Chapter 2: Physical Features Influencing Vegetation in Texas

Texas ranks among the most important states in biological diversity, and ranks first among the states in the number of vascular plant species, with more than 4,300 (Hatch et al. 1990). The diversity of Texas is evident in vegetation types, which range from temperate and subtropical forests to grasslands, shrublands and deserts.

Only a brief summary of the varied geology of Texas is possible in this chapter. The Balcones Escarpment roughly bisects the state from northeast to southwest, following lines of older mountain ranges formed in the Precambrian and the Ouachita Mountains uplifted during the Pennsylvanian. East and south of the escarpment is the Gulf Coastal Plain, a flat or rolling plain consisting of sedimentary formations deposited during the Mesozoic by riverine deposition and shallow marine deposition in the Gulf of Mexico. In uplands of eastern Texas, these formations have weathered into sandy clays and sands supporting pine-hardwood forests or, where drier, post oaks. Geologically recent (mostly Pleistocene) formations nearer the Gulf coast are covered by a belt of nutrient-rich, often poorly drained clays that support coastal prairies and marshes. Around the edges of the coastal prairies and in the South Texas Plains are formations of harder sandstone supporting post oaks and, on the drier South Texas Plains, brush species such as acacias and cacti. Weathering of upper Cretaceous limestones in north-central Texas formed the nutrient-rich calcareous clays of the Blackland Prairies. West of the Balcones Escarpment, the geology is far more varied, with outcrops of Paleozoic shale, limestone, sandstone, chert, and dolomite (largely of shallow marine origin) occurring throughout western Texas; Precambrian exposures are limited to the Llano Uplift in central Texas and a few small areas in the Trans-Pecos. Lower Cretaceous limestones make up the Edwards Plateau and much of the Cross Timbers, areas of mostly shallow calcareous soils. The High Plains or Llano Estacado of northwestern Texas is a vast sedimentary plain of material from the Rocky Mountains deposited in the

Pliocene; stream erosion during the Pleistocene cut away the eastern part, exposing the Permian and Triassic shales of the Rolling Plains. Grasslands form on deeper soils through these regions, with shallower and rocky soils supporting woodlands or brush. West Texas is the most geologically diverse region of the state, with every geologic period represented. Near Marathon, the Ouachita range is exposed; ancient intermountain basins around the Ouachitas accumulated limestone deposits that were later uplifted to form the Guadalupe and other mountain ranges. Several lower mountain ranges were formed during the Rocky Mountain uplift period, which also exposed older materials. Extensive volcanic activity in the Eocene and Oligocene produced the Davis, Chisos, and other mountains (Sellards et al. 1932). Igneous-derived soils generally hold more available water than limestone surfaces, and grasslands in West Texas occur at lower elevations on igneous formations (Gehlbach 1967). Active floodplains hold significant volumes of water and support forests or woodlands throughout Texas, even in the driest parts of the state.

Most of Texas is located in a warm-temperate climate zone, with average temperatures and length of growing season decreasing gradually from south to north. Mountainous areas of the Trans-Pecos produce local "islands" of cool-temperate climate, and the northwestern Panhandle (the High Plains) has a dry, cool-temperate climate with hot summers. Areas adjacent to the Gulf of Mexico, including the Gulf Coastal Prairies and South Texas Plains, are subtropical and freezing temperatures are infrequent in the southernmost counties of Texas (the Lower Rio Grande Valley). The average length of growing season ranges from 178 days in the northern High Plains to 341 days at Brownsville (Dallas Morning News 1994). Climatic variation, and corresponding change in vegetation, across the state is significant but gradual, except in West Texas where temperatures are influenced by local elevation (Bray 1906, Hatch et al. 1990).

Average annual rainfall decreases somewhat uniformly across Texas from east to west, ranging from 55-60 inches in Newton and Orange counties on the Louisiana state border to 8 inches at El Paso. Annual rainfall exceeds potential

evapotranspiration in eastern Texas, but evapotranspiration exceeds rainfall throughout the western half of the state. In all parts of the state, 50 percent or more of average rainfall falls during the warmest six months of the year. In West Texas and the High Plains, the wettest months are in summer; elsewhere in the state, rainfall typically peaks in spring and fall, and summer droughts are frequent.

Rainfall is probably the most obvious factor influencing the structure and composition of vegetation in Texas, with soil characteristics also of importance. The easternmost one-fourth of Texas receives more than 40 inches of annual rainfall and is almost entirely forested except for the grasslands that occur on clay soils near the Gulf coast. In the east-central one-fourth of Texas, which receives roughly 30 to 40 inches of annual rainfall, the natural vegetation prior to settlement was a mosaic of tallgrass prairie on clay soils (the Blackland and Coastal Prairies), oak woodlands on sandy soils, and juniper-oak woodlands on caliche (the Post Oak Savanna and Cross Timbers). West of the 30-inch line, grasslands become increasingly important except on caliche surfaces, which are dominated by brushy woodlands. Mesquite is a common invader on deeper soils within this zone, which includes the Rolling Plains, Edwards Plateau, and most of the South Texas Plains. The western one-fourth of Texas is demarcated by the 20-inch rainfall line, which runs slightly to the east of Amarillo, Lubbock, San Angelo, and Del Rio. West of that line, shortgrasses are often dominant and trees and taller grasses are restricted to mesic habitats such as riparian corridors, deep sands, and mountains.

The Trans-Pecos region contains areas of higher elevation than the rest of Texas (to 8,700 feet), and stratification of vegetation following elevational gradients is evident; bands of grasslands, shrublands, and even forest occur at higher elevations. Microclimatic effects of slope and landscape position are also influential, with north and east slopes of mountains supporting more mesophytic vegetation than south or west facing slopes (Gehlbach 1967). Sites at higher elevations and north-facing slopes usually receive more precipitation than surrounding areas and evapotranspiration is lower, so these habitats are not exceptions to the rule that rainfall strongly influences vegetation.

The extent of pre-European influence on the structure of vegetation is uncertain. Spain controlled Texas from the late sixteenth century until the early nineteenth century, but Spanish efforts at colonization were minimal; large-scale conversion of land for agricultural uses began with Anglo-European settlement and annexation by the United States in the 1830s and 1840s. The population of Texas grew explosively in the late nineteenth century with the rise of the cattle industry and the settlement and cultivation of the grasslands. By the mid-twentieth century, farming and ranching operations occupied more than 80 percent of the land in Texas. During the twentieth century Texas ranked first among the fifty states in production of cotton, cattle, goats and sheep, and among the leading producers of wheat, grain sorghum, rice, dairy products, poultry, and truck crops (Dallas Morning News 1994). Agriculture has profoundly influenced the landscapes of Texas in many ways. Livestock grazing affects the largest land area, as cattle production is important in every county in Texas. In areas where cattle ranching is the dominant economic activity, population density is relatively low and populations of wildlife are often high; thus, cattle ranching has relatively less impact on the landscape than many other economic activities. However, overgrazing can have very deleterious effects on vegetation and range condition. Rotation of livestock is necessary to assure the persistence of preferred grasses and forbs; many palatable native grasses (e.g. Texas bluegrass) have become rare as a result of intensive grazing. Severe overgrazing was practiced during the first years of the cattle industry in western Texas (1880-1910) and resulted in long-term degradation of range soils and a permanent loss of grass cover over large areas (Warnock 1970). Livestock may also have been instrumental in propagating or encouraging the spread of destructive brush species such as mesquite, prickly pear, and junipers in rangelands. The most dramatically altered landscapes of Texas, however, are areas of former grasslands in east-central Texas (the Blackland and Coastal Prairies), south Texas, and parts of the High Plains, as these areas have been almost completely (90 percent or more) converted to cropland and pasture to grow cotton, corn, sorghum, wheat, hay, and other crops.

Private ownership of land is highly valued by Texans. Many private landowners in Texas are strongly interested in practicing good land stewardship and wildlife management, but most Texans are not very knowledgeable about the state's natural vegetation, which has been extensively modified for several generations.