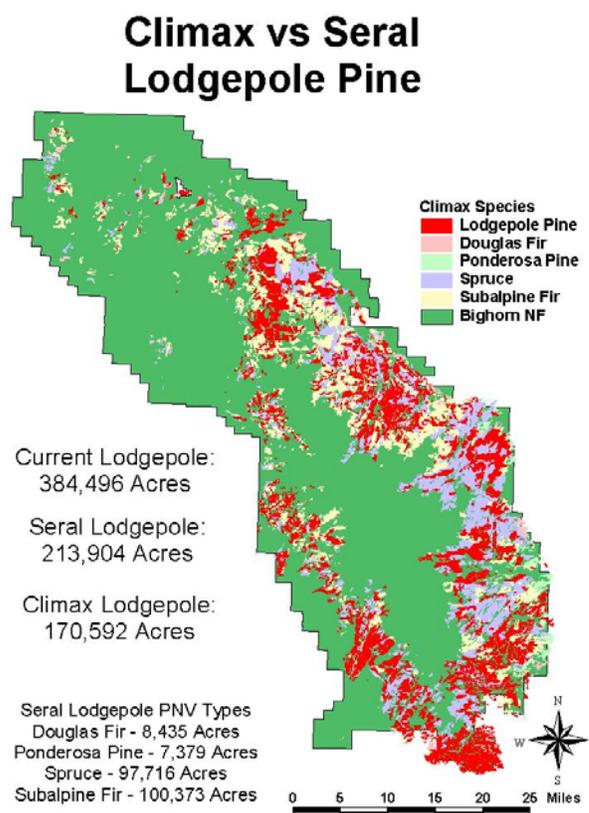


Forested Vegetation - Lodgepole Pine Forest

Lodgepole pine (*Pinus contorta*) is the most common tree species in the Bighorn Mountains where it occurs at elevations between 2000 m (6560 ft) and timberline at 3050 m (Hoffman and Alexander 1976). Lodgepole pine is common in the central third of the Bighorns where it occurs on most granitic soil types. Further north small stands of lodgepole pine occur in isolated areas within expanses on spruce-fir forests on sedimentary-derived soils (Despain 1973). Lodgepole pine forests currently cover approximately 385,000 acres in the Bighorn National Forest with 90% of that on granitic soils.

COMPOSITION

Hoffman and Alexander (1976) and Jones & Ogle (2000) describe lodgepole pine as both seral and climax in the Bighorns. Houston (2001) as part of this assessment estimated 214,000 acres of lodgepole pine to be seral within the Bighorn National Forest. Higher elevation mesic sites have approximately 100,000 acres of lodgepole pine that is seral to subalpine fir and 98,000 acres seral to Engelmann spruce. Lower elevation xeric sites have 8,500 acres and 7,500 acres that are seral to Douglas-fir and ponderosa pine respectively. Seral lodgepole pine is typically found as even-aged stands with a high proportion of serotinous cones. Climax lodgepole pine can be found at intermediate elevations as the dominant self-reproducing species. Where lodgepole pine is the potential natural vegetation, it has several age classes and no competition from its common associates (Hoffman and Alexander 1976). Bornong (1996) identified climax lodgepole pine stands as old as 500 years. Houston (2001) estimated lodgepole pine is the climax species on 171,000 acres in the Bighorn National Forest.



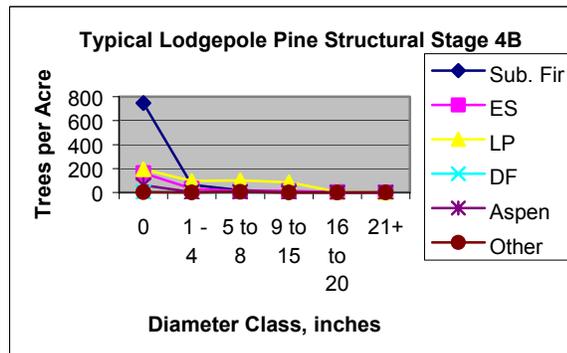
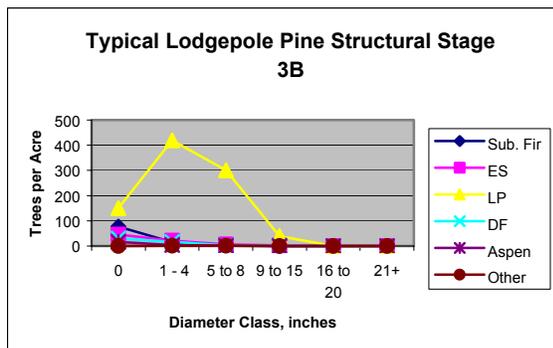
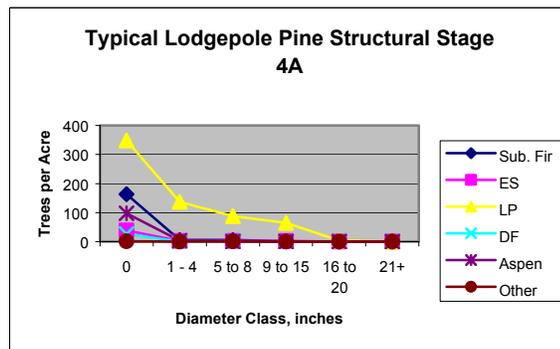
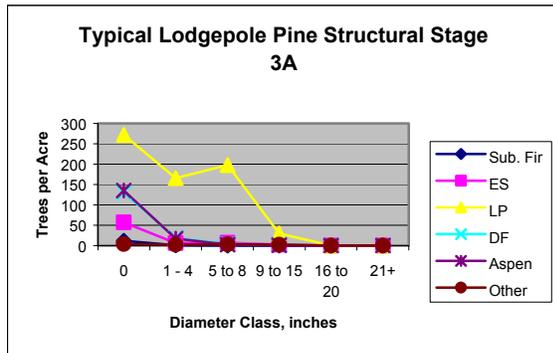
Hoffman and Alexander (1976) described two lodgepole pine habitat types:

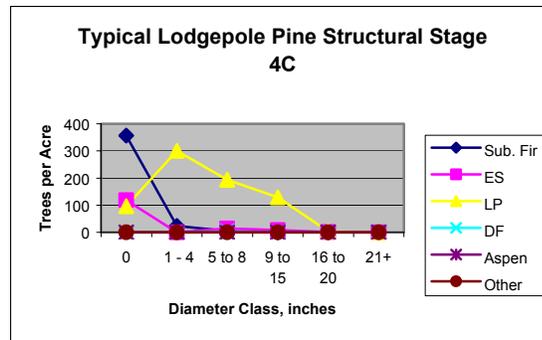
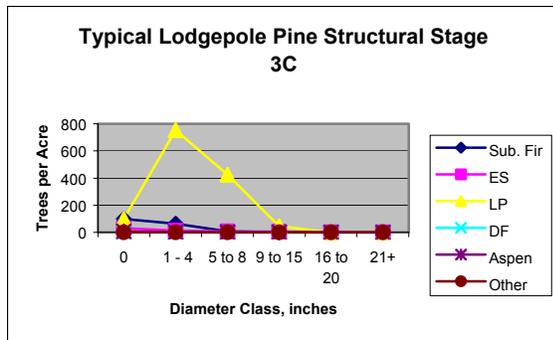
Habitat Type	Description	Important Associated Species
<i>P. contorta</i> / <i>Arctostaphylos uva-ursi</i> Lodgepole pine/bearberry	The warmest, driest, and most frequently burned <i>P. contorta</i> habitat type. Confined to soils of granitic origin with low fertility.	<i>Juniperus communis</i> , <i>Spiraea betulifolia</i> , <i>Lupinus argenteus</i> , <i>Senecio streptanthifolius</i> , and <i>Solidago spatulata</i> .
<i>P. contorta</i> / <i>Vaccinium scoparium</i> Lodgepole pine/ grouse whortleberry	Central third of the Bighorn Mountains on granitic soils, but on more mesic habitats than the <i>P. contorta</i> / <i>Arctostaphylos uva-ursi</i> habitat type	<i>Festuca ovina</i> , <i>Poa interior</i> , <i>P. nervosa</i> , <i>Trisetum spicatum</i> , <i>Antennaria rosea</i> , <i>Arnica cordifolia</i> , <i>Epilobium angustifolium</i> , and <i>Rosa acicularis</i> .

STRUCTURE

Lodgepole pine exhibits highly variable stand characteristics. Despain (1973) found lodgepole pine densities of 4060 +/- 1450 trees per hectare with basal areas of 33.2 +/- 3.7 square meters per hectare. The stands were stratified into sparse stands with densities of 909 +/- 136 trees per hectare with a basal area of 27.4 +/- 3.2 square meters per hectare and dense stands with densities of 9575 +/- 1810 trees per hectare with a basal area of 43.3 +/- 6.1 square meters per hectare. The stands are generally even aged with most of the trees in only two or three size classes. The sparse stands are generally 125-225 years old while the denser stands are typically younger. Lodgepole pine typically reaches 20-25 cm dbh at 150-200 years (Despain 1973). Thinned stands result in stand densities of approximately 750 trees per hectare (Thomas).

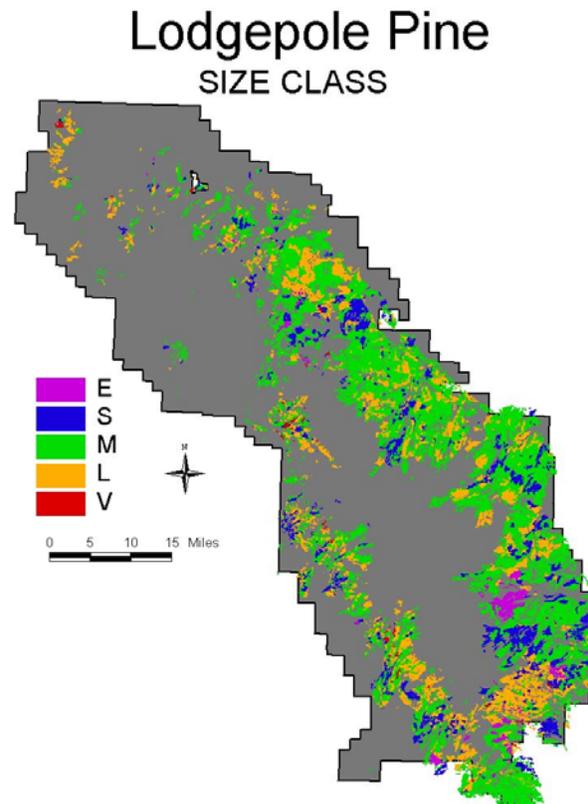
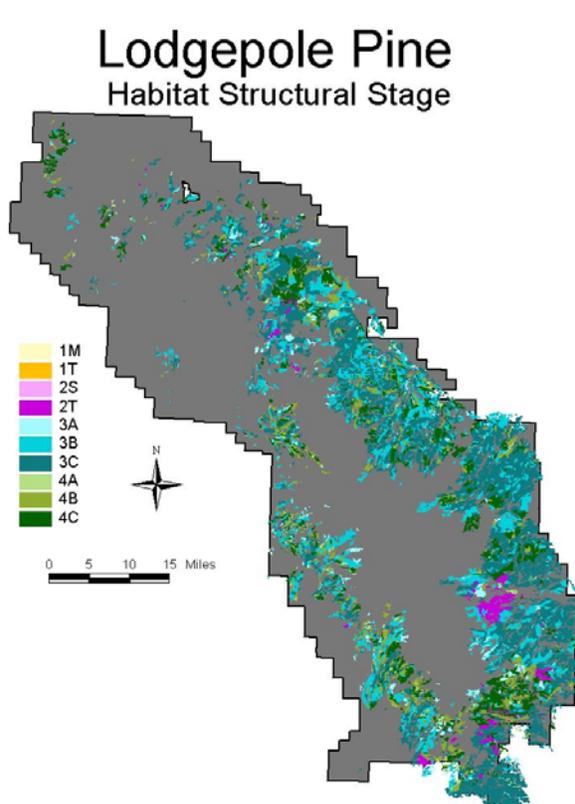
	Structural Stage 3 based on 85 stands, 960 points	Structural Stage 4 based on 74 stands, 764 points
Age	111 years	143 years
Height	40 feet	45 feet
Quadratic Mean Diameter	5.3 inches	7.4 inches
Basal Area (1"+ dbh)	133 ft ² /ac	125 ft ² /ac
Trees per acre (total)	1243	1380
Trees per acre (5"+ dbh)	365	232
Hard Snags per acre	4	6
Soft Snags per acre	11	26
Dwarf Mistletoe Rating	Light	Light
Gross Growth	28 ft ³ /ac/yr	26 ft ³ /ac/yr
Gross Mortality	5 ft ³ /ac/yr	11 ft ³ /ac/yr
Timber Productivity	22 ft ³ /ac/yr	24 ft ³ /ac/yr
Site Index	46	49
% of plots unstocked	2	3





Old-growth lodgepole stands are described as having an overstory of large old trees with sparse crowns containing dead and dying tops. Often dwarf mistletoe, rust, and/or stem rots contribute to the decadence of the overstory. Old-growth stands are at least 150 years old and have at least 10 trees per acre over 10 inches dbh (Mehl 1992).

Fire's influence on forest structure may have been reduced the past century as fire suppression and timber management began to influence forest structure in harvest areas. Timber harvest may create some effects similar to fire; however, other structural variables are in contrast to natural processes. Tree and snag density, species diversity, genetic diversity, coarse woody debris, soil characteristics, regeneration time, and canopy gaps in managed stands may be different than in historic stands (Meyer and Knight in draft).



Structural Stage	1	2	3a	3b	3c	4a	4b	4c	5
Existing (%)	0?	2	4	24	44	1	9	16	0?

NATURAL DISTURBANCE AND FUNCTION

Fire is the predominant natural disturbance agent in the Bighorn Mountains. Meyer and Knight (in draft) determined the fire-free interval for an individual high elevation stand is 150-700 years. They estimated the mean frequency interval for some fire occurrence in lodgepole pine high elevation watersheds to be 13 years. Lodgepole pine in Yellowstone National Park has had stand replacing fires covering 5-25% of the landscape approximately every hundred years. The Bighorn may have a slightly different fire regime, but Yellowstone provides perspective for unmanaged high-elevation forests (Meyer and Knight in draft).

The Bighorn National Forest Fire Database identifies 224,000 acres that have burned between 1895 and 1997 in or near the Bighorn National Forest.

Mountain pine beetles have not caused extensive loss of lodgepole pine in the Bighorn Mountains. Cold, high elevations found in the Bighorn Mountains may inhibit mountain pine beetle epidemics (Amman 1989). Lower elevation lodgepole pine trees, particularly older stands, are at risk of mountain pine epidemics (Meyer and Knight in draft). Epidemics typically start in stressed trees greater than 20 cm dbh over 80 years old. Groups of 100 or more trees may be killed which reduces the average stand diameter and creates openings (Schmid and Mata 1996). An epidemic can be expected to occur on the National Forest every 20-40 years and last one to 10 years (Schmid and Mata 1996). Amman et al. (1977) estimated lodgepole pine forests above 2,500 m are susceptible to stand mortality rates less than 25% while lower elevation mortality rates are up to 50%.

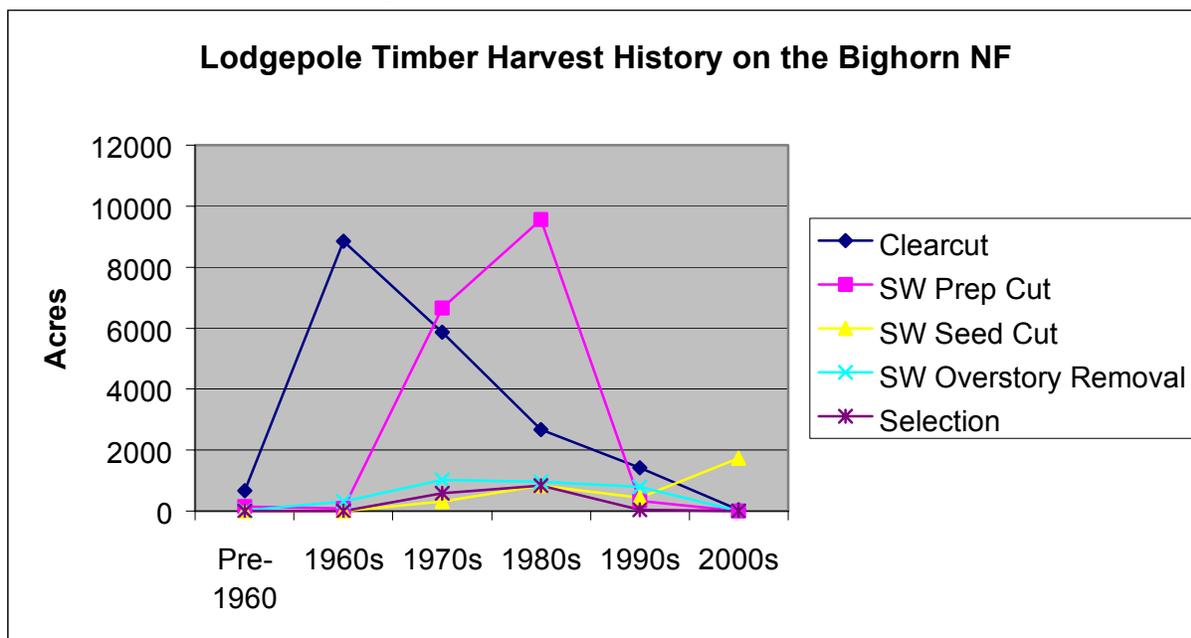
Comandra blister rust is the most common disease in lodgepole pine in the Bighorns. Lundquist (1993) used roadside surveys to determine 77% of the townships had infected lodgepole pine and 20% of the townships were severely infected. The infected areas are scattered throughout the Forest with the severe infections on the east side. Trees 80-90 years old are most susceptible to comandra blister rust (Johnson 1986, Geils and Jacobi 1990). The rust increased dramatically from 1910-1945 as a result of unusually warm, moist summers and preponderance of susceptible lodgepole pine (Krebill 1965).

Dwarf mistletoe is the second most widespread disease on the Bighorn National Forest (Meyer and Knight in draft). Johnson (1986) found 36% of the stands he surveyed along existing roads were infected with the most severe infections in the southern portion of the Forest.

RECENT HUMAN DISTURBANCE

As the dominant species, lodgepole pine (both seral and climax) has also been the most harvested forest type in the Bighorn Mountains. Harvest techniques have varied over time. Most disturbances were associated with natural causes until the past few decades. Lodgepole has been harvested since before settlement times, as the wood is preferred for teepees, fences, lumber, and most notably railroad ties, which were harvested around the turn of the century. Lodgepole pine harvest occurred on 12,500 acres in the 1960s. These harvests tended to be 200-400-acre clearcuts (Bornong personal communication) with 8,800 acres clearcut and 3,300 acres thinned. Shelterwood harvest became more common in the 1970s with 8,000 acres in shelterwood harvests, 5,900 acres in clearcuts, 3,600 acres in thinning, and 1,400 acres in other silvicultural systems. These harvest areas typically covered 30-200 acres. The 1980s had nearly 29,000 acres of timber harvest with individual harvest units of 5-30 acres (Bornong personal communication). The silvicultural treatments were 2,700 acres in clearcuts, 11,400 acres in shelterwood harvests, 2,400 acres of commercial thinning, 10,000 acres of pre-commercial thinning, 800 acres of selection harvest, and 1,400 acres of salvage/sanitation. Timber management has included approximately 14,000 acres since 1990 with 1,500 acres clearcut, 3,300 acres of shelterwood harvest, 1,300 acres of salvage/sanitation, 7,300 acres of pre-commercial thinning, and 200 acres using other silvicultural systems.

Approximately 60,000 acres or 19% of lodgepole pine in the Bighorn National Forest has had active forest management.



FINDINGS

Lodgepole pine is the most common forest type on the Bighorn National Forest comprising 385,000 acres and is most common on granitic soils.

Lodgepole pine that is seral to more shade tolerant species (primarily subalpine fir and Engelmann spruce) has a higher portion of serotinous cones and is more likely to occur as even-aged stands than areas with climax lodgepole pine.

Various timber harvest methods have not mimicked the natural disturbance regimes resulting in some departure from the historic stand structure and patch size. Over 80% of the lodgepole pine forest has not been harvested in the past.

Fire's influence on the lodgepole pine forest structure may have been reduced as a result of timber management and fire suppression, however, a change to the landscape lodgepole pine stand structure is not evident due to the long fire return intervals.