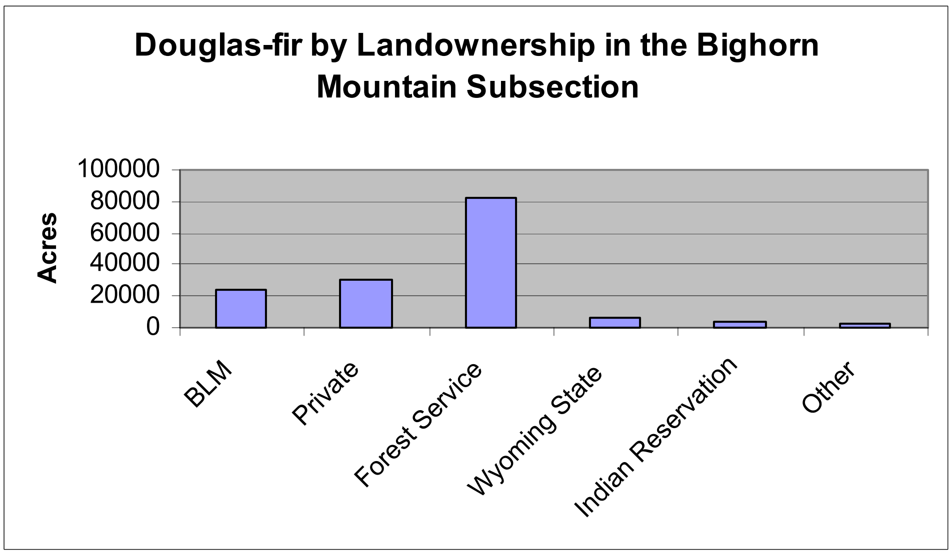
# Forested Vegetation - Douglas-Fir

Douglas-fir (*Pseudotsuga menziesii* (*Mirb*.) *Franco var. glauca* (*Beissn*.) *Franco*) (Nelson and Hartman, 1984) is the third most dominant forest cover type on the Bighorn National Forest, covering about 14% of the forested acres. Table B1 shows the distribution of Douglas-fir across the different land ownerships within the Bighorn Mountain section. The Bighorn National Forest manages most of the Douglas-fir in this section. This is GAP data, and does not match acres with the CVU cover type data, but the relative percentage by ownership is the important piece of this table.

**Table B1. Distribution of Douglas-fir across Land Ownerships**




Douglas-fir is known to reach diameters of up to 50 inches in the Tepee Creek area and heights of approximately 100 feet just west of Meadowlark Lake. Trees of up to 400 years old are known from the Tepee Creek area.

The most significant insect or disease occurring on Douglas-fir in the Big Horn mountains is the Douglas-fir beetle, *Dendroctonus pseudotsugae*. The 2001 aerial survey showed this insect to be at endemic levels, affecting about 17 acres of National Forest and non-National Forest lands (Johnson and Long, 2001). Although not detected on the Big Horn Mountains in either the 2000 or 2001 aerial surveys, the western spruce budworm, *Choristoneura occidentalis*, has also been known to attack Douglas-fir in this area.

## COMPOSITION

a. Driving factors influencing composition

Numerous environmental influences dictate where Douglas-fir forests occur. These factors interact with each other, creating environmental continuums that result in a complex spatial pattern of species distributions. Among these are:

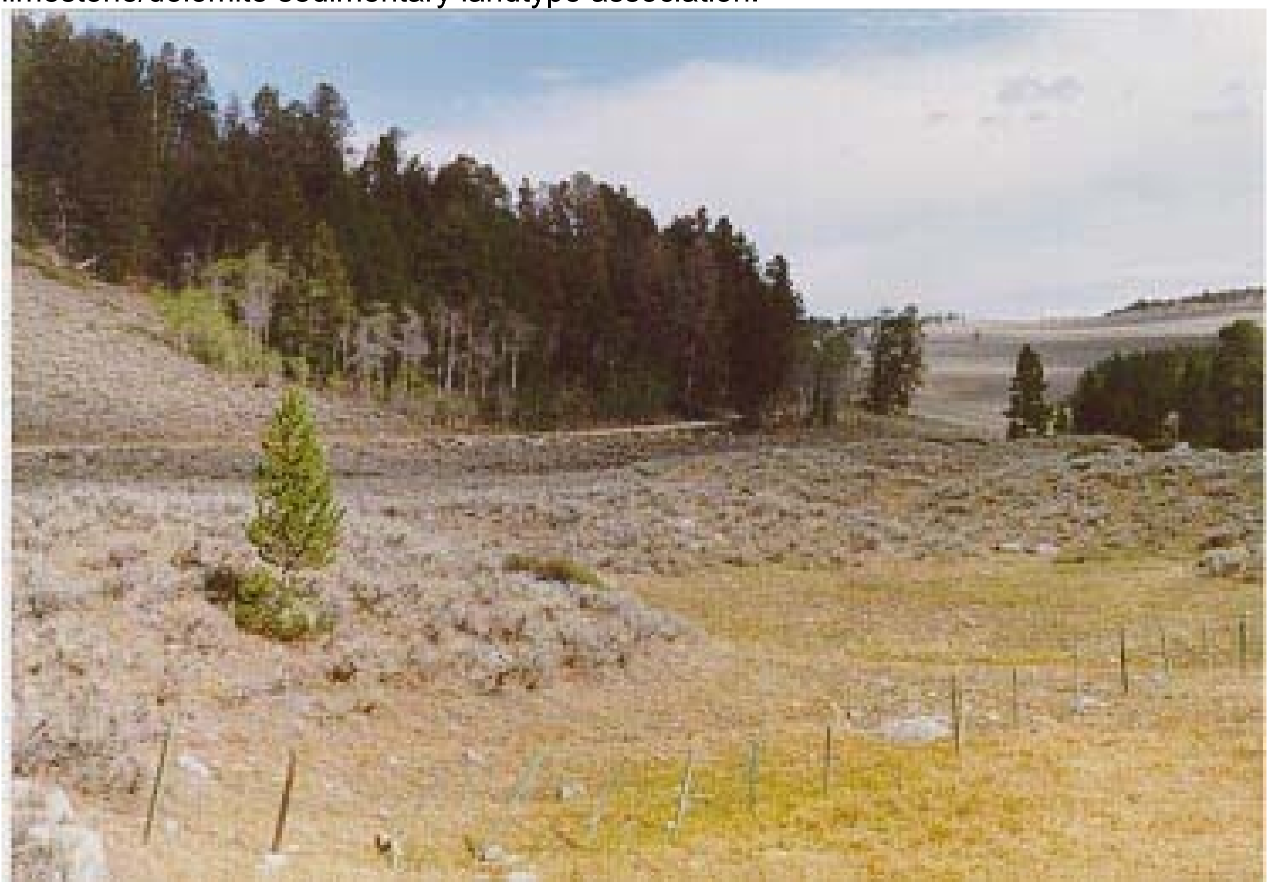
- Elevation
- Aspect
- Soil substrate
- Precipitation patterns
- Topographic position
- Temperature

While Douglas-fir on the Bighorn NF occurs between 6000 and 9000 feet, it is most common between 6500 and 7500 feet (Despain, 1973). On the east flank of the Bighorns, Douglas-fir occurs between ponderosa pine and lodgepole, while on the west flank, it is often the lowest elevation forest, due to the lack of ponderosa (Despain, 1973; Hoffman and Alexander, 1976).

Aspect is important in Douglas-fir distribution especially in warm, dry, low elevation environments where it is restricted to north slopes. These areas usually have grass/forb or sagebrush habitats on the south slopes, thus forming Douglas-fir forested islands. At higher, more mesic elevations, Douglas-fir can occur on any aspect.

The CVU database shows that 93% of the acreage of Douglas-fir cover type occurs on sedimentary soils, and are best developed on limestone or dolomite derived soils (Despain, 1973; Hoffman and Alexander, 1976). Picture 1, below, is an excellent example of the abrupt species change between granitic and sedimentary soils on the Bighorn NF. The small patch of trees on the right is on the edge of a granitic, glacial deposit. Those trees are lodgepole pine, with a few Engelmann spruce in the understory in wet areas. The stand on the left side of the picture is 20 to 30 inch Douglas-fir, which is on the limestone/dolomite sedimentary landtype association.

**Picture 1: Douglas-fir Distribution Related to Substrate**
The small patch of trees on the right is on the edge of a granitic, glacial deposit. Those trees are lodgepole pine, with a few Engelmann spruce in the understory in wet areas. The stand on the left side of the picture is 20 to 30 inch Douglas-fir, which is on the limestone/dolomite sedimentary landtype association.

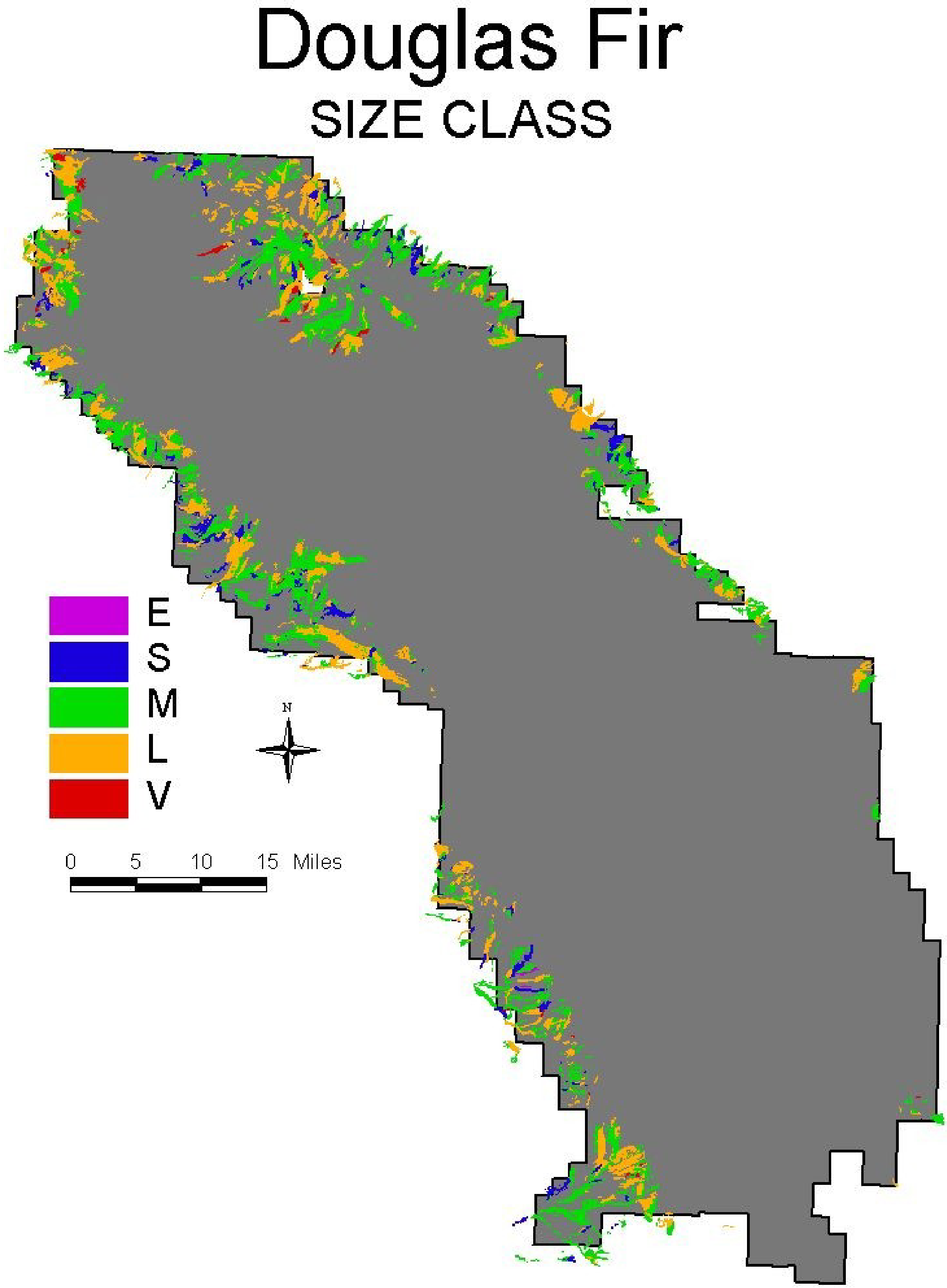


The following map shows the distribution and size class of Douglas fir on and near the Bighorn National Forest. Table B2 provides the size class definitions.

**Table B2. Size Class Definitions for the map on Page 4**

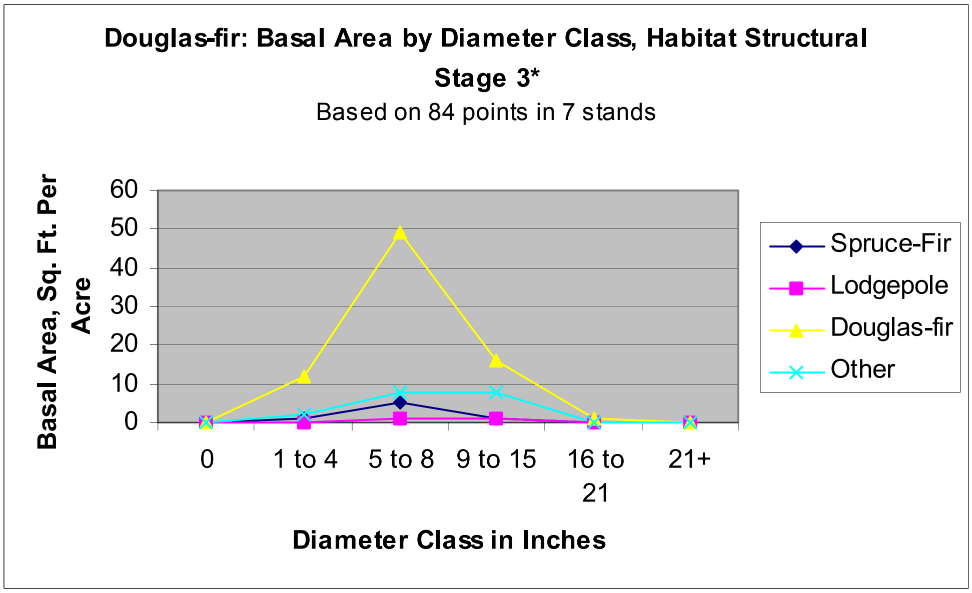
| Size Class | Description | Diameter Range |
|---|---|---|
| E | Established | Less than one inch |
| S | Small | 1.0 to 4.99 inches |
| M | Medium | 5.0 to 8.99 inches |
| L | Large | 9.0 to 15.99 inches |
| V | Very Large | 16 inches plus |

The elevation and soil effects on Douglas-fir distribution is evident in this map.

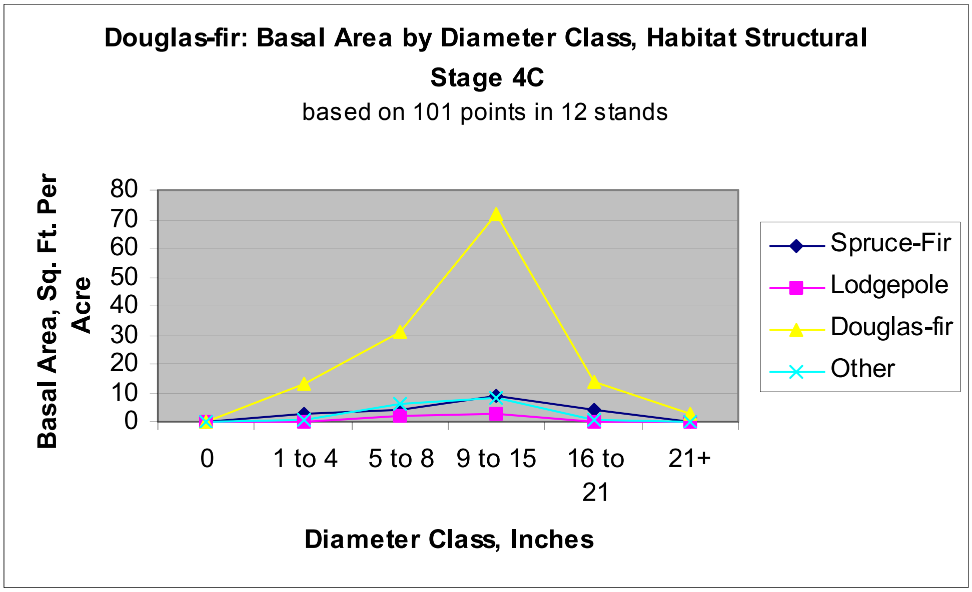


The following tables show basal area by diameter class distributions for Douglas-fir stands in the 3* (3A, 3B and 3C) and 4C wildlife habitat structural stages. Douglas-fir is clearly the dominant overstory species, with minor amounts of lodgepole pine, spruce-fir, ponderosa pine and aspen. This data is from Bighorn National Forest Stage I inventory plots.

### Table B3. Basal Area by Diameter Class in Habitat Structural Stage 3* Douglas-fir on the Bighorn National Forest




### Table B4. Basal Area by Diameter Class in Habitat Structural Stage 4 Douglas-fir on the Bighorn National Forest



Despain (1973) lists several factors affecting the distribution of Douglas-fir forests on the Big Horn Mountains:

- Douglas-fir has a strong negative association with granitic substrates. See also Table B5, below, which shows that 93% of the existing Douglas-fir cover type occurs on sedimentary substrates (CVU database).
- Douglas-fir on sedimentary substrates has a strong negative association with southwest aspect slopes.

b. Major species/plant associations

Plant associations recognized by Hoffman and Alexander (1976) include:

| **Hoffman and Alexander (1976) Habitat Type** | ***Pinus ponderosa*** | ***Pseudotsuga menziesii*** | **Pinus flexilis** | **Pinus contorta** | **Other important species** |
|---|---|---|---|---|---|
| **P. menziesii/Berberis repens, Juniperus communis *phase*** | S | C | s | | *Arnica cordifolia, Lupinus argenteus, Symphoricarpos oreophilus, Galium boreale, Rosa acicularis, Hesperochloa kingii, Festuca ovina, Astragalus miser* |
| *P. menziesii/Berberis repens* | s | C | s | s | *Juniperus communis,Arnica cordifolia, Ribes lacustre, Symphoricarpos oreophilus, Hesperochloa kingii, Poa Spp.,Galium boreale, Senecio streptanthifolius, Smilacina racemosa* |
| *P. menziesii/Physocarpus monogynus* | S | C | s | s | *Rosa acicularis, Symphoricarpos oreophilus, Berberis repens, Spiraea betulifolia* |

C = major climax species; S = seral; s = seral in some stands

Despain (1973) found that the understory of Douglas-fir forests consists mostly of the dominant tree species, and other species in the understory were quite variable in that only grasses, lichens and mosses occurred on more than 2 of the 5 Douglas-fir plots. "No specific group of species seems to be especially adapted to living under *Pseudotsuga menziesii*" (Despain, 1973).

c. Successional pathways, patterns

Douglas-fir is considered to be a climax species for much of its range on the Bighorn NF (Despain, 1973; Hoffman and Alexander, 1976). It is seral to spruce-fir forests at the higher elevational edge of its range, and can replace ponderosa pine at some lower elevation sites (Despain, 1973).

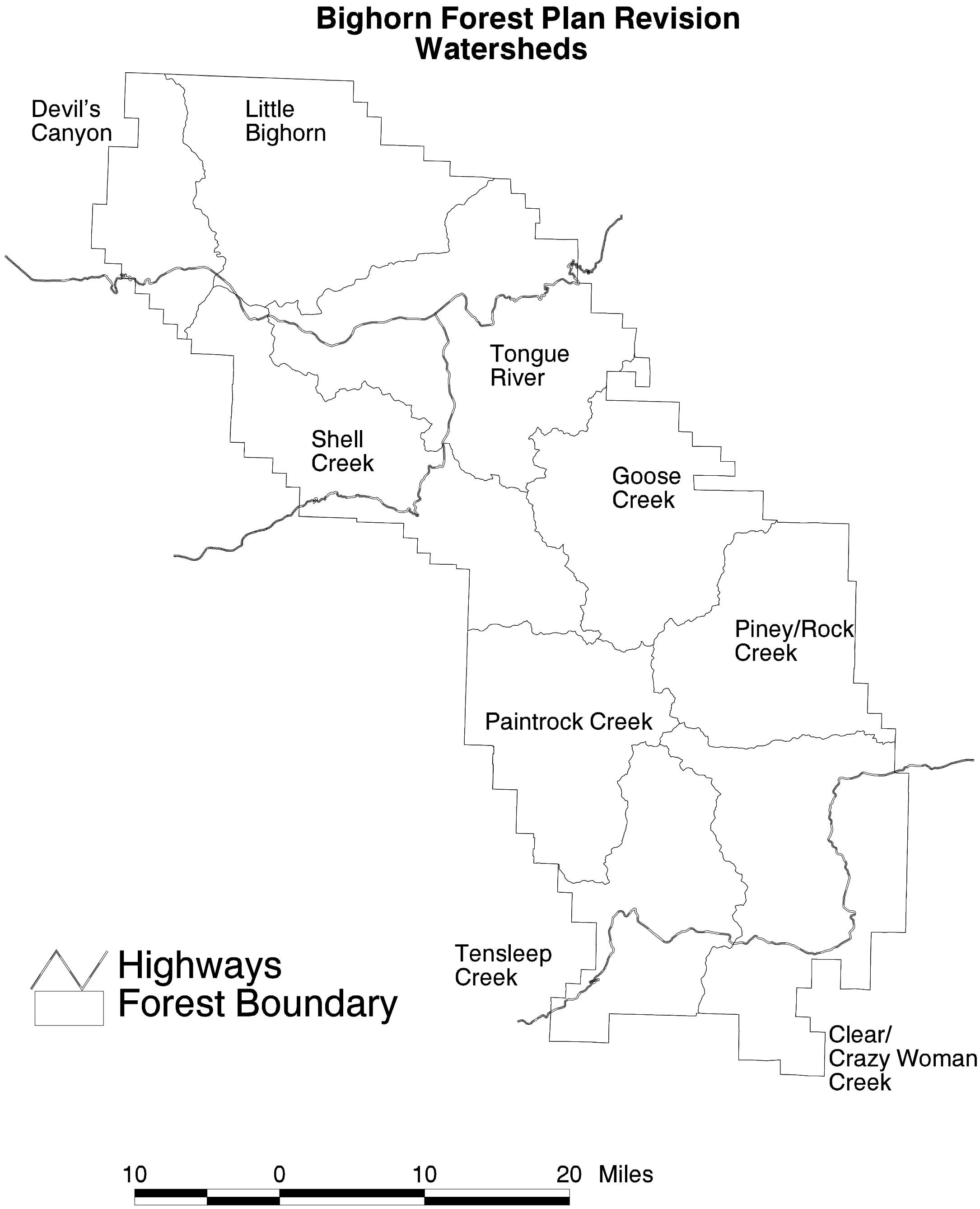
d. Differences in composition among stratification units

Table 4 above shows how the various forest species affinities for specific soil substrates on the Bighorn National Forest. Douglas-fir has a very strong affinity for sedimentary substrates, with approximately 93% of the current Douglas-fir cover type.

The Bighorn National Forest has been stratified by watershed, see the watershed map on page 8. The following table shows how the cover types vary by watershed. The number of acres is the total acres, including lands of other ownerships, that occur within the proclaimed boundary of the Bighorn National Forest. Douglas-fir varies from the second most prevalent forest cover type in the Shell, Devil's Canyon and Little Bighorn watersheds, to barely existing in the granite dominated Clear-Crazy and Piney-Rock watersheds.

**Table B5. Major Vegetation Types by Watersheds on the Bighorn National Forest**

| | | Vegetation Cover Types | | | | Forested Cover Types | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Watershed** | **Acres** | **Forest** | **Grass-forb** | **Non-Veg.** | **Shrub** | **Spruce-fir** | **Lodge-pole** | **Doug-fir** | **Other** |
| Clear-Crazy | 155,774 | 72% | 13% | 13% | 2% | 16% | 79% | >1% | 5% |
| Tensleep | 101,130 | 59% | 14% | 17% | 10% | 29% | 51% | 19% | 1% |
| Paintrock | 107,944 | 52% | 20% | 20% | 8% | 38% | 43% | 15% | 4% |
| Shell | 140,130 | 49% | 29% | 7% | 15% | 40% | 18% | 36% | 6% |
| Devil's Canyon | 61,197 | 58% | 22% | 3% | 17% | 47% | 13% | 38% | 2% |
| Little Bighorn | 141,307 | 69% | 22% | 5% | 4% | 54% | 12% | 27% | 7% |
| Tongue | 177,069 | 69% | 21% | 3% | 7% | 37% | 48% | 7% | 8% |
| Goose | 116,953 | 80% | 10% | 10% | 0% | 26% | 67% | 4% | 3% |
| Piney-Rock | 110,255 | 79% | 4% | 17% | 0% | 27% | 66% | 1% | 6% |




e. Changes in species composition/anthropogenic influences/departures from HRV

Table B6 is from Table 7 in Meyer and Knight (2001 Draft) for low elevation forests on the Bighorn National Forest. Low elevation forests include Douglas-fir, ponderosa pine and limber pine.

**Table B6. Historic Range of Variability for Upland Vegetation for Low Elevation Forests on the Bighorn NF**

| | Stand Level | | Landscape Level | |
|---|---|---|---|---|
| **Variable** | **Within HRV** | **Outside HRV** | **Within HRV** | **Outside HRV** |
| **Disturbances** | | | | |
| Fire frequency | | x | | x |
| Fire intensity | | x | | x |
| Fire size | NA | | | x |
| Insect outbreaks | x | | x | |
| Disease outbreaks | x -most | x - WPBR | x -most | x - WPBR |
| Blowdowns | x | | x | |
| **Structure** | | | | |
| Tree/sapling density | | x | | x |
| Canopy cover and gaps | | x | | x |
| Understory composition and amount | | x | | x |
| Species diversity | x | | x | |
| Genetic diversity | x | | | |
| Size and age structure | | x | | x |
| Spatial distribution of trees | | x | | x |
| Snag density | x - most | x – cut areas | x | |
| Forest floor depth | | x | | x |
| Mineral soil affected | | | | |
| Coarse woody debris | x - most | x – cut areas | x | |
| Patch sizes and configuration | NA | | | x |
| Percentage of landscape in old trees | NA | | | x |
| Percentage in high density snags and coarse woody debris | NA | | x | |
| Interspersion and proportion of landscape in different cover types | NA | | | x |

f. Measures of ecological integrity or sustainability and what is required to restore or maintain integrity or sustainability
g. Implications of composition conditions

## STRUCTURE AND FUNCTION

a. Cycling of carbon, nutrients (nitrogen), water, primary productivity

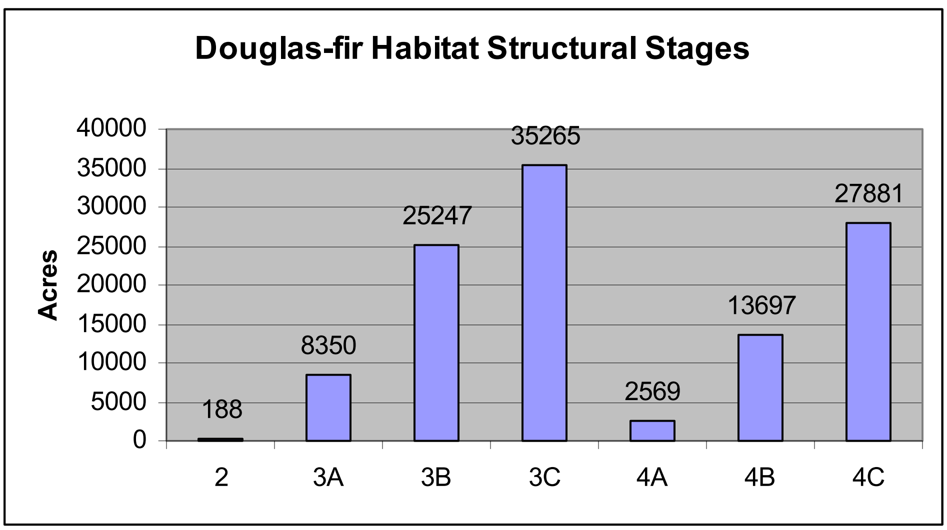
b. Habitat Structural Stage descriptions

Habitat structural stage provides a "coarse filter" look at habitats provided by forests. It gives an indication of forest size and density, which can be interpreted for wildlife habitat suitability. Forested stands provide an infinite variety of tree sizes and canopy densities, and to consider the amount, type, and spatial distribution of wildlife habitats, people need a simplified system to comprehend this variety. Many habitat considerations, such as amount and type of understory vegetation; size and amount of snags and coarse woody debris; and, the amount of hiding cover provided, can be approximately inferred from the broad habitat groupings described in the habitat structural stage model.

Table B7 shows that the 3* structural stages cover the most acres in the current Douglas-fir cover type. The B and C crown covers are much more prevalent than the low density A crown cover.

**Table B7. Douglas-fir Cover Type Wildlife Habitat Structural**

**Stages in the Big Horn Mountains**




Data from Bighorn NF CVU database, 11/01. Includes all lands covered by CVU database.

Habitat structural stages are defined in Hoover and Wills (1987). Structural stages describe the developmental stages of tree stands in terms of tree size and the extent of canopy closure. Structural stages can be considered a descriptor of the succession of a forested stand from regeneration, or bare ground, to maturity. For the purposes of describing wildlife habitat, forest structural stages are divided into four categories, consisting of Stage 1, grass/forb; Stage 2, shrub/seedling; Stage 3, sapling/pole; and Stage 4, mature, Table B8. It is important to recognize that structural stages represent succession in *forested stands* only; the grass/forb, structural stage 1, refers only to forested stands that have undergone a stand replacing event, and are temporarily in a "non-forested" condition. Structural Stage 1 does not include naturally occurring meadows. The letter in the structural stage naming convention (a, b, or c) refers to the crown density, Table B8.

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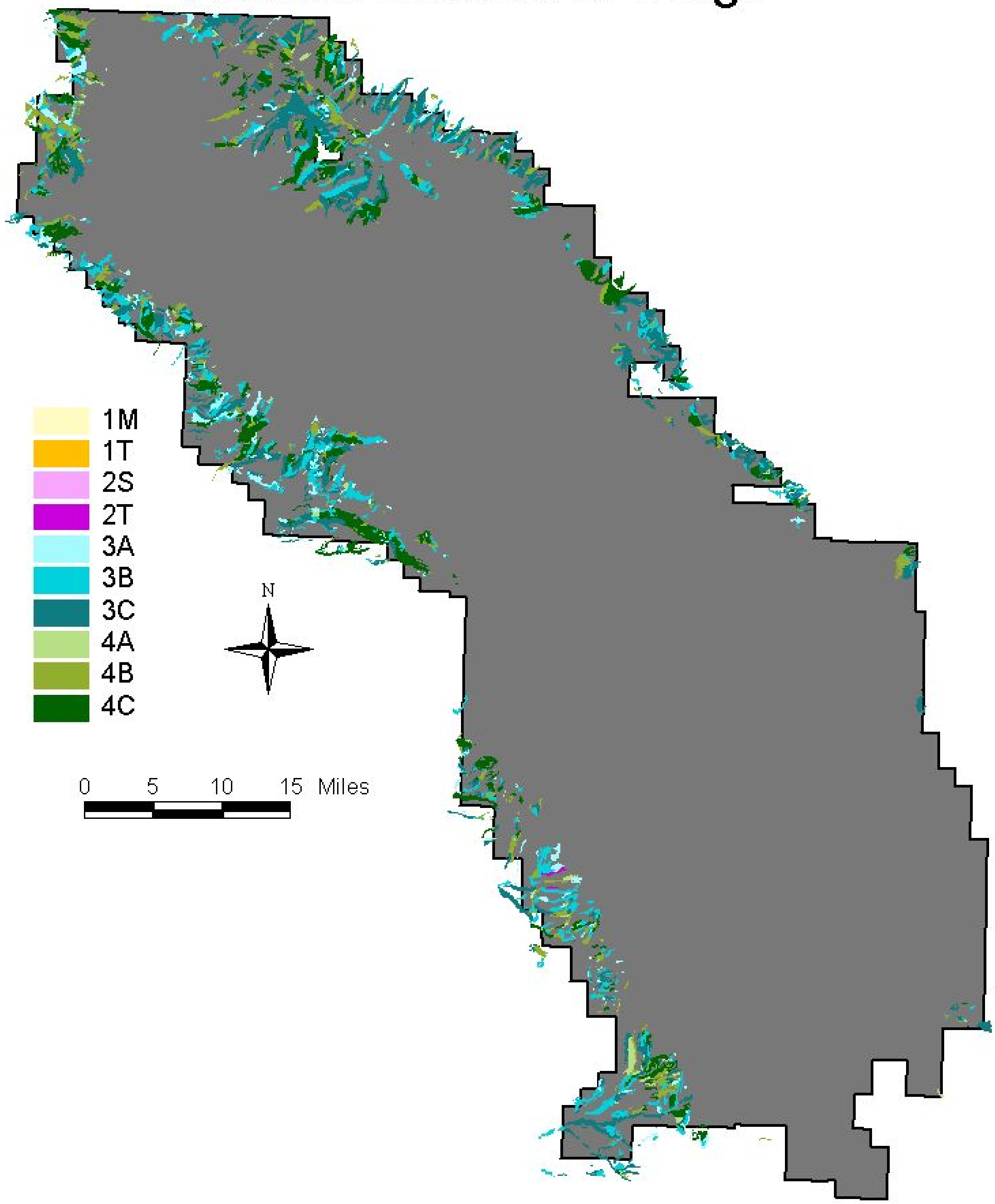
**Table B8. Habitat Structural Stage Definitions, Hoover and Wills 1987**

| Habitat Structural Stage | Diameter | Crown Cover % | Habitat Structural Stage | Diameter | Crown Cover % |
|---|---|---|---|---|---|
| 1 | Not applicable | 0-10% | 3C | 1 – 9 inches | 70-100% |
| 2 | < 1 inch | 10-100% | 4A | 9+ inches | 10-40% |
| 3A | 1 – 9 inches | 10-40% | 4B | 9+ inches | 40-70% |
| 3B | 1 – 9 inches | 40-70% | 4C | 9+ inches | 70-100% |

The following map shows the distribution of Douglas-fir by habitat structural stage for the Bighorn National Forest.

# Douglas Fir

## Habitat Structural Stage



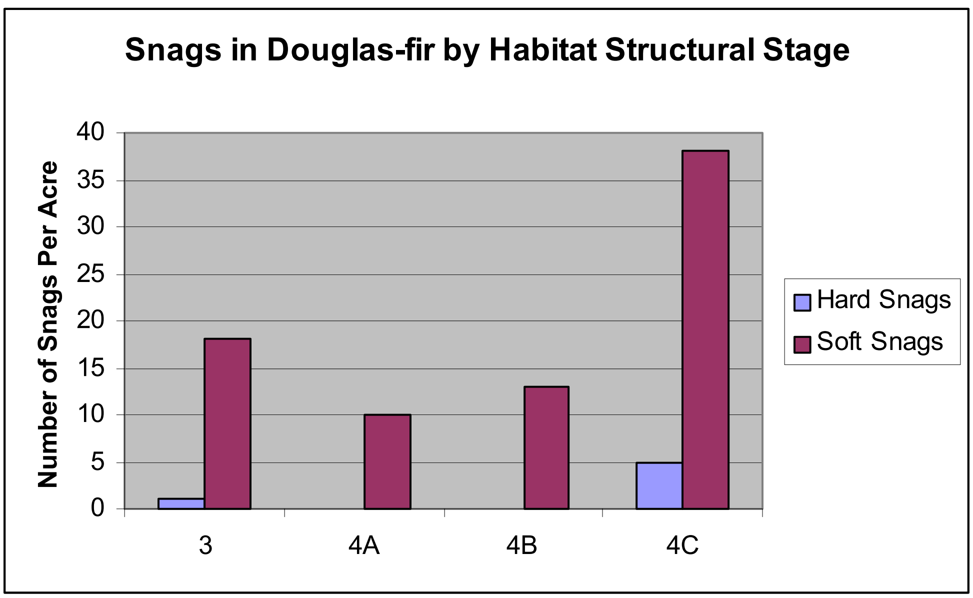
c. Expected Range of coarse woody debris

Graham, et al., (1994) studied the amount of coarse woody debris (CWD) in various forested habitat types in the Intermountain Region. They used ecotmycorrhizae as a bioindicator of healthy, productive forest soils. For the *Pseudotsuga menziesii/physocarpus monogynus* habitat type in Montana, their recommendation was that 10 to 20 Megagrams per hectare (4.5 to 8.9 tons per acre) of CWD over 3.0 inches in diameter should be left on site following logging. These amounts may not represent the extremes of the historic range of coarse woody debris, but may be more of a mean over time.

d. Expected range of snag structure

Table B9 shows average snags per acre in Douglas-fir forests on the Bighorn National Forest, based on 29 Douglas-fir stands (291 variable-radius plots) of Stage I inventory data. Since these are per acre stand averages, they do not represent the range of snags that occurred historically.

**Table B9. Average Snags per Acre in Douglas-Fir Stands on the Bighorn NF**

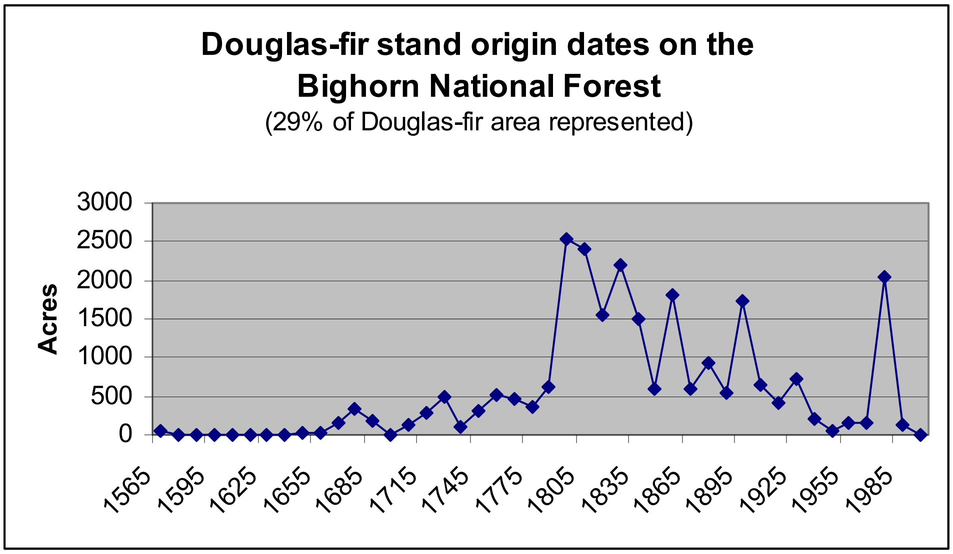



e. Old Growth characteristics

The Bighorn NF is using the old-growth definitions in Mehl (1992) for various forest cover types specifically, and the old-growth definition in Kaufmann (1992) generically.

Table B10 shows the stand origin dates for Douglas-fir forests on the Bighorn NF. Mehl (1992) cites that the minimum age for Douglas-fir old-growth is typically 200 years old; approximately 27% of the Douglas-fir area with origin date information has stand origin dates before 1800. This information should be used carefully for two reasons. First, only 29% of the Douglas-fir forest has stand origin data, so 27% is certainly less than the total amount of Douglas-fir forest over 200 years old. Second, age is only one of approximately 9 criteria Mehl (1992) uses to describe Douglas-fir old growth.

**Table B10. Stand Origin Dates for Douglas-fir Forests on the Bighorn NF**



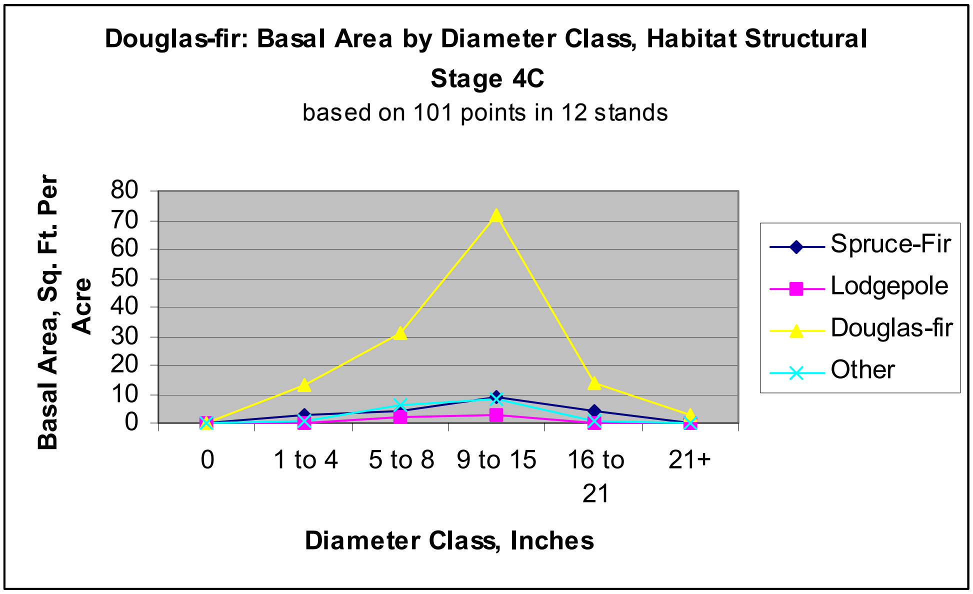

The spike on the far right of table B10 represents timber harvests and fires between the 1960s and present. The dip in the data centered around 1935 and 1955 can be attributed to fire suppression. This age distribution is much older than the lodgepole distribution.

Douglas-fir is known to reach diameters of up to 50 inches in the Tepee Creek area and heights of approximately 100 feet just west of Meadowlark Lake. Trees of up to 400 years old are known from the Tepee Creek area. One stand in the Tepee Creek area had a Stage II stand average diameter of 23 inches. Based on these statistics, it is clear that Douglas-fir on the Bighorn NF can reach old ages and large sizes.

f. Within stand age class and diameter distribution characteristics, occurrence or abundance of large trees

Table B11 shows the basal area by diameter class for Habitat Structural Stage 4C. The shape of the curve is the same with the same relative species distribution for HSS 3*, 4A and 4B. The difference is that the peak of the Douglas-fir is 50, 46 and 52 square feet of basal area per acre for the 3*, 4A and 4B HSS, respectively.

**Table B11. Basal Area by Diameter Class in Habitat Structural Stage 4 Douglas-fir on the Bighorn National Forest**




g. Stand densities

Table B12 and B13, trees per acre by diameter class for Douglas-fir habitat structural stages 3* and 4C, respectively, are typical of stand densities for Douglas-fir forests on the Bighorn National Forest. The data in Tables B12 and B13 are presented below in Table B14.

**Table B12. Trees per Acre by Diameter Class for Douglas-fir Habitat Structural Stage 3*.**

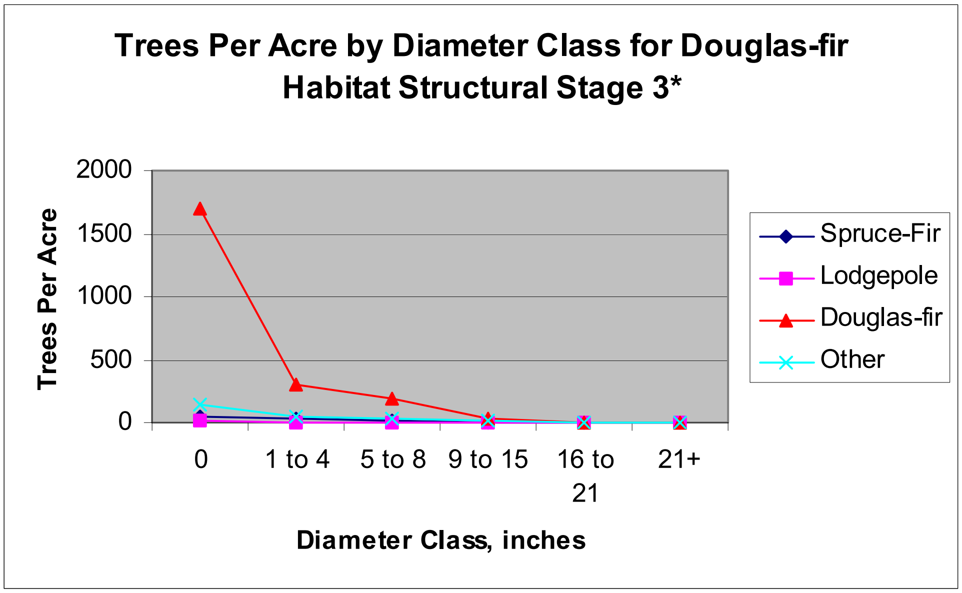



**Table B13. Trees per Acre by Diameter Class for Douglas-fir Habitat Structural Stage 4C**.

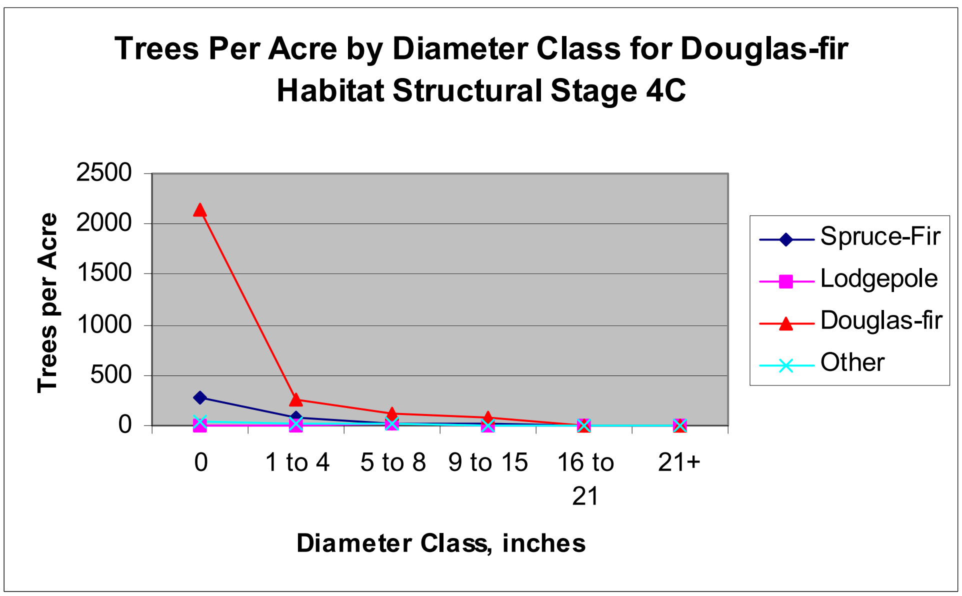


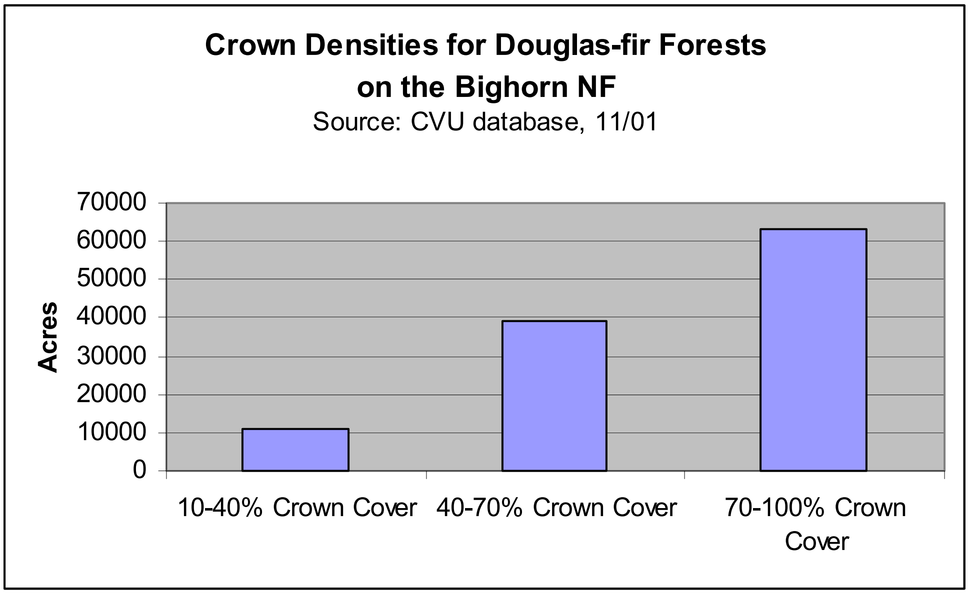
**Table B14. Trees per acre for Douglas-fir on the Bighorn NF**

| Douglas-fir Habitat Structural Stage 3* | | | | |
|---|---|---|---|---|
| **DBH** | **Spruce-fir** | **LP** | **Douglas-fir** | Other |
| 0 | 50 | 11 | 1706 | 150 |
| 1 - 4 | 39 | 7 | 297 | 55 |
| 5 to 8 | 19 | 5 | 189 | 31 |
| 9 to 15 | 6 | 2 | 24 | 14 |
| 16 to 20 | 0 | 0 | 1 | 0 |
| 21+ | 0 | 0 | 0 | 0 |
| 1"+ | 64 | 14 | 511 | 100 |
| Douglas-fir Habitat Structural Stage 4A | | | | |
| **DBH** | **Spruce-fir** | **LP** | **Douglas-fir** | Other |
| 0 | 0 | 0 | 612 | 72 |
| 1 - 4 | 0 | 12 | 36 | 0 |
| 5 to 8 | 0 | 0 | 74 | 28 |
| 9 to 15 | 0 | 0 | 63 | 1 |
| 16 to 20 | 0 | 0 | 2 | 1 |
| 21+ | 0 | 0 | 1 | 0 |
| 1"+ | 0 | 12 | 176 | 30 |
| Douglas-fir Habitat Structural Stage 4B | | | | |
| **DBH** | **Spruce-fir** | **LP** | **Douglas-fir** | Other |
| 0 | 36 | 4 | 63 | 19 |
| 1 - 4 | 7 | 2 | 80 | 19 |
| 5 to 8 | 7 | 2 | 72 | 12 |
| 9 to 15 | 2 | 0 | 6 | 0 |
| 16 to 20 | 1 | 0 | 2 | 0 |
| 21+ | 53 | 8 | 223 | 50 |
| 1"+ | 36 | 4 | 63 | 19 |
| Douglas-fir Habitat Structural Stage 4C | | | | |
| **DBH** | **Spruce-fir** | **LP** | **Douglas-fir** | Other |
| 0 | 270 | 3 | 2145 | 30 |
| 1 - 4 | 71 | 0 | 261 | 18 |
| 5 to 8 | 15 | 13 | 115 | 20 |
| 9 to 15 | 13 | 6 | 89 | 9 |
| 16 to 20 | 1 | 0 | 5 | 1 |
| 21+ | 0 | 0 | 1 | 0 |
| 1"+ | 100 | 19 | 471 | 48 |

h. Canopy Closure

Table B15 shows the crown densities for Douglas-fir stands on the Bighorn NF. This table is from the CVU database, and includes all Douglas-fir stands in the habitat structural stage 3 and 4 size classes.

**Table B15. Crown Densities for Douglas-fir Forests on the Bighorn NF**




i. Patchiness and
j. Vertical Complexity

Relative to spruce-fir stands on the Bighorn NF, which have a relatively high amount of species and size patchiness, Douglas-fir stands are relatively homogeneous in terms of vertical and horizontal complexity.

k. Changes in structure/anthropogenic influences

Little timber harvest has occurred in the Douglas-fir forests on the Bighorn in the past 40 years, despite the fact that it is a desirable wood for commercial purposes. The primary reason for this is that Region 2 of the Forest Service classified Douglas-fir as a non-commercial species, at least through the early 1980's, because so little silvicultural information is available on inland Douglas-fir.

The largest anthropogenic influence upon the Douglas-fir of the Bighorn NF has been fire suppression. The extremely thick bark (up to 5 inches thick) is an indicator that periodic surface fires were important in this forest type. The past 100 years of Forest Service management has reduced the amount of fire, and increased the understory density of the Douglas-fir forests.

**Table B16. Douglas-fir Timber Harvest History on the Bighorn NF**

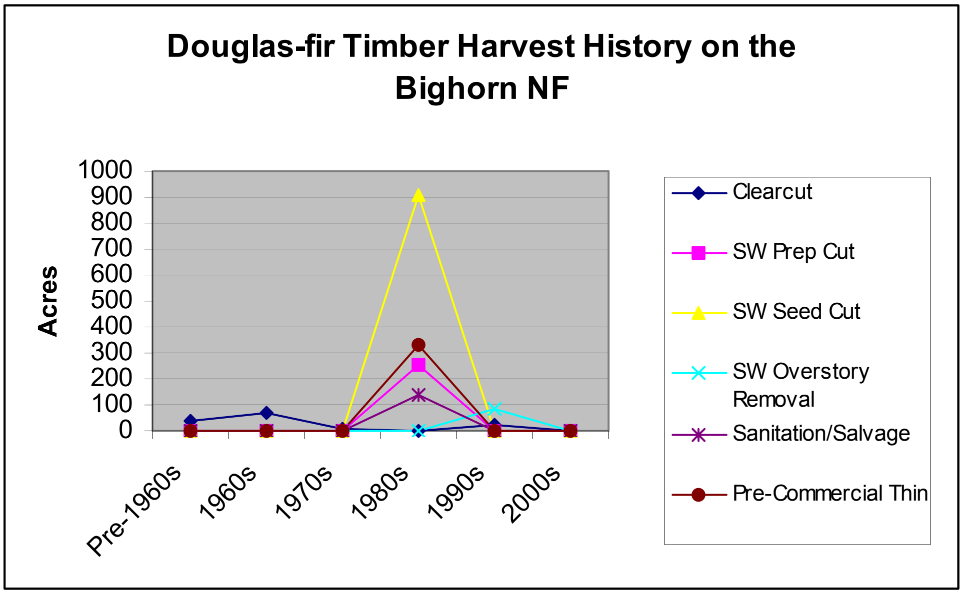



Table B17, showing activities in Douglas-fir forests on the Bighorn NF, should be interpreted with the following caveats:

- The data for silvicultural activities is considered to be accurate from the 1960s on.
- The fire data is not the most accurate available; the large fire coverage is more accurate for fire acres than this data.
- This table over represents the total acreage of timber harvest activities, since some areas received more than one event, and this table lists all activities that occurred. For example, some stands that were burned were subsequently logged under a sanitation/salvage prescription.

**Table B17. Activities in Douglas-fir Cover Type on the Bighorn NF**

| **Activities in Douglas-fir cover type on Bighorn NF** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Pre-1960s | 1960s | 1970s | 1980s | 1990s | 2000s | Total |
| Clearcut | 35 | 71 | 9 | 0 | 24 | 0 | 139 |
| SW Prep Cut | 0 | 0 | 3 | 254 | 0 | 0 | 257 |
| SW Seed Cut | 0 | 0 | 0 | 904 | 0 | 0 | 904 |
| SW Overstory Removal | 0 | 0 | 0 | 0 | 88 | 0 | 88 |
| Selection | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Seed Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commercial Thin | 0 | 0 | 0 | 138 | 0 | 0 | 138 |
| Sanitation/Salvage | 0 | 0 | 0 | 329 | 0 | 0 | 329 |
| Pre-commercial Thin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fire | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blowdown | 0 | 0 | 0 | 20 | 0 | 0 | 20 |
| Total | 35 | 71 | 12 | 1645 | 112 | 0 | 1875 |

Data source: RMACT activity region coverage, 11/2001.

Some of the interpretations that can be made from this table include:

- Based on the information in this table, approximately 2% of the Douglas-fir forests have had some sort of “activity” in the past 40 years.
- The rate of silvicultural activity (activities other than fire and blowdown) has slowed over the past decade, going from a total of 1645 acres in the 1980s to 112 acres in the 1990s. The 1990s silvicultural activity occurred prior to 1994.