegetation. (U.S. Department of the Interior, Bureau of Land Management.)