Aspen Regeneration in South-Central Colorado, San Isabel National Forest

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Abstract—*The potential for aspen regeneration in conifer stands has been underestimated on the Salida Ranger District. Harvest of mature aspen stands on the Salida and San Carlos Districts encouraged regeneration. Following harvest, the Douglas-fir and some Engelmann spruce stands in the Arkansas Hills area regenerated primarily to aspen. Disturbance through aspen harvest, prescribed fire, wildfire, and other approaches is critical to aspen sustainability and health for the San Isabel National Forest. Disturbance must take place to regenerate the aspen component and reduce the conifer invasion.*

Introduction

Quaking aspen (*Populus tremuloides*) covers about 80,450 acres of the San Isabel National Forest's Salida and San Carlos Ranger Districts in south-central Colorado (figure 1). Although aspen is present in many conifer sites throughout the San Isabel National Forest, aspen occupies only about 10% of the two ranger districts. The potential for aspen regeneration in conifer stands (i.e., Douglas-fir) has been underestimated on the Salida Ranger District. Disturbance through aspen harvest, prescribed fire, wildfire, and other approaches is critical to aspen sustainability and health for the San Isabel National Forest. About 13,320 acres of aspen are suitable sites for harvest (figure 2).

In the past, the public and small purchasers on the San Isabel have primarily harvested aspen for fuelwood. Only recently has there been an increased demand for aspen fiber. This is due to a decrease in local supply that results in purchasers having to haul longer distances to meet their current demand. The majority of aspen could be utilized by mills found in Delta and Olathe, Colorado. These mills produce aspen flakeboard and panels.

Aspen is highly valued for its scenic beauty. In south-central Colorado, it is found at elevations ranging from 8,200 to over 10,000 feet (Powell 1988). In the fall, usually mid to late September, many visitors come to view the vibrant colors of yellow, gold, orange, and red. People seek out the aspen to take pictures, stopping along the roadside to view it. Some want to write about it, others want to take in this slice of Colorado and enjoy it. Aspen has many other values such as enhancing wildlife habitat and providing forage for cattle. It also has an ecological value for forest health and diversity.

Aspen is an unusual tree species. On the one hand, aspen stems are among the shortest lived in the area and usually die before their first century. On the other hand, aspen clones are often among the longest-lived individuals in an area, tenaciously holding to a site and living through many regenerating events, to maximum ages of centuries or even millennia (Johnston 1996).

Aspen is one of the most shade-intolerant species in the Rockies (Shepperd 1985). Most stands in the Rockies reproduce by root suckering after a disturbance to existing overstory stands (DeByle and Winokur 1985). This is also true of treated aspen stands throughout the Salida and San Carlos Districts of the San Isabel National Forests.

[1]Pike and San Isabel National Forests, USDA Forest Service, Pueblo, CO.

Figure 1—Aspen landscape on the San Isabel National Forest.

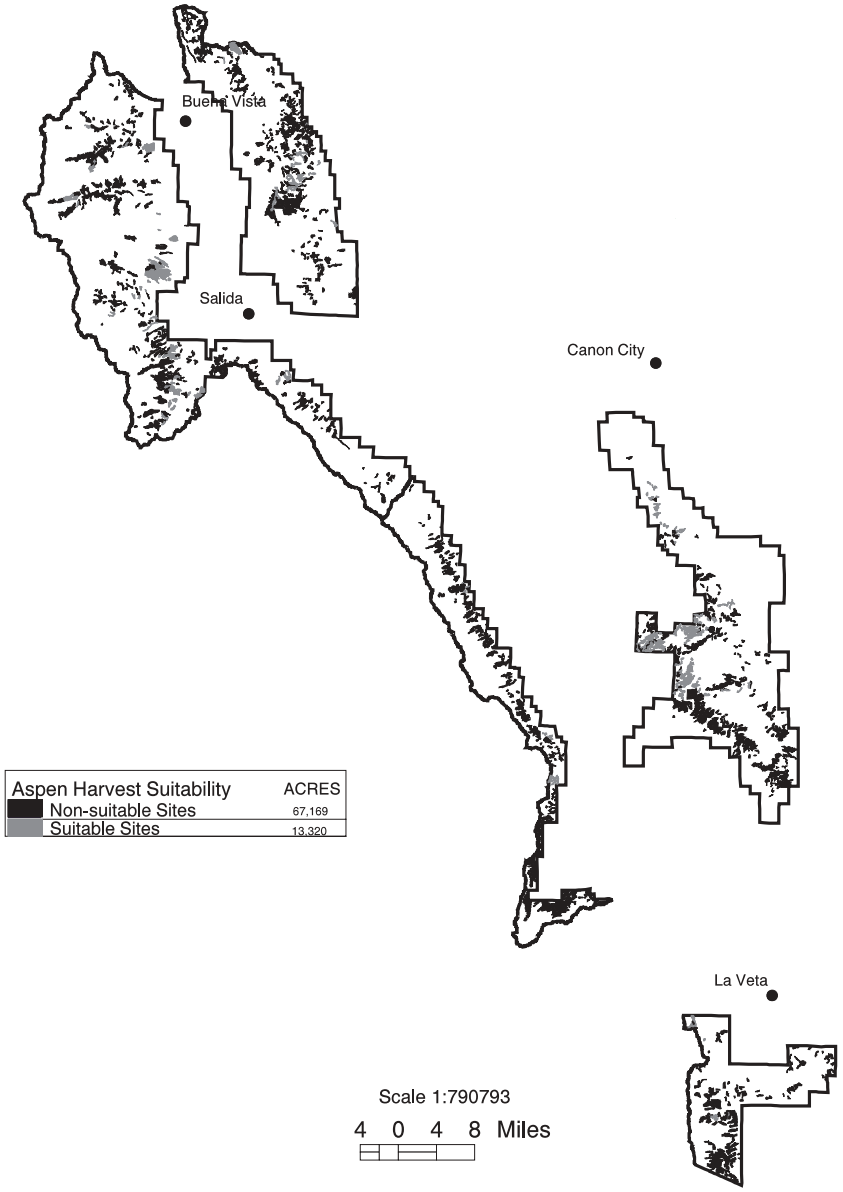

Figure 2—Suitable and nonsuitable sites for aspen harvest on the San Carlos and Salida Ranger Districts, San Isabel National Forest.

Regeneration Data

Treated aspen sites were queried from the Region 2 Resource Information System (R2RIS) and site folders reviewed from 1980 to 1997 for the Salida and San Carlos Districts, as this is where the majority of the aspen sites reside on the San Isabel National Forest. These data and associated information are summarized in appendix 1, which lists the most current regeneration survey, stems per acre, and other key data. The regeneration surveys consisted of walk-throughs that sampled representative regeneration or systematic sampling of the site with fixed plots ($1/100^{th}$ or $1/300^{th}$ acre), generally 1 plot per acre for the site. For example, if you had a 20-acre site, crews would sample 20 plots of the site in a general grid of three chains by three chains.

Salida Ranger District Aspen

Appendix 1 illustrates 13 aspen clearcuts varying in size from 11 to 45 acres. There were some small patch cuts varying in size from 2 to 5 acres. The aspen cover types greater than 11 acres seemed to regenerate well. The number of stems/acre ranged from 800 to 9,000, generally in the fifth year following harvest (figure 3). The median for stems/acre is 2,400. The small patch cuts appeared to regenerate (on some patch cuts upward to 2,000 stems/acre from earlier regeneration surveys); but over time, due to repetitive big game and cattle damage and other reasons not known, they failed to survive.

The average stocking percentage for the 13 aspen sites clearcut is at 90% of minimum stocking and distribution. The Forest Plan states a minimum stocking of 300 trees/acre and 75% of the plots are stocked. However, one of those sites regenerated mainly into conifer. The elevation ranges are 9,400 to 9,800 feet. Aspect did not limit regeneration. All aspen types that were clearcut averaged 21 acres. The average heights of aspen 3 to 5 years after harvest ranged from 1 to 5 feet with the majority of sites being 3 feet. There was no site preparation on any of these sites indicated in the records.

The treatment or disturbance from cutting encouraged the regeneration of the mature aspen stands that were harvested. When movement of auxin into roots is halted or reduced by cutting, burning, girdling, or defoliation of trees, auxin levels in the roots decline rapidly (Eliasson 1971, 1972). This permits new

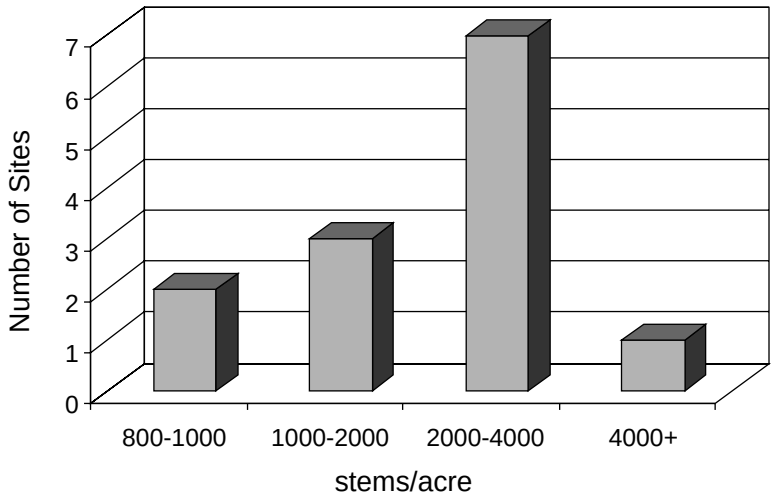

Figure 3—Summarized regenerated stems/acre for 12 aspen sites harvested from 1984 to 1991, Salida Ranger District, San Isabel National Forest. (One stand regenerated to conifer and was not included in the graph.)

suckers to begin; it also allows preexisting primordial, buds, and shoots whose growth had been suppressed by auxin to initiate growth (DeByle and Winokur 1985).

Aspen Regeneration in Conifer Stands

Following harvest, the Douglas-fir and some Engelmann spruce stands in the Arkansas Hills area (East Salida District—Kaufman Ridge, Herring and Bald Mountain) regenerated primarily to aspen (appendix 2). This was found quite unexpectedly in the Herring Timber Sale area when units planted to conifers began sprouting aspen. However, in the original planning this was not apparent. There was an existing aspen root system or remnant aspen scattered throughout these conifer sites that consisted mainly of Douglas-fir in the Kaufman Ridge area. Individual genotypes can cover several hectares and ramet generations may persist over 150 years (Shepperd 1981). The Herring Creek area was primarily Douglas-fir with a lodgepole pine component on three sites. When these conifer stands were harvested, these areas sprouted in aspen. Regeneration surveys showed mainly aspen regeneration with some conifer reproduction (appendix 3). The stems/acre varied from 855 to 2,550 mainly on level ground or northern aspects. This was 4 years after harvest. In the Kaufman Ridge area, aspen stems/acre ranged from 652 to 1,233 with heights of 1 to 3 feet. In 1998, aspen had grown to 6 feet plus.

According to research in Colorado of eight plant species studied, Berndt and Gibbons (1958) found quaking aspen roots to have the greatest lateral extent, up to 48 feet from the tree. Also, several studies of soil water depletion by aspen imply effective rooting depth to be at least 9 feet on deep well-drained soils (Johnston 1970; Johnston et al. 1969). The scattered aboveground aspen and the existing root systems were present for quite some time in the Kaufman Ridge and Herring areas, and the harvest disturbance caused the aspen to sprout.

It is theorized that during past succession cycles, an aspen stand was ultimately replaced by Douglas-fir in these areas. If a coniferous seed source is present, young conifers will soon begin to establish themselves under aspen (Shepperd 1985). The aspen acts as a nurse for the more tolerant conifers (usually spruce, subalpine fir, or Douglas-fir, but in some cases ponderosa pine and lodgepole), resulting in a mixed aspen/conifer stand (Shepperd 1985).

Wildland and Prescribed Fire

Possibly in the 1800s, prolonged drought conditions encouraged wildfire that created sufficient disturbance to conifer stands and as a result aspen sprouted. Perhaps this succession cycle continued for a long period. Another possible source of ignition for fires were human caused (i.e., Native Americans using fire to improve area for big game). Even a mere scattering of aspen in a coniferous stand commonly will restock the area with a new aspen forest after a severe wildfire (DeByle and Winokur 1985).

There were 59 fires recorded from 1970 to 1992 on the east side of the Salida District (figure 4). Thirty-one of these fires were fires less than ¼ acre. These small fires comprised the majority of fires. The policy during this timeframe was to suppress fires as soon as they were reported. Most fires were kept small due to suppression efforts. Typically, unless there is a very dry year associated with

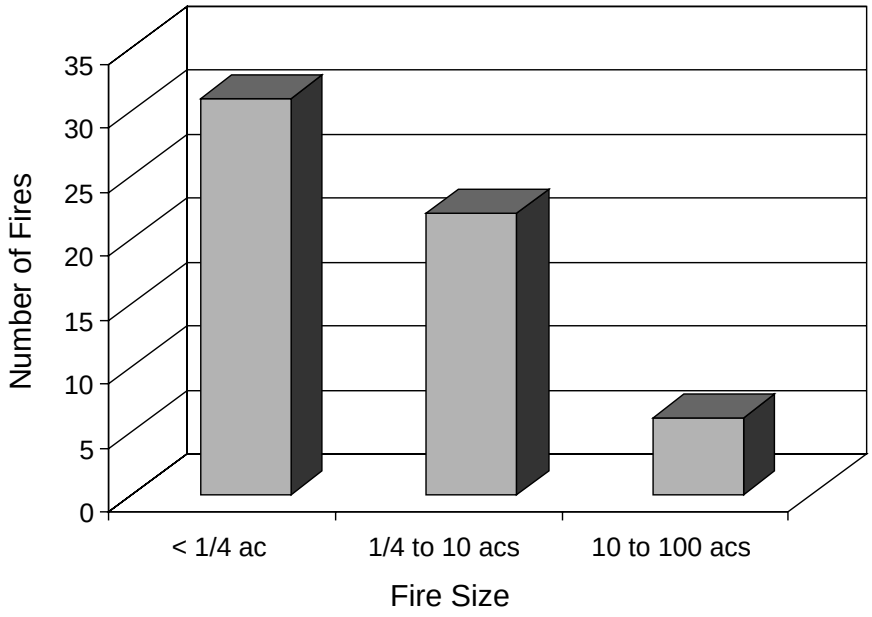

Figure 4—Fire frequency from 1970 to 1992 for the East Side of Salida District, San Isabel National Forest.

high winds, most fires stay small. The typical fire season is from mid-April to early/mid July. Most of the lightning in this time frame is late June to early July followed by monsoon rains around the Fourth of July.

Lightning was the main cause (83%) with the remainder human caused (17%)(table 1). One could surmise that lightning-caused fires in the 1800s (prior to suppression efforts) along with other causes that created disturbance quite possibly regenerated aspen.

There were only six of the 59 fires between 10 and 100 acres. Although this is not a long period, it does indicate that in a 22-year timeframe fires have not grown to large size. This would show a minimal disturbance from wildland fire. This could be attributed to the aggressive program to put out fires, lack of fuel continuity, and green vegetation.

The Bald Mountain Prescribed Burn also regenerated aspen (appendix 2). This was observed 2 to 3 years after treatment in an aspen patch that had sprouted and grown very dense. Most prescribed burns in the aspen type are designed to regenerate declining, overmature clones. To maximize sprouting, at least 80% of the overstory should be killed (Powell 1988). Research indicates that fires with flame lengths of 1.7 to 2.1 feet are required to kill aspen trees. This equates to fireline intensities of 18 to 28 BTU/ft/sec (Brown and Simmerman 1986). To achieve this intensity in aspen community types with undergrowths dominated by shrubs or tall forbs, the herbaceous vegetation should be at least 50% cured (Brown and Simmerman 1986). A good burning window to create a high burning intensity in aspen sites is immediately after leaves have fallen in September and before leaves are compacted.

Table 1—Fire cause summary (1970–1992, east side Salida District).

Cause	Fire occurrence	Percentage
Lightning	48	83
Campfires	8	14
Smoking	2	3

Source: GIS fire history maps.

San Carlos District Aspen

The San Carlos District has aspen intermixed in the conifer stands throughout the district. In one instance a unit in the Little Froze Timber Sale (located in the Wet Mountains) regenerated 500+ stems/acre on a conifer site after being harvested. Aspen sites throughout the district are experiencing a conifer invasion. Generally, there has been a lack of disturbance. From the R2RIS records, only 172 acres of aspen have been treated since 1986. It has been observed that aspen encroachment is occurring in natural meadows as aspen crowd the edge and tiers of different age classes (Mike Smith, personal communication).

The Forest Plan (Land and Resource Management Plan, Pike and San Isabel National Forests, Comanche and Cimarron National Grasslands) states that wildfire has historically been the primary disturbance initiating aspen root sprouting. Control of wildfire has permitted many aspen stands to become overmature with little success in regenerating. In the absence of disturbance, either natural or human caused, much of the aspen will convert to conifer types in 100 to 200 years.

Management Recommendations

It is clear that to sustain healthy aspen on the San Isabel National Forest, disturbance/management must take place to regenerate the aspen component and reduce the conifer invasion. Here are some recommendations:

- Manage aspen sites at a minimum of 8 to 10+ acres. Small patches seem to be vulnerable to big game or cattle damage. Consider treatments scattered over a large landscape.
- In areas where access is limited or does not exist, consider prescribed burning to meet resource goals and objectives. It is critical to burn at an intensity to kill a majority of the overstory to obtain regeneration.
- Explore market opportunities to encourage future aspen treatment.
- Aspen management does not need site preparation to regenerate aspen. This will serve as a reduced cost when considering other conifer species that will require site preparation.
- Consider conifer sites (i.e., Douglas-fir) with an aspen remnant or root system that will sprout/regenerate after disturbance (prescribed fire or cutting). Some indicators of aspen presence are: downed aspen from past years, occasional live standing aspen, and adjacent aspen stands.
- Consider wildland fire use and integrated fire planning through an approved Fire Management Plan. This examines the appropriate management responses to a management area. In some areas “fire breaks” of pure aspen are being considered so that a catastrophic fire could stopped much easier by running into pure aspen.

- Look at boundaryless management through agreements and memorandums of understanding between state and federal agencies to treat the landscape.

Aspen sites throughout the San Isabel National Forest need further management due to lack of disturbance. Treatment and care of this important species is critical to continued scenic beauty, forest health/diversity, wildlife, range and forest management, and sustainability of our forest for future generations.

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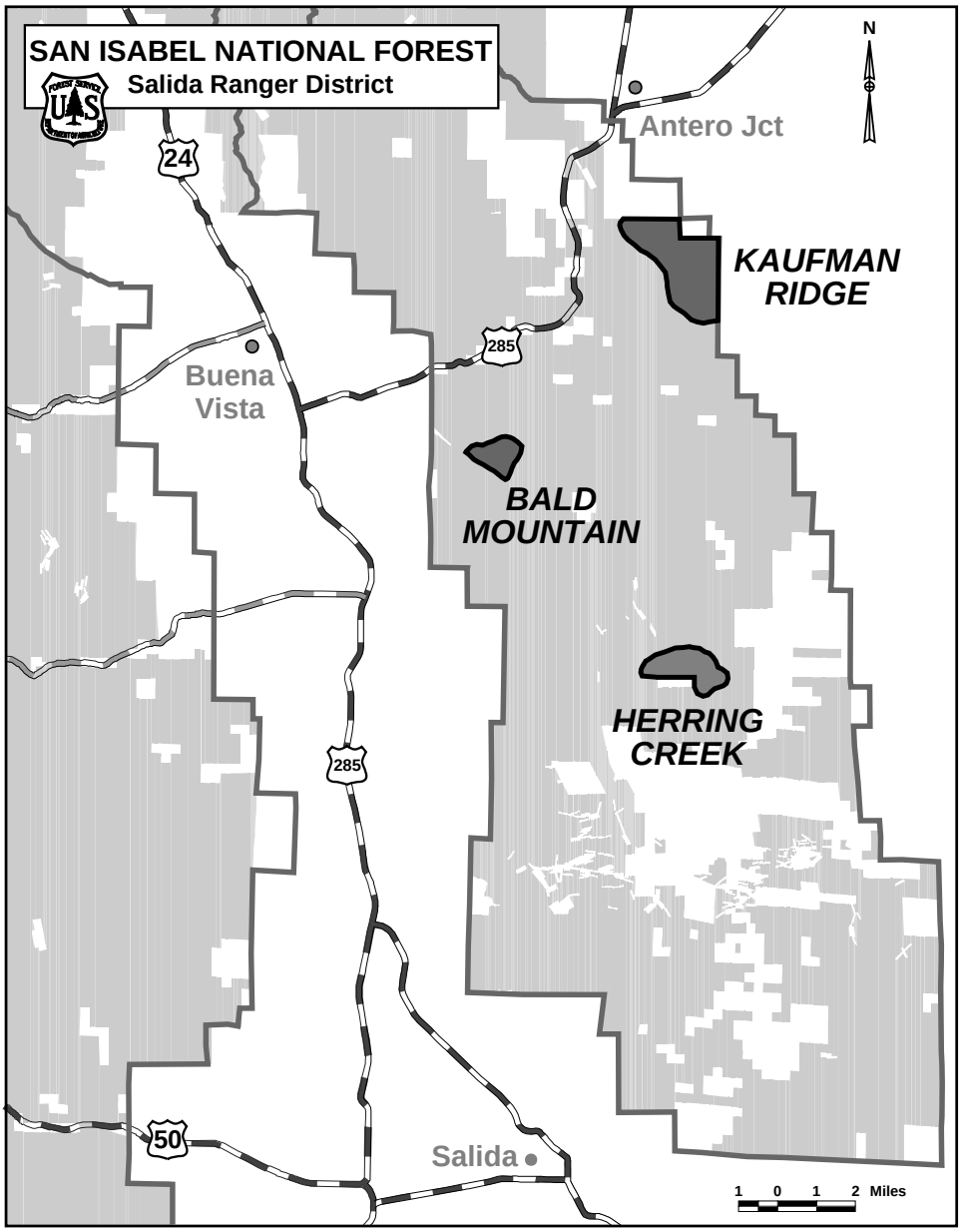
Appendix 1: Regeneration Surveys of Treated Aspen Sites of the Salida District, San Isabel National Forest

Location and site	Acres	Plant assoc.	Elevation	Aspect	Harvest year	Regen. survey type and year[1]	# of stems/acre	% stocked and ave. height
			ft.					
101301-004	22	—	9,700	NE	1987	1996 P	2,086	100% 3 ft.
101301-014	45	—	9,900	NE	1984	1989 W	3,000–4,000	95% 4–5 ft.
101301-036	42	—	9,900	NE	1985–1986	1988 P	2,500+	100% 3–4 ft.
101301-043	17	—	9,700	NE	1986	1989 W	2,500+	100% 3.5 ft.
1013001-044	22	—	9,700	NE	1987	1992 W	4,000	90% 3–5 ft.
101405-0100	16 Thurberi	POTR-Festuca	9,800	N	1988	1992 W	2,400 patchy	50% 5 ft.
101405-0102	16 Thurberi	POTR-Festuca	9.800	Level	1989	1994 W	9,100	100%
101405-0105	11 Thurberi	POTR-Festuca	9,800	Level	1990	1993 P	1,782	100% 0.5 to 2 ft.
101405-0106	19 Thurberi	POTR-Festuca	9,800	Level	1991	1996 P	1,021	100% 3 ft.
101801-003 (11 acs)	4 (1–5 acre) patch cuts	—	9,400	Level	1978–1980	1992 W on the edge	0 Some aspen regen.	0%*
101806-008 (13 acs)	5 (1–4 acre) patch cuts	—	9,800	Level	1980–1981 for stocked site	1992 W and P aspen regen. on the edge	0 Some	0%*
101806-012	4 and 5 acre patch cuts(9)	—	9,600 9,500	Level Level and 1993, 5 acs	Approx. 1980, 4 acs 1996 W	1992 W 1,000 Mainly conifer	0 100%	0%*
102311-066	14 Thurberi	POTR-Festuca	9,500	Level	1989	1996 P	833	87% 2 ft.
102206-46	29	—	9,400	S	1983–1984	1989 P	3,300	88%
102206-047	22	—	9,400	S	1986	1990	800	100%
102206-048	11	—	9,500	E	1987	1992	1,264	63%

[1]P = Systematic sampling with plots and W = Walk-through.
*Big game and cattle damage, 101801-003 and 101806-008 showed earlier surveys with regeneration.

Appendix 2: General Locations of Aspen Regeneration in Conifer Stands



Appendix 3: Aspen Regeneration in Conifer Stands (Mainly Douglas-fir) of the East Salida Ranger District, San Isabel National Forest

Location and site	Acres	Plant assoc.	Elevation	Aspect	Harvestyear and method[1]	Regen. survey type and year[1]	# of stems/acre[2]	% stocked and ave. height
			ft.					
Herring Creek								
101405-107	9	PSME/ARUV JUCO	9,880	Level to E	1990 CC	1996	855 P	89% 2 ft.
101405-0108	26	PSME/ARUV JUCO	9,880	NE	1990 ST	1996	2,550 P	100% 3 ft.
101405-109	15	PSME/ARUV JUCO	9,880	N-NE	1990 CC	1996	1,353	93%
Kaufman Ridge								
101402-0097	38	PSME/JAAM	9,850	NE	1992 ST	1996	1,137 P	89% 1–3 ft.
101303-0067	23	PSME/JUCO	9,800	NE	1992 ST	1996	652 P	91% 3 ft.
101305-086	28	PSME/ARAD JUCO	9,700	NE	1992 ST	1996	1,233 P	92% 2–3 ft.
Beaver Creek								
102311-069	5	PIPU-PSME JUCO	9,100	NE	1993 CC	1996	350 P	100%
102311-070	43	PIEN/JUCO PICO/JUCO	9,360	NE	1993 ST	1996	440 P	91% 1–3 ft.

Note: The majority of the regeneration is aspen with some conifer intermixed.
[1]ST = Seed tree and CC = Clearcut.
[2]P = Systematic sampling with plots.