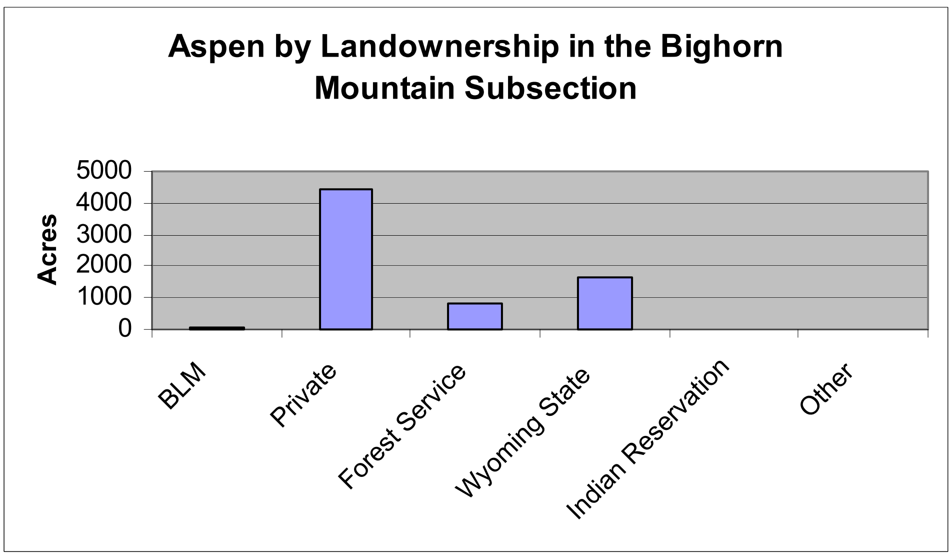
Forested Vegetation - Aspen White Paper

Aspen (*Populus tremuloides Michx.*) (Nelson and Hartman, 1984) is the cover type on about 1% of the Bighorn National Forest (cvu database). Its importance for wildlife species, biodiversity and aesthetics is disproportionately large compared to the small amount of land it occurs on. On the Bighorn NF, aspen occurs in small stands which range in size from a few trees to a few acres (Bornong, personal observation).

Table D1 shows the distribution of aspen forests across land ownerships in the Bighorn Mountain subsection. The Bighorn National Forest manages a fairly small portion of the aspen forests in this subsection. This is GAP data, and does not match acres with the CVU cover type data, but the percentage by ownership is the important piece of this table.

Table D1. Aspen Cover Type Landownership - Big Horn Mountain Section



The distribution of aspen across the Big Horn Mountains is less dependant upon elevation or substrate than most of the other tree species. The primary variable affecting the distribution is moisture availability, that aspen typically occurs where there is a seep, or low wet area. Knight (1994) cites Kaufmann (1985), who observed that adult aspen uses considerably less water per unit leaf area than lodgepole pine, subalpine fir, and Engelmann spruce. The general restriction of aspen to moist areas is probably due to the intolerance of aspen seedlings to drought, not the intolerance of mature trees (Knight, 1994).

It is suspected that aspen is declining in the Bighorn Mountains, based on observational evidence in the Bighorn National Forest (Bornong, 1996), and research from elsewhere in the Rocky Mountains (Meyer and Knight, 2001). This decline could be due to one or more of the following reasons:

- There is evidence of “long-term” climatic changes that could be influencing aspen:
    - The Wisconsin glacial advance occurred from about 15,000 to 10,000 years ago. During that time period, the Bighorn Mountains were glaciated, barren or tundra; the surrounding basins were dominated by spruce-fir forests (G. Beauvais, personal communication).
    - Recent unpublished research in the Bighorn Mountains indicates that Ponderosa Pine arrived about 1800 years ago in this section, and that Utah Juniper also arrived in this section relatively recently (C. Regan, personal communication). These warm, dry species could be bio-indicators of a warmer, dryer climate, which could also be evidenced by the decline of aspen.
- There is also evidence of shorter term climatic change that could be affecting aspen. Meyer and Knight (2001) cite Fastie, et al in preparation, who documented from treeline chronologies that since 1900 the average temperature near Powder River Pass has been above average.
- There is some suspicion that disturbance processes could also be affecting aspen regeneration:
    - While livestock grazing levels have declined since the turn of the century, the combined livestock and wildlife grazing/browsing intensities are thought to be higher than the level of historic grazing/browsing, which probably affects the success of aspen regeneration on the Bighorn.
    - While it is unclear whether or not fire suppression activities in the subalpine forests of the Rocky Mountains have actually changed the fire disturbance pattern, it is possible that a decline of regeneration inducing disturbances could be playing a role (Romme, et al 2000 in Knight et al fragmentation, 2000).

While it appears that the aspen on the Bighorn Mountains is generally not in a healthy, vigorous condition with a naturally reproducing variety of structural stages, Knight (2001) challenges the “conventional wisdom” that aspen is declining by offering the following observations:

- Widespread disturbances caused by fires in the late 1800s may have enabled aspen to become unusually abundant, and we may be observing a “natural” fluctuation.
- Although aspen shoots are relatively short-lived, the plant itself could be thousands of years old; aspen may live longer than any other tree.
- Seedling establishment is rarely encountered, but only a few successful seedlings are necessary to maintain populations of such long-lived plants.
- The climate appears to be drying and warming, but because of aspen’s long term success as a species, aspen clones must have survived many such episodes of climate change.

Table 2 is a cursory sustainability analysis for aspen, assuming various “rotation” ages. This analysis gives some guidance as to how much aspen regeneration could be conducted on an annual basis.

Table 2. Sustainability analysis for Bighorn NF aspen given various rotation ages

Rotation Age	Total Acres Aspen Cover Types	Limit to Annual Regeneration for Aspen Cover Types	Total Acres of All Aspen	Limit to Annual Regeneration for all Aspen
100	11,358	114 acres	14,953	150 acres
125	11,358	91 acres	14,953	120 acres
150	11,358	76 acres	14,953	100 acres

Table 3 summarizes the CVU database information for aspen on the Bighorn NF. There are 11,358 acres of aspen cover type on the Bighorn database. There are at least 3625 additional acres of aspen in 626 other forested polygons, for an approximate total of 14,983 acres of aspen on the Bighorn National Forest.

Table 3. Summary of CVU database information for Aspen on Bighorn National Forest

Polygons where aspen is the dominant cover type					
	No. polygons	**Average Acres**	**Total Acres**	**Avg. Cover Pct.**	
Aspen	360	31.55	11,358	50	
Polygons where aspen is the 2nd or 3rd most dominant cover type					
		Avg. Aspen Acres	**Sum Aspen Acres**	**Sum Acres**	**% Aspen**
Potr	4	2.75	11	86	7.8
PienPotrxxxx	27	3.52	95	786	8.3
PienAblaPotr	17	4.18	71	737	10.4
PienPicoPotr	30	5.97	179	1587	8.9
PicoPotrxxxx	269	6.5	1748	20717	11.9
PicoPipoPotr	15	9.13	137	1810	13.2
PicoPsmePotr	6	2.67	16	159	9.9
PicoPienPotr	82	5.83	478	9011	18.9
AblaPotr	9	4.89	44	406	9.2
PsmePotrxxxx	67	4.94	331	2830	8.5
PsmePipoPotr	11	5.09	56	667	11.9
PsmePiflPotr	11	2.09	23	394	17.1
PsmePicoPotr	3	3	9	139	15.4
PsmePienPotr	14	2.5	35	594	17.0
PopulPotr	4	10.75	43	343	8.0
PipoPotrxxxx	25	6.8	170	2036	12.0
PipoPsmePotr	10	5.5	55	616	11.2
PipoPicoPotr	11	6	66	825	12.5
PipoPiflPotr	2	9.5	19	390	20.5
PiflPotrxxxx	5	5	25	270	10.8
PiflPsmePotr	4	3.5	14	214	15.3

Only one habitat type for aspen was recognized by Hoffman and Alexander (1976):

Hoffman and Alexander (1976) Habitat Type	P. tremuloides	Other important species
P. tremuloides/Lupinus argenteus	C	*Fragaria viginiana, Lupinus argenteus, Poa nervosa, Agropyron spicatum, Carex platylepis, C. scopulorum, Festuca idahoensis, Hesperochloa kingii, Achillea millefolium, Astragalus alpinus, Anemone multifida, Lupinus wyethii, Taraxacum officinale,Trifolium spp., Juniperus communis, Ribes lacustre, Potentilla fruticosa, Phleum pratense, Dactylis glomerata.*

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

Where other species do not become established, aspen persists as a climax community, with sprouts replacing the older stems as they senesce (Knight, 1994). Aspen is seral to lodgepole pine or more often, Engelmann spruce or subalpine fir.

About 60% of the existing aspen on the Bighorn National Forest occurs on granitic substrates, compared to 40% that occurs on sedimentary substrates.

Observations on existing aspen stands in the Bighorn National Forest indicate that the overall amount of aspen is declining, and there is less natural regeneration occurring than one would expect. The discussion on page 1 speculates on some reasons why this might be. Meyer and Knight (2001) do not speculate whether this condition is in or out of the HRV due to the small amount of aspen existing and conflicting research on the status of aspen compared to HRV.

STRUCTURE AND FUNCTION

Knight (1994) discusses the distribution of aspen related to nutrient and productivity considerations:

> "Aspen is unique because it is the only upland deciduous tree in Wyoming that grows in an environment that would seem to favor evergreen plants. The loss of all leaves each fall is not particularly efficient with regard to nutrient conservation, and this may partially explain why aspen seems restricted to depressions and other sites where nutrient availability is not a problem. As with conifers, aspen

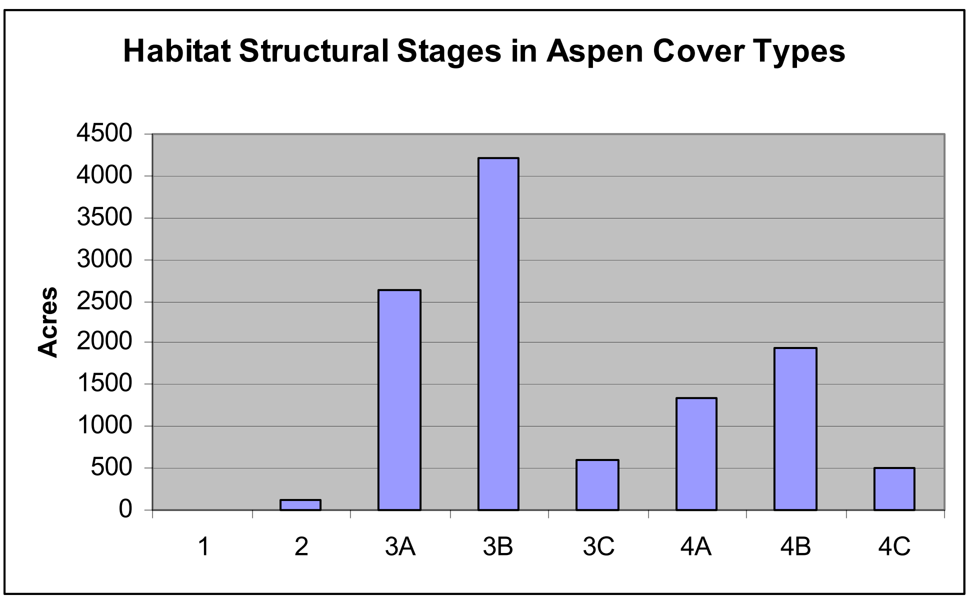
> twigs are probably capable of reabsorbing nutrients from the leaves, another mechanism for nutrient conservation. And although aspen loses its leaves in the fall, there is chorophyll in the bark."

Lupinus argenteus is listed as the dominant understory species in the habitat type cited above (Hoffman and Alexander, 1976). The fact that this plant fixes atmospheric nitrogen into a form available for plants may account for the supposition that fixation rates may be higher in aspen forests than other forest cover types (Knight, 1994).

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

Table 4. Aspen Cover Type Wildlife Habitat Structural Stages in the Big Horn Mountains



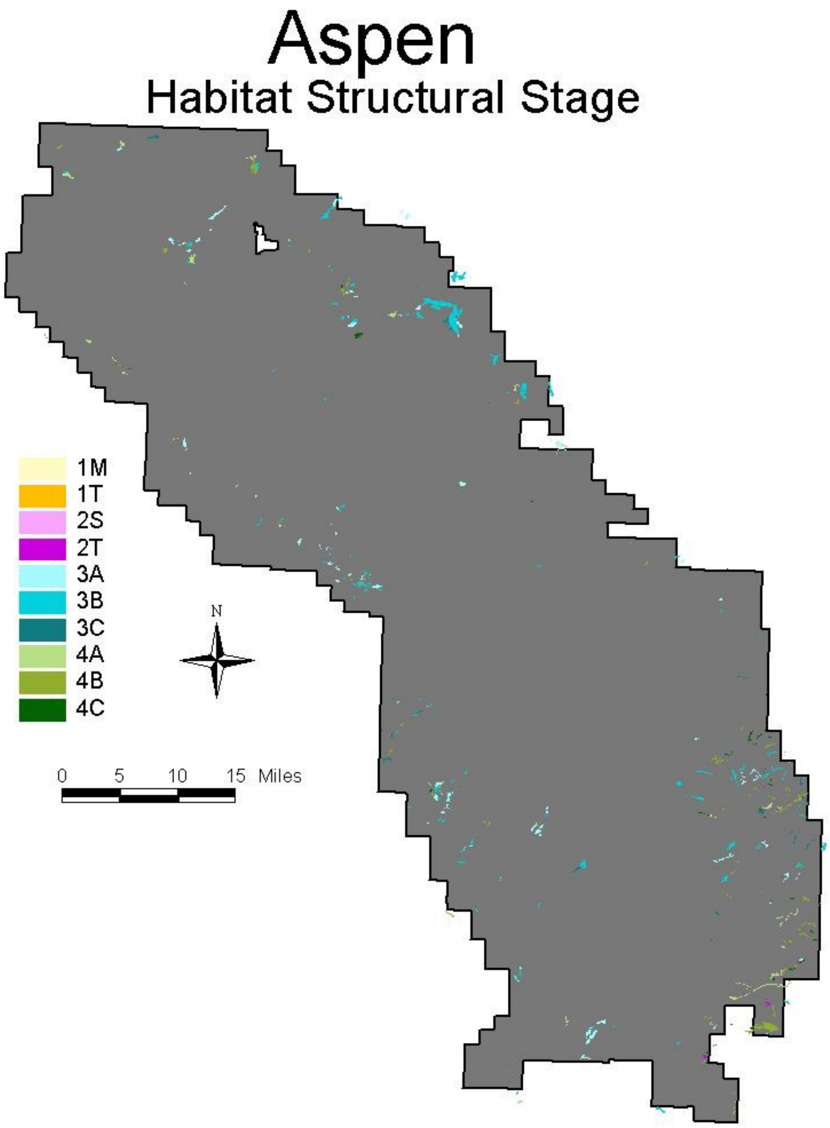
Data from Bighorn NF CVU database, 11/01. Includes all lands covered by CVU database.

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 4. 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 5.

Table 5. 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%

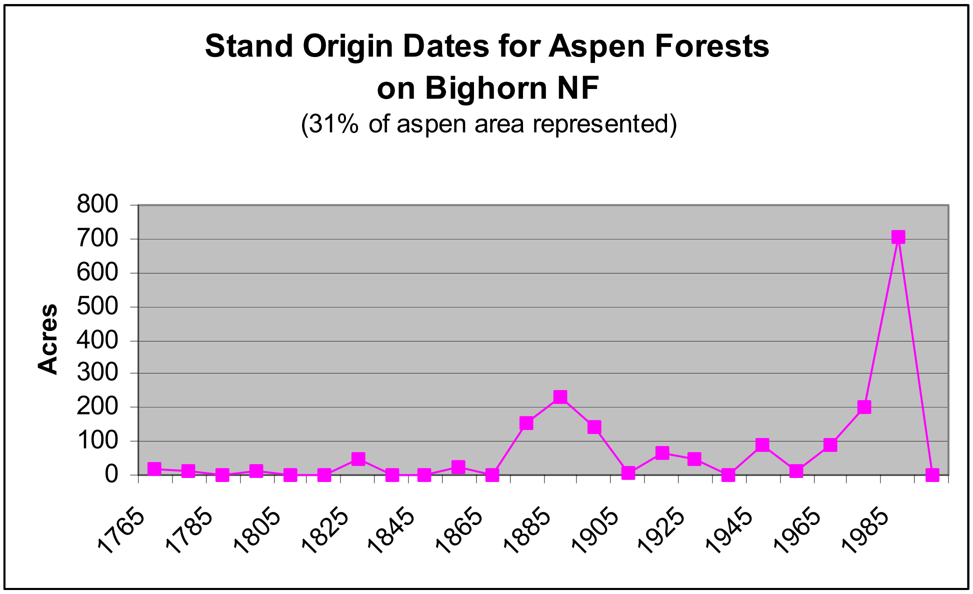
The following map shows the distribution of aspen by habitat structural stage for the Bighorn National Forest. The map also shows the small size of the aspen clones.



Typcially, aspen snags are small, since aspen rarely exceeds 15" dbh in the Big Horn mountains. They do not last over about a decade, as they rot within a decade and fall down. Most aspen stands over about 50 years old have snags, however, because of the large number of fungi, including *Cytospora chrysosperma*, *Ceratocystis fimbriata*, and *Cryptosphaeria populina* that affect aspen.

Table 6 shows the stand origin dates for aspen forests on the Bighorn National Forest. The origin date pattern for aspen is quite different than the other forest species, as there is a very low percentage of stands over 100 years old. This is due to the fact that this data is skewed as aspen is oftentimes not sampled during Stage II intensive forest inventory projects, while the more recent origin dates are relatively over represented since data was entered following regeneration treatments over the past few decades. However, we do know that aspen is a short lived species, with the average life span about 125 years, although trees to 160 years are known (Mehl, 1992).

Table 6. Stand Origin Dates for Aspen Forests on the Bighorn National Forest



While some argue that old-growth aspen does not exist, it is helpful to think about what old aspen stands look like. There is a higher proportion of dead stems, there may be aspen sprouts in the understory of the stand, or in more dense clusters along one or more edges of the clone. Most stands would include Engelmann spruce, subalpine fir or lodgepole saplings or pole-sized trees. Aspen boles would be present on the ground.

The aspen in the Big Horn Mountain section is naturally patchy, occurring in clones of up to a few acres. This is at least partially explained by aspen's regeneration method, which is almost entirely from root sprouts, or "suckering". Although aspen seeds are generally prolific, seedling establishment is rare because the conditions required for seedling establishment are rarely encountered (Knight, 1994). Almost every aspen clone has an abrupt edge with either a grassland/sagebrush or conifer forest cover type.

Most of the aspen clones on the Big Horn Mountains are so small that it is difficult to think of much vertical structure. However, there is a range, from single story, pure aspen, to multi-story. The multi-storied stands can be caused by either multiple aspen layers, which are usually spatially explicit within the clone, or caused by "encroaching" conifers, which are typically mixed throughout the aspen clone.

Domestic livestock has browsed aspen since they were introduced in the Big Horn mountains, particularly heavily prior to the establishment of the Forest Reserves. "Wherever the Quaking Aspen (*Populus tremuloides*) occurs on the ground that has been overstocked or where other food is not abundant all foliage within reach is generally stripped from the plants and young shoots are browsed." (Jack, 1900)

Browsing by wildlife and domestic livestock, potential climate changes (discussed on page 1), and interruption of the historic fire regime are the primary suspects in the apparent loss of vigor and amount of aspen existing on the Bighorn.

Table 6 provides an indication of the amount of aspen regeneration treatments that have occurred over the past few decades. Most of the 700 acres regenerated was by mechanical clear-felling. Different protection measures following the clear-felling have been employed, including fencing, jack-strawing the downed logs, and nothing. The causes of regeneration success or failure is not readily apparent, as Forest monitoring indicates that sometimes it works and sometimes it doesn’t (Harold Golden, personnal communication).

Monitoring of the 1988 Lost Fire area indicates that conditions in July 1988 were sufficient to burn the aspen clones at the edge of the lodgepole forest, and that regeneration was good.