

2 ECOSYSTEM CLASSIFICATION

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The ecosystem classification in this report is based on the ecoregions developed through the Commission for Environmental Cooperation (CEC) for North America (CEC 1997). Only ecosystems that occur in the United States are included. CEC ecoregions are described, with slight modifications, below (CEC 1997) and shown in Figures 2.1 and 2.2. We chose this ecosystem classification system because it is easily accessible, hierarchical, and based on biological, rather than purely climatic characteristics. An ecoregion is a geographically defined area that contains distinct physical features and biological communities. The descriptions include the whole ecoregion as it occurs in North America. Descriptions in the individual chapters reflect the ecoregion as represented in the United States.

Within the ecoregions, where data are available, we present the results by subcategory (e.g., for forest, chaparral and coastal sage scrub ecosystems within the Mediterranean California ecoregion). Certain life forms that occur across many ecosystem types, such as lichens and mycorrhizal fungi, are presented within each ecosystem for which data are available, and also, in some detail, in Chapter 19. Common names for species are used throughout this report; scientific names are given at first mention in each chapter, and are also provided in Appendix 1. Wetlands and inland surface waters occur across most ecoregions in the United States and are addressed extensively in Chapters 17 and 18. Ecoregion chapters include a cursory discussion of wetlands and surface water where data are available.

2.1 Ecosystem Descriptions

Tundra

This ecoregion is a mosaic of alpine meadows, foothills, mesas, low-lying coastal plains, river corridors, and deltas. A key feature is that soils are frozen in permafrost and contain large stores of organic carbon. Vegetation is characterized by dwarf shrubs that decrease in size moving north, with very low and flattened plants being most characteristic of the northern and central locales.

Major river valleys support scattered clumps of stunted spruce trees. Typical shrubs include dwarf birch (*Betula nana*), willows (*Salix* spp.), and heath species commonly mixed with various herbs and lichens. Wetlands are common in the low-lying areas, mainly supporting sedge and moss covers.

Taiga

The Taiga ecoregion contains elements of both Tundra and Northern Forests ecoregions. It is characterized by innumerable lakes, bogs, other wetlands, and northern boreal forests, interwoven with open shrublands and sedge meadows more typical of the tundra. From south to north, forests become open and form woodlands with a characteristic groundcover of lichens, which merge into areas of tundra. Along the northern edge of this ecological region the latitudinal limits of tree growth are reached and dwarf birch, Labrador tea (*Ledum* spp.), willow, bearberry (*Arctostaphylos alpina*), mosses, and sedges are dominant. Further south, the region contains open stands of stunted black spruce (*Picea mariana*) and jack pine (*Pinus banksiana*) accompanied by alder (*Alnus* spp.), willow, and tamarack (*Larix laricina*) in the fens and bogs. Mixed wood associations of white (*Picea glauca*) and black spruce, lodgepole pine (*Pinus contorta*), quaking aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white birch (*Betula papyrifera*) are found on well drained and warm upland sites, as well as along rivers and streams. Along the nutrient-rich alluvial flats of the larger rivers, white spruce and balsam poplar grow to sizes comparable to the largest in the boreal forests to the south.

Northern Forests

Over 80 percent forested, the ecoregion is dominated by conifers, largely white and black spruce, jack pine, balsam fir (*Abies balsamea*), and tamarack. Toward the south and the Canadian Maritimes provinces, there is a wider distribution of white birch, quaking aspen, balsam poplar, eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), sugar maple (*Acer saccharum*),

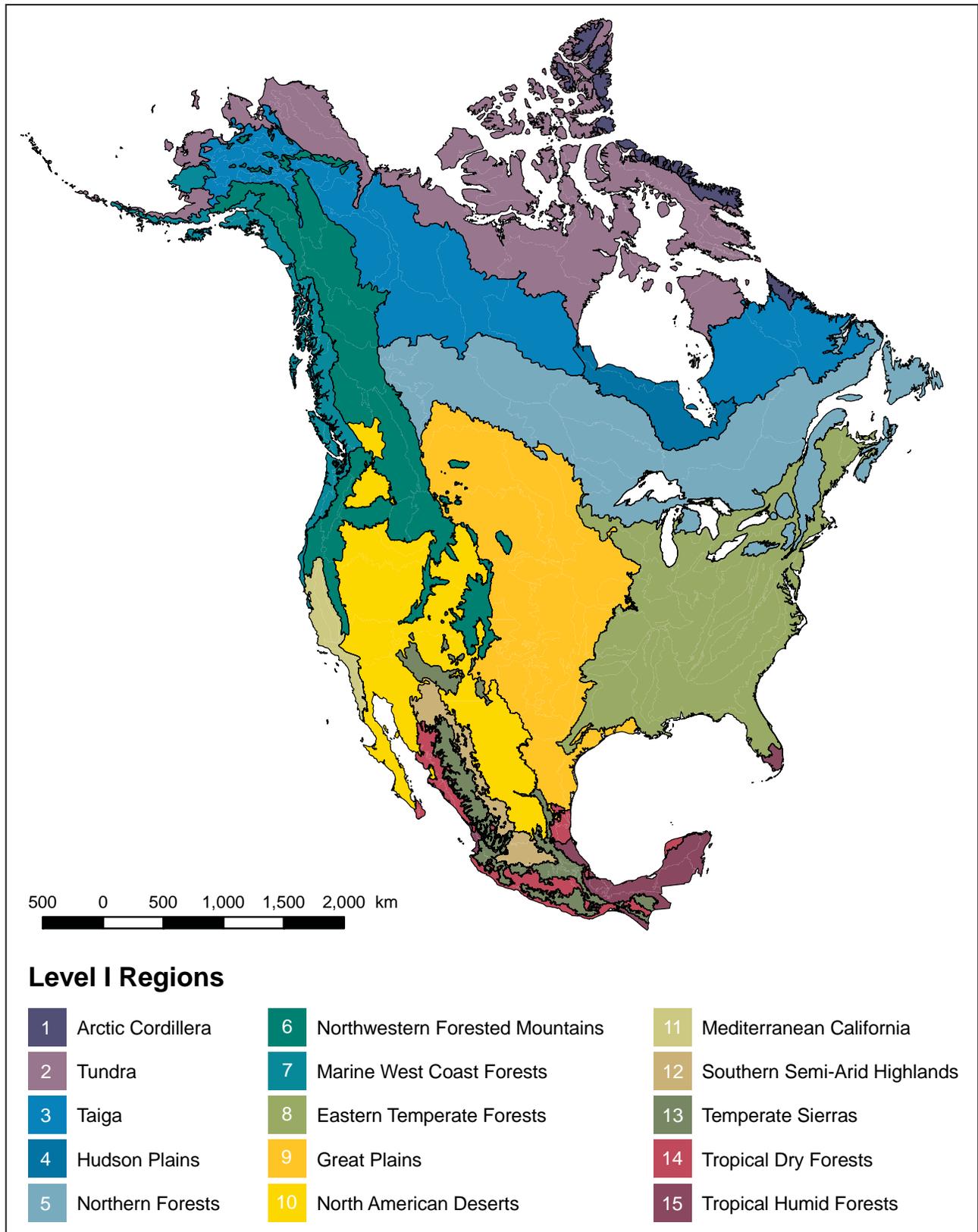


Figure 2.1—Ecological Regions of North America, Level I. From the Commission for Environmental Cooperation (1997).

Ecoregions of the US Level II

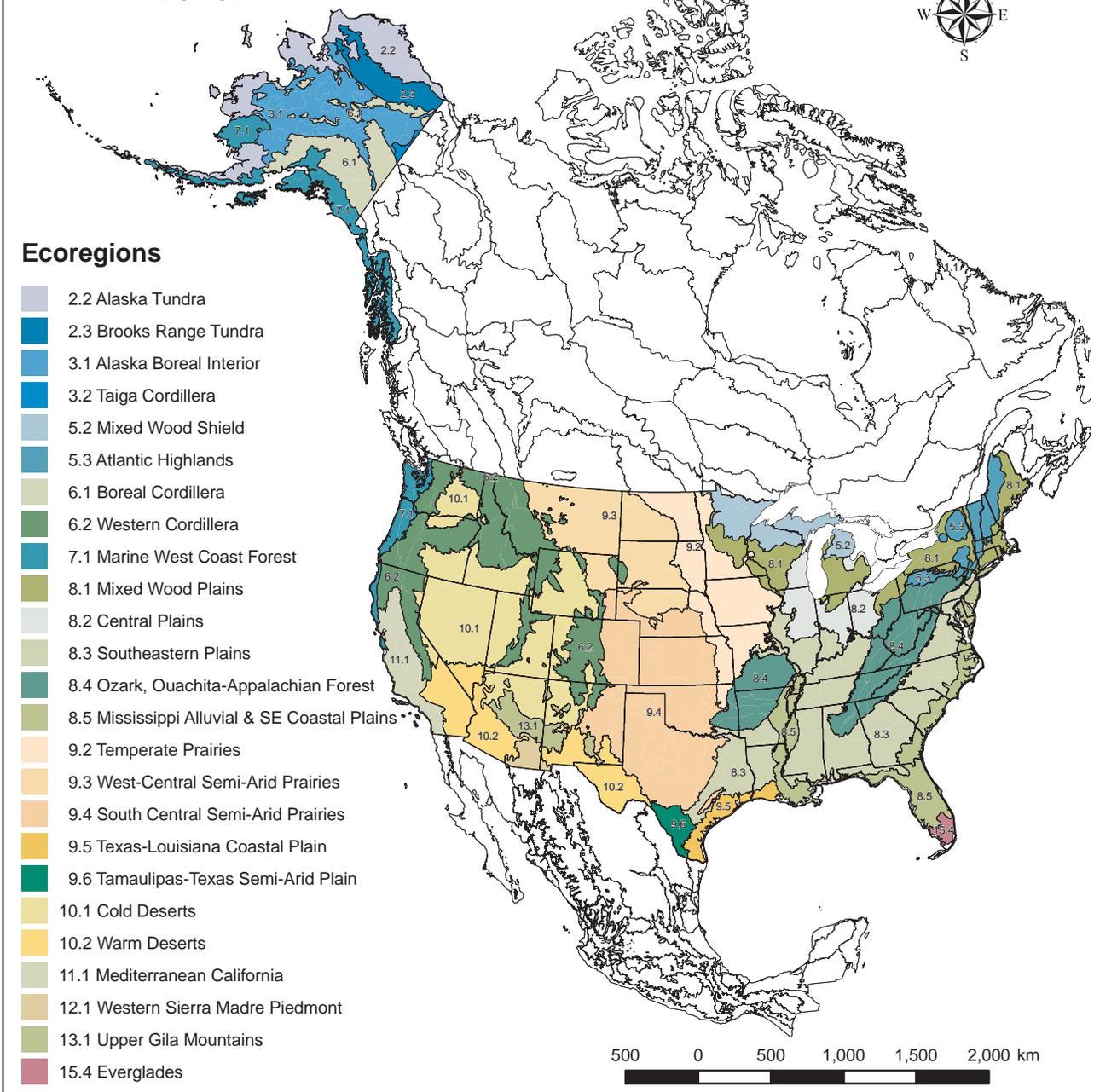


Figure 2.2—Ecological Regions of North America, Level II. From the Commission for Environmental Cooperation (1997).

beech (*Fagus* spp.), red spruce (*Picea rubens*), and various species of oak (*Quercus* spp.). Areas of shallow soils and exposed bedrock are common and tend to be covered with a range of plant communities, dominated by lichens, shrubs and forbs. It is underlain by ancient Canadian Shield bedrock interspersed with glacial moraine deposits, creating a hilly terrain dotted with numerous lakes. Soils derived from the bedrock are generally coarse textured and nutrient-poor. Peatlands are extensive in northern Minnesota. The climate is characterized by long, cold winters (means of -20.5 °C in the west to -1 °C in the east) and short, warm summers (means of 11 to 18 °C). Annual precipitation ranges from 400 to 1,000 mm.

Northwestern Forested Mountains

Vegetative cover is extremely diverse, with distinct elevational bands: alpine environments contain various herb, lichen, and shrub associations; whereas the subalpine forest has species such as lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), and Engelmann spruce (*Picea engelmannii*) in interior assemblages; and Pacific silver fir (*Abies amabilis*), grand fir (*Abies grandis*), lodgepole pine, and Engelmann spruce in the west. Mid-elevation forests are characterized by ponderosa pine (*Pinus ponderosa*), Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), lodgepole pine, and quaking aspen in much of the southeast and central portions; and western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*) and western white pine (*Pinus monticola*) in the west and southwest. White and black spruce dominate the plateaus of the north. Shrub vegetation found in the dry southern interior includes big sagebrush (*Artemisia tridentata*), rabbit brush (*Chrysothamnus* spp.), and antelope bitterbrush (*Purshia tridentata*). Most of the natural grasslands that existed in the dry south have been replaced by agriculture.

Marine West Coast Forests

Variations in altitude create widely contrasting ecological zones within the region. They range from mild, humid coastal rain forest to cool boreal forests and alpine conditions at higher elevations. The maritime influence of the Pacific Ocean causes high precipitation

(600 to 5000 mm), a long growing season, and moderate mean annual temperatures (5 to 9 °C). The temperate coastal forests are composed of mixtures of western red cedar, Nootka Cypress (Alaska yellow cedar; *Callitropsis nootkatensis*), western hemlock, Douglas-fir, Pacific silver fir, white spruce, Sitka spruce (*Picea sitchensis*), California redwood (*Sequoia sempervirens*), and red alder (*Alnus rubra*). Many of these trees reach very large dimensions and live to great age, forming ancient or old growth. In the drier rain-shadow areas, Oregon white oak (Garry oak; *Quercus garryana*) and Pacific madrone (*Arbutus menziesii*) occur with Douglas-fir. Sub-alpine forests are characterized by mountain hemlock (*Tsuga mertensiana*) and Pacific silver fir. Alpine tundra conditions are too severe for growth of most woody plants except in dwarf form. This zone is dominated by shrubs, herbs, mosses, and lichens.

Eastern Temperate Forests

The Eastern Temperate Forests form a dense forest canopy consisting mostly of tall, broadleaf, deciduous trees and needle-leaf conifers. Beech-maple (*Fagus-Acer*) and maple-basswood (*Acer-Tilia*) forest types occur widely, especially in the eastern reaches of this region; mixed oak-hickory (*Quercus-Carya*) associations are common in the Upper Midwest, changing into oak-hickory-pine (*Quercus-Carya-Pinus*) mixed forests in the south and the Appalachians. These forests have a diversity of tree, shrub, vine, and herb layers. While various species of oaks, hickories (*Carya* spp.), maples (*Acer* spp.), and pines (*Pinus* spp.) are common, other wide-ranging tree species include ashes (*Fraxinus* spp.), elms (*Ulmus* spp.), black cherry (*Prunus serotina*), yellow-poplar (*Liriodendron tulipifera*), sweet gum (*Liquidambar styraciflua*), basswood (*Tilia* spp.), hackberry (*Celtis occidentalis*), persimmon (*Diospyros virginiana*), eastern red cedar (*Juniperus virginiana*), and flowering dogwood (*Cornus florida*). A key tree species, the American chestnut (*Castanea dentata*), was virtually eliminated from the Eastern Temperate Forests in the first half of the 20th century by an introduced fungus.

Great Plains

The Great Plains ecoregion was once covered with natural grasslands that supported rich and highly

specialized plant and animal communities. The interaction of climate, fire, and grazing influenced the development and maintenance of the Great Plains. Rainfall increases from west to east, defining different types of native prairies. Short-grass prairie occurs in the west, in the rain shadow of the Rocky Mountains, with mixed-grass prairie in the central Great Plains and tall-grass prairie in the wetter eastern region. Because of the suitability of the Great Plains for agricultural production, many native prairie vegetation types have been radically altered. The short-, mixed-, and tallgrass prairies now correspond to the western rangelands, the wheat belt, and the corn/soybean regions, respectively. Drier sites are home to prickly pear (*Opuntia* spp.), with sagebrush (*Artemisia* spp.) also abundant.

The Aspen Parkland, the northern transition zone to the boreal forest, has expanded south into former grasslands since settlement effectively stopped prairie fires. In the United States, native prairie vegetation ranges from grama grass (*Bouteloua* spp.), wheatgrass (*Agropyron* spp.), and bluestem (*Andropogon* spp.) prairie in the north to different shrub and grassland combinations (e.g., mesquite-acacia (*Prosopis-Acacia*) savanna and mesquite-Texas live oak (*Prosopis-Quercus fusiformis*) savanna) and grassland and forest combinations (e.g., juniper-oak [*Juniperus-Quercus*] savanna and mesquite-buffalo grass [*Prosopis-Buchloe dactyloides*]) in the south. There are also patches of blackland prairie, bluestem-sacahuista (*Andropogon-Nolina*) and southern cordgrass (*Spartina*) prairie in the southern United States. The eastern border of the region, stretching from central Iowa to Texas, shows patterns of grassland and forest combinations mixed with oak-hickory forest. Throughout the remainder of the Great Plains there are few native deciduous trees that occur, except in the eastern regions or in very sheltered locations along waterways or at upper elevations.

North American Deserts

In this ecological region of altitudinal, latitudinal, and landform diversity, there are a variety of vegetation types, but low-growing shrubs and grasses predominate. In the northern Palouse and Snake River Basin areas, grasslands and sagebrush steppes were once common. However, most of these northern grasslands have

been converted to agriculture, and in some areas, the sagebrush steppe is being invaded by western juniper (*Juniperus occidentalis*) and cheatgrass (*Bromus tectorum*). The Great Basin and greater Colorado Plateau are characterized by sagebrush (*Artemisia* spp.), with saltbush (*Atriplex* spp.) and greasewood (*Sarcobatus* spp.) on more alkaline soils.

In the warmer southern deserts, creosote bush (*Larrea tridentata*) is common; the Mojave Desert also contains areas of the distinctive Joshua tree (*Yucca brevifolia*). The Sonoran Desert has greater structural diversity in its vegetation than the other North American deserts. Its paloverde (*Parkinsonia* spp.), cactus, and shrub vegetation includes various types of succulents, such as saguaro (*Cereus gigantea*), cholla (*Cylindropuntia* spp.), and agave (*Agave* spp.). The Chihuahuan Desert is characterized by smaller leaved, shorter statured vegetation such as American tarwort (*Flourensia cernua*), creosote bush, and intermixed grasses.

Mediterranean California

The Mediterranean California region is characterized by a mostly evergreen shrub vegetation called chaparral, plus patches of oak woodland, grassland, and coniferous forest on upper mountain slopes. The chaparral has thickened, hardened foliage resistant to water loss, and forms a cover of closely spaced shrubs 1 to 4 m tall. Common shrubs include chamise (*Adenostoma fasciculatum*), buckbrush (*Ceanothus cuneatus*), and manzanita (*Arctostaphylos* spp.). Coastal sagebrush (*Artemisia californica*), summer-deciduous plants that tolerate more xeric, or dry, conditions than the evergreen chaparral, are found at lower elevations. About 80 percent of the presettlement coastal sage scrub in southern California has been displaced, primarily by residential development and agriculture. Several dozen threatened and endangered species occur in the coastal sage scrub community. To the north, the chaparral is less continuous, occurring in a mosaic with grassland, as well as broadleaf and coniferous forests. A blue oak-California foothills pine (*Quercus douglasii* – *Pinus sabiniana*) woodland community forms a ring around the Central Valley, which itself once had extensive grasslands and riparian forests. The southern oak woodland extends into the transverse and peninsular

ranges and includes California walnut (*Juglans californica*) and Engelmann oak (*Quercus englemannii*). The high elevation mixed pine forests are dominated by Jeffrey pine (*Pinus jeffreyi*) and ponderosa pine, with incense cedar (*Calocedrus decurrens*), black oak (*Quercus velutina*), white fir (*Abies concolor*), and others.

Southern Semi-Arid Highlands

The characteristic natural vegetation, which presently is very diminished or altered, consists of grasslands and combinations of grasslands with scrublands, and woodlands and forests in the higher elevations. Certain species of grasses are dominant, particularly bluestem, threeawn (*Aristida* spp.), galleta (*Hilaria jamesii*), and muhly (*Muhlenbergia* spp.) grasses. Among the shortgrasses, blue grama (*Bouteloua gracilis*) is important in Arizona, New Mexico, and in the northern Mexican states at the foot of the Western Sierra Madre. On deep clay soils, mesquite groves are the most conspicuous plant community, and mesquite occurs with acacia in some sites, especially in Mexico. Oak and western juniper are common at the foot of the Sierras. Where the climate is warmer in Mexico, one finds subtropical scrublands with a diversity of shrub species.

Temperate Sierras

Vegetation can be evergreen or deciduous, composed primarily of conifers and oaks. They grow from 10 to 30 m, sometimes reaching 50 m. This vegetative cover may comprise from one to three tree layers, one or two shrub layers, and an herbaceous stratum. This forest community is characterized by about 3,000 vascular plant species, 30 percent of which are endemic to Mexico. Overall most of this vegetation type occurs in Mexico, where there is a high diversity of oaks, pine and other species, and includes mountain cloud forests that do not occur in the United States.

Tropical and Subtropical Humid Forests

This ecoregion includes tropical humid forests at the southern tip of the Florida Peninsula in the United States, as well as subtropical humid forests in coastal, low-elevation, and lower montane regions on the Hawaiian Islands and in Puerto Rico. The region spans from sea level to approximately 1,800 m of altitude. For subtropical and tropical humid forests, including those in the lower montane regions, average annual precipitation typically exceeds 1,000 mm and year round temperatures average between 16 °C and 26 °C. Evergreen and semi-deciduous forests are the most characteristic plant communities of this region, which is one of the most biodiverse zones in the world. Forest stands are typically of mixed ages with a great abundance of air plants (epiphytes), including bromeliads, ferns, and orchids. The mature tree layer may attain heights up to 30 m or more. In the tropical humid forest of the Florida peninsula, flooded marshes and swamps (both saltwater and freshwater) are widespread, with characteristic mangrove vegetation and tropical tree islands. Native subtropical humid forests in Hawaii include the common dominant trees Ohi'a lehua (*Metrosideros polymorpha*) and Koa (*Acacia koa*), as well as tree ferns and a diverse understory of epiphytes and shrubs. Puerto Rican forests on volcanic soils include Tabonuco, Colorado, and dwarf cloud forests; sclerophyllous, evergreen vegetation is found on serpentine and limestone derived soils.

LITERATURE CITED

CEC (Commission for Environmental Cooperation). 1997. Ecological regions of North America. **Toward a common perspective**. Montreal, Canada: Commission for Environmental Cooperation. 71 p. Available at http://www.cec.org/files/pdf/BIODIVERSITY/eco-eng_EN.pdf (Accessed May 24, 2010).