Great Plains

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Natural vegetation of the Great Plains is primarily grassland and shrubland ecosystems with trees occurring in scattered areas along streams and rivers, on planted woodlots, as isolated forests such as the Black Hills of South Dakota, and near the biogeographic contact with Rocky Mountains and eastern deciduous forests. Trees are used in windbreaks and shelterbelts for crops and within agroforestry systems, extending the tree-covered area considerably (e.g., over 160 000 ha in Nebraska) (Meneguzzo et al. 2008). Urban areas in the Great Plains benefit from trees providing wildlife habitat, water storage, recreation, and aesthetic value. The Great Plains are divided here into three areas for discussion: northern Great Plains (North Dakota, South Dakota, Kansas, Nebraska), southern Great Plains (Oklahoma, Texas), and western Great Plains (Montana, Wyoming).

Forests in the northern Great Plains comprise less than 3 percent of the total land area within each state (Smith et al. 2009) (table A1-2). More than half of the forest land in South Dakota is in public land ownership in contrast to the other three states. Dominant forest types are ponderosa pine (*Pinus ponderosa* Lawson and C. Lawson var. *scopulorum* Engelm.), fir-spruce, and western hardwoods. Eastern cottonwood (*Populus deltoides* Bartr. ex Marsh.) forests are an important source of timber in North Dakota (Haugen et al. 2009) and Nebraska (Meneguzzo et al. 2008). Many cottonwood stands in this region are quite old, and regeneration has been minimal owing to infrequent disturbance (Haugen et al. 2009, Meneguzzo et al. 2008, Moser et al. 2008, South Dakota Resource Conservation and Forestry Division 2007). The decline of this species often leads to establishment of nonnative species (Haugen et al. 2009) or expansion of natives such as green ash (*Fraxinus pennsylvanica* Marsh.), which is susceptible to the invasive emerald ash borer (*Agrilus planipennis* Fairmaire). In North Dakota, quaking aspen (*Populus tremuloides* Michx.) forests are generally in poor health and have minimal regeneration because of fire exclusion (Haugen et al. 2009). In South Dakota, forest land is dominated by ponderosa pine forest, which supports a local timber industry in the Black Hills area. Management concerns include densely stocked stands, high fuel loadings and fire hazard, and mountain pine beetle (*Dendroctonus ponderosae* Hopkins) outbreaks. Eastern redcedar (*Juniperus virginiana* L.) is expanding in many states, the result of fire exclusion and prolonged drought conditions (Meneguzzo et al. 2008, South Dakota Resource Conservation and Forestry Division 2007). This presents opportunities for using redcedar for wood products, but also raises concerns about trees encroaching into grasslands and altering wildlife habitat (Moser et al. 2008). Land use activities that support biofuel development, particularly on marginal agricultural land, may affect forests in this area (Haugen et al. 2009, Meneguzzo et al. 2008).

Forests in the southern Great Plains comprise less than 17 percent of the land area (table A1-2) (Smith et al. 2009), are often fragmented across large areas, and are mostly privately owned. In Texas, the forest products industry is one of the top 10 manufacturing sectors in the state, with a fiscal impact of $33.6 billion on the state economy (Xu 2002). Loss of forest to urbanization, oil and gas development, and conversion to cropland and grassland has led to a permanent reduction in forest cover (Barron 2006, Johnson et al. 2010).

Forests in the western Great Plains comprise less than 27 percent of the land area (Smith et al. 2009) (table A1-2), and most of this land is in public ownership. Montana has large contiguous areas of forest, particularly in the western part of the state where public land, forest industry, and private land intermingle. Both Montana and Wyoming have forested areas on mountains where the surrounding ecosystems are grassland and shrubland. The three major forest types in Montana are also the most commercially important species: Douglas fir (*Pseudotsuga menziesii* [Mirb.] Franco), lodgepole pine (*Pinus contorta* Douglas ex. Loudon var. *latifolia* Engelm. ex S. Watson), and ponderosa pine (Montana Department of Natural Resources and Conservation 2010).

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Table A1-2—Land area in the Great Plains 2007

	Total land area	Total forest land	Total timberland	Planted timberland	Natural origin	Reserved forest land	Other forest land	Other land
				Thousands of hectares				
Northern Great Plains:								
Kansas	21 241	852	821	16	805	0	31	20 389
Nebraska	19 913	504	475	14	461	4	25	19 409
North Dakota	17 943	293	216	2	214	10	67	17 650
South Dakota	19 601	681	628	7	621	17	36	18 920
Total Northern Great Plains	78 697	2330	2140	39	2101	32	158	76 367
Southern Great Plains:								
Oklahoma	17 788	3102	2523	257	2265	18	561	14 686
Texas	67 863	6990	4799	1132	3668	46	2145	60 873
Total Southern Great Plains	85 651	10 092	7322	1389	5933	64	2706	75 559
Western Great Plains:								
Montana	37 760	10 123	8009	76	7933	1594	520	27 637
Wyoming	25 116	4632	2427	19	2407	1531	673	20 484
Total Western Great Plains	62 876	14 755	10 436	95	10 340	3125	1193	48 121
Total Great Plains	227 244	27 177	79 898	1523	18 374	3221	4057	200 047

Source: Smith et al. 2007.

Fire exclusion has caused higher fire hazard and more mountain pine beetle outbreaks. In recent years, the forest industry has been adversely affected by reduced timber supply and general economic trends. Wyoming forests are dominated by lodgepole pine, followed by spruce-fir and ponderosa pine, and land ownership is a mosaic of public, private, and industial. Similar to Montana, the forest industry in Wyoming has faced several challenges but continues to be a significant component of the state economy (Wyoming State Forestry Division 2009). Both Montana and Wyoming have urban forests, riparian forests, and windbreaks and shelterbelts associated with agriculture. Tree species used in windbreaks and shelterbelts, including ponderosa pine and the nonnatives Scots pine (*Pinus sylvestris* L.) and Austrian pine (*P. nigra* Arnold) are being attacked by mountain pine beetles, and green ash is susceptible to the emerald ash borer. Similar to other parts of the Great Plains, some lower elevation riparian forests are in decline, because regeneration has been reduced by fire exclusion, water diversions, drought, agricultural activities, and urban development.

Little information is available on the potential effects of climate change on Great Plains forests. However, this area has been part of continental and national studies (Bachelet et al. 2008), and areas such as the Greater Yellowstone Ecosystem have a long history of research that has recently included climate change. Tree species in the Yellowstone area are expected to move to higher elevation in a warmer climate (Bartlein et al. 1997, Koteen 2002, Whitlock et al. 2003). However, projecting future vegetation distribution is complicated by the complex topography of Wyoming, which influences the microclimatic environment that controls vegetation distribution. Forests in this area and Montana are currently affected by insect outbreaks and wildfire, and changes in these disturbances under climate change could potentially disrupt ecosystems across large landscapes. A recent modeling study suggests that a warmer climate will increase the frequency and spatial extent of wildfire in the Yellowstone area (Westerling et al. 2011).

In a review of the literature on the effects of climate change in semiarid riparian ecosystems, Perry et al. (2012) noted that climate-driven changes in streamflow are expected to reduce the abundance of dominant, native, early-successional tree species and increase herbaceous, drought-tolerant, and late-successional woody species (including nonnative species), leading to reduced habitat quality for riparian fauna. Riparian systems will be especially important locations on which to focus monitoring for the early effects of climate change.

Reduced tree distribution in the Great Plains will likely have a negative effect on agricultural systems, given the important role of shelterbelts and windbreaks in reducing soil erosion. In these "linear forests," warmer temperatures are expected to reduce aboveground tree biomass and spatial variation in biomass at lower elevations, but may increase biomass on upland habitats (Guo et al. 2004). Carbon sequestration through agroforestry has been suggested as a potential mitigation activity (Morgan et al. 2010).

Across the Great Plains, forests are currently exposed to many stressors. Common to all states in this region is a concern about land use changes that would reduce the total area of forests, fragment intact forests, and alter forest dynamics. Current stressors such as insects, fungal pathogens, and altered hydrologic dynamics may be exacerbated by a warmer climate. The potential for increased wildfire hazard, longer droughts, and increased risk of insect outbreaks, individually and in combination, could significantly modify Great Plains forest environments. Whereas most studies in this region have explored the potential influence of elevated carbon dioxide (CO_2)on grassland, Wyckoff and Bowers (2010) analyzed the relationship between historical climate and tree growth and suggest that the interaction of climate change and elevated CO_2 could be a potential factor in the expansion of forests from the Eastern United States into the Great Plains.

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