Aspen recruitment on the UP: why aren't there more young aspen?

-- Progress Report, December 2012 –

I. Overview of the Issue

The Uncompahgre Plateau is characterized by vast forests of aspen and aspen mixed with conifers. Very few locations on the upper Plateau lack aspen; aspen trees can be seen within a stone's throw of just about any spot. Forests are always changing, and the UP forests of the future will be different from those of the recent past for many reasons. One key concern is that the Plateau doesn't have enough young aspen trees to replace the older age classes; the trends of recent decades indicate a reduction in aspen abundance on the Plateau in coming years (Figure 1). The low numbers of younger trees could reflect the lack of large disturbances such as fires and logging in the past century, or other pressures such as intense browsing or increased competition with conifers. The Uncompahgre Partnership has developed several studies to gain insights on possible factors, as a first step towards sustaining high levels of aspen on the Plateau.

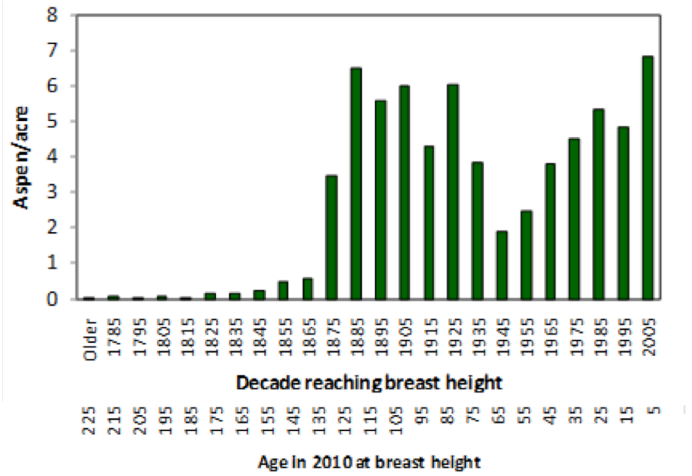


Figure 1. Most of the aspen trees on the Uncompahgre Plateau established more than 60 years ago. Many younger trees are present, but given a normal background mortality rate of about 15% each decade, there are not nearly enough young trees to "refill" the older ages classes in coming decades.. The Plateau will have far fewer aspen in the future unless recruitment of new stems increases substantially.

Aspen on the UP reproduce primarily by producing root suckers which have the potential to grow into new trees if conditions are right. One possible cause of low aspen regeneration could be simply a lack of aspen suckers (Table 1). Rapid growth of a sucker under sunny, open conditions typically leads to one or a few dominant leaders, and a transition from a shrub growth form to a tree-sized aspen stem. This rapid growth doesn't happen under the influence of three possible factors (Table 1). Aspen suckers may not develop beyond the multi-stemmed shrub growth form when browsers clip off stem leaders. Suckers might also remain in a shrub growth form if low resources (too much shade) prevent the rapid growth needed to produce single, dominant stems. Some scientists also expect the shrub form may be maintained by hormone (perhaps auxin) production by large, dominant aspen trees sharing the same root system as the shrub-form suckers.

To date we have been examining the first factor – browsing – in detail, and the second part of this report summarizes what we have learned so far. We have only some preliminary insights into the potential importance of the other two factors (Table 1), but those factors may warrant direct attention in coming seasons.

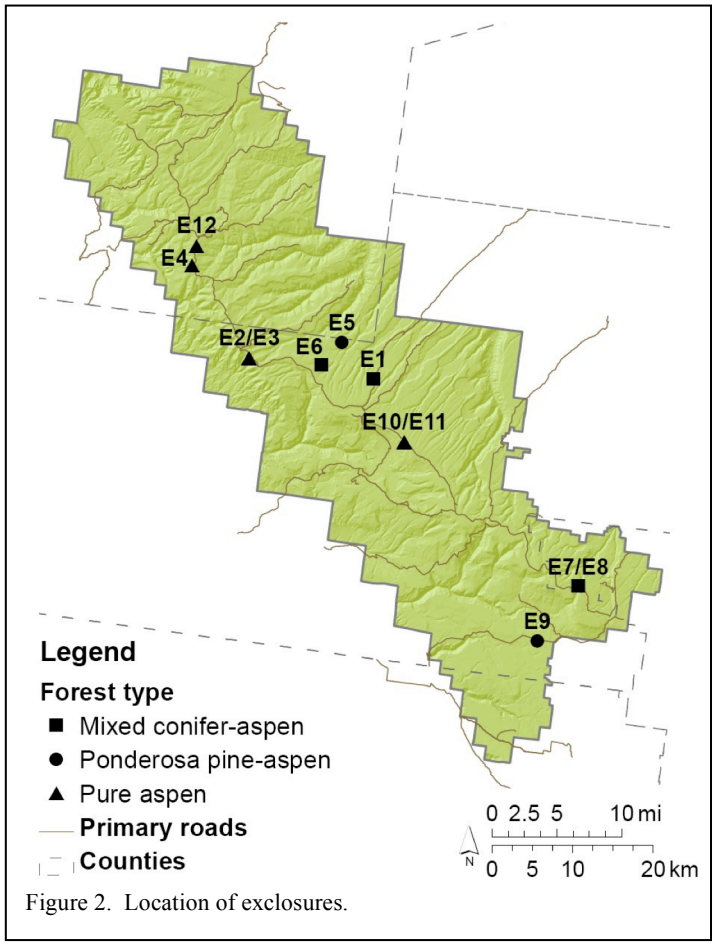


Figure 2. Location of exclosures.

II. Browsing studies and findings 2010-2012

Is ungulate browsing impairing or preventing aspen regeneration on the UP? This is the core question of our UP aspen study, and it actually involves three questions:

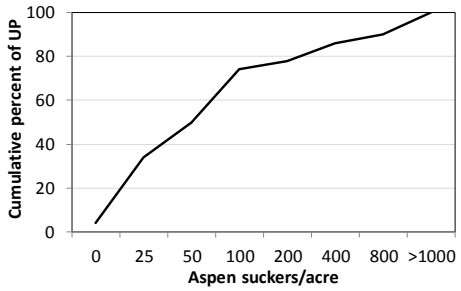
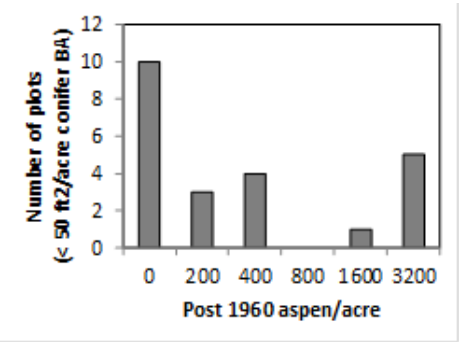
1. Is new aspen tree recruitment occurring? We define regeneration as recruitment of new tree-sized aspen stems into the canopy.

2. Where recruitment of new trees into the canopy is not occurring, what prevents recruitment?

3. How much variation is there for questions 1 and 2 around the Plateau, and across years of different precipitation?

We have conducted three kinds of studies to answer these questions. First, we built hard exclosures around aspen suckers and saplings, at 11 sites distributed across the UP within a variety of forest types and elevations. The hard exclosures are constructed of hog panels and exclude both wildlife (elk & deer) and livestock. Second, the USFS installed soft exclosures in close proximity to the hard exclosures at six of the 11 sites. The soft exclosures consist of low wire fences through which an electric current flows, and they exclude only livestock; deer and elk can easily jump the fences. Third, we tallied the density of aspen suckers and saplings, as well as browsing intensity on aspen stems < 6 feet tall, along a 300-m transect at each of the 11 hard exclosure sites. A soft exclosure also was established within a clearcut area adjacent to the WAPA powerline; however, this site has neither a hard exclosure nor an associated transect.

Table 1. Possible factors leading to low numbers of young aspen on the UP.

Factor	Why it might matter	Evidence as of 2012
Lack of aspen suckers	If the number of aspen suckers was low (e.g., from a lack of fire or harvesting, or suppression by adult aspen trees), this would limit the opportunity for young aspen trees, irrespective of other factors.	This is not apparently a problem; our Plateau-wide survey showed that about 65% of the Plateau had 25 suckers/acre or more, and 25% of the Plateau had 100 suckers/acre or more: 
Browsing	Aspen suckers are an important food source for livestock and many species of wildlife.	Exclosures and transects show that aspen browsing may be heavy enough to limit transition of aspen suckers into trees in some locations, but not all. We don't have enough information to map where browsing may or may not be important, but our best estimate would be that only about half, or less than half, of the Plateau has browsing intense enough to be a major factor in preventing aspen recruitment. Browsing by wildlife appears to be the major factor at one such site; browsing by livestock appears important at a second site; we don't yet know the relative importance of wildlife vs. livestock browsing at other sites. (The remainder of this report summarizes our findings to date on this topic.)
Increasing conifer competition	High basal area (BA) of conifers (in the absence of large disturbances) would be associated with low light and other resources needed for recruitment of young aspen trees.	This may be an important factor in some places. Across the UP, no sites had high densities (>100/acre) of post-1960 aspen if conifer BA was high (>80 ft^2/acre). High densities of post-1960 aspen were limited to conifer BA < 50 ft^2/acre; however, there was no direct relationship between conifer BA and aspen density at these lower levels of conifer BA, so other factors are also involved: 
Suppression by hormones	Adult aspen stems produce hormones that inhibit sucker production and growth	This is not apparently a problem: across the UP, neither the density of aspen suckers (< breast height) nor the density of post-1960 aspen tree recruitment, was related to local aspen BA. (If hormones were suppressing regeneration, we would expect consistently less regeneration with higher total aspen BA.)

The initial answers to the three questions appear to be:

(1) Is new aspen tree recruitment occurring?

The answer appears to be NO in six of our eleven sites, and YES in the remaining five sites (Table 2). The important conclusion here is that aspen regeneration is not being suppressed uniformly throughout the UP, but suppression is occurring locally, perhaps within particular environmental contexts.

(2) Where recruitment of new trees into the canopy is not occurring, what prevents recruitment?

Of the six sites where recruitment is poor, browsing clearly appears to be important in two sites (Table 2). However, other factors appear to limit the transition of aspen suckers into tree-size stems in the other four sites that lack recruitment. There also are four sites where browsing intensity is relatively high, yet recruitment of new aspen stems appears to be occurring

despite the browsing. Many aspen suckers appear stunted and bush-like, but recent browsing is not always responsible: we have observed many terminal leaders that were not browsed but had died from other (unknown) causes.

(3) How much variation is there for questions 1 and 2 around the Plateau, and across years of different precipitation?

We had anticipated greater browsing intensity in a dry year (2012) than in a wet year (2010). Browsing intensity at any given site did vary somewhat among years, but browsing was not consistently greater in 2012; in some sites browsing actually was less intense in 2012. It's clear that no single pattern characterizes very much of the UP; some areas show good aspen recruitment, some do not, and in many areas browsing does not appear to be a crucial factor limiting recruitment. We are not yet able to confidently predict where on the UP we will see a particular pattern of recruitment and browsing.

Table 2. Summary of aspen recruitment success, browsing intensity, and relative impact of wildlife & livestock at 12 intensively studied sites across the UP.

Location	Site Number	Forest Type	Is Recruitment Occurring ? [a]	Min & Max Recorded Browsing Intensity [b]	Is Browsing Impairing Recruitment? [c]	Relative Elk/Deer Impact [d]	Relative Cattle Impact [d]
Sanborn Park Road	E-9	Ponderosa-aspen	**No**	90 - 91	**Yes**	**High**	**Low**
Uncompahgre Butte	E-4	Pure aspen	**No**	86 - 100	**Yes**	unknown	unknown
Beautiful aspen stand - healthy	E-11	Pure aspen	**No**	35 - 35	**No**	--	--
Delta-Nucla Road	E-1	Mixed con-aspen	**No**	21 - 34	**No**	--	--
South Divide Road – open forest	E-7	Mixed con-aspen	**No**	17 - 33	**No**	--	--
Cottonwood Road	E-5	Ponderosa-aspen	**No**	7 - 15	**No**	--	--
Windy Point	E-2, E-3	Pure aspen	**Yes**	18 - 43	**Maybe**	unknown	unknown
Lockhart Road	E-6	Mixed con-aspen	**Yes**	30 - 62	**Maybe**	**Low** to **Moderate**	**Moderate** to **High**
South Divide Road – dense forest	E-8	Mixed con-aspen	**Yes**	25 - 45	**Maybe**	unknown	unknown
Northern Plateau	E-12	Pure aspen	**Yes**	62 - 62	**Yes**	unknown	unknown
WAPA Powerline	--	Mixed con-aspen CC	--	--	**Yes**	**Low**	**High**
Beautiful aspen stand - SAD	E-10	Pure aspen	**Yes**	9 - 31	**No**	--	--

[a] **Yes** if numerous 6-9 foot tall aspen saplings were recorded along transects in 2010; **No** if saplings were scarce or absent.

[b] Browsing intensity was measured at the 11 sites in October of 2010, 2011, and 2012. All aspen stems < 6 feet tall were tallied within six circular quadrats located at regular intervals along the 300-m transects. A stem was recorded as browsed if the apical bud had been removed from any terminal leader within the current year's growth in 2011 and 2012. In 2010, a stem was recorded as browsed if any apical bud had been removed from the current year's growth whether the bud was on a terminal leader or on a side shoot. The numbers in the table are percent of aspen stems that were browsed in the year of sampling. Browsing on previous year's growth was not recorded – only on the current year's growth.

[c] **Yes** if more than 40% of the stems < 6 feet tall lost one or more terminal leaders in all three years of sampling; **Maybe** if more than 40% of plants lost a terminal leader in one but not all three years of sampling; **No** if fewer than 40% of plants lost a terminal leader in all three years. Note that many shrub growth form aspen have multiple terminal leaders; these were recorded as browsed even if only one leader was lost.

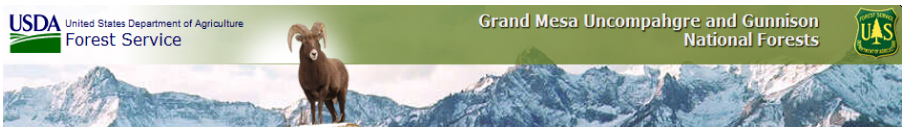
[d] If browsing by wildlife is having a greater impact on aspen recruitment, browsing intensity inside a soft exclosure (which excludes livestock only) would be similar to browsing intensity outside the soft exclosure; but if browsing by livestock is having a greater impact on aspen recruitment, browsing intensity would be substantially lower inside than outside the soft exclosure.

III. Possible Next Steps

Probably the surest way to ensure that high densities of aspen continue on the Plateau would be to have widespread fires or logging that regenerate aspen and remove the suppression of aspen regeneration by strong conifer dominance. In the absence of widespread events that start new stands, aspen recruitment could be increased in some (but not all) areas by reducing browsing pressure. The next step of deciding how browsing pressure might be managed will require better insights on a) where aspen recruitment is low, and b) whether low recruitment results from suppression by old aspen, by conifer dominance or by browsing.

If the collaborators would value stronger insights, we have six suggestions (in no particular order) for the collaborators to consider for future work:

1. Install more exclosures (both hard and soft) to gain better spatial information on where browsing inhibits aspen recruitment, paying attention to the presence of large aspen (that might suppress suckers) and degree of conifer dominance. Rather than a shotgun approach, we could target specific areas where modifications of browsing pressure might be envisioned by managers, and the new exclosures could be located to provide site-specific information on likely payoff of changes in browsing.
2. Re-measure the heights of aspen suckers and sprouts inside and outside the 11 hard exclosures that were constructed in 2010. If browsing is suppressing height growth, the protected suckers and saplings inside the hard exclosures (last measured in 2010) should be substantially taller in 2013. If they have not become much taller, then something other than browsing must be holding them down. If that something else is conifer competition, we would expect to see less height growth at those sites where local conifer basal area is greater; if hormone production by mature aspen is holding down the young trees, we would expect to see less height growth where local mature aspen basal area is greater.
3. Conduct new fieldwork to determine what is suppressing the transition from suckers to tree-sized aspen stems in the four intensive study sites where recruitment of new stems is not occurring and where browsing does not appear to be the major mechanism involved (this could also be done in similar places across the Plateau). For example, we could easily measure light intensity in places where new canopy trees are and are not present, and we might find thresholds that separate sites with high and low recruitment. We could also consider trenching experiments to test for hormonal suppression.
4. Look for opportunities to learn more about browsing impacts, including contribution of livestock and wildlife. This can be done by maintaining the current hard and soft exclosures, and also by having some pastures, or portions of pastures (at least a few acres in size) with little or no cattle grazing, along with small hard exclosures inside. We know there will be variation around the Plateau; this approach will help begin the process of understanding which local areas might benefit from shifts in management.
5. Design learning opportunities in restored areas, documenting aspen response to the mechanical treatments, to fire, and to browsing (some exclosures would be needed).
6. Utilize older exclosures established by Tim Garvey (>10 years ago) to document the longer-term impacts of browsing on aspen recruitment. We have visited some of these, and it appears that aspen densities and heights are generally greater inside exclosures, but that stocking and growth outside exclosures may be sufficient to regenerate the stand in at least some areas. Measurement of these exclosures would give a basis for solid conclusions.



This summary comes from the work of Attia Alsanousi, Ben Lowrance, Drew Derderian, Taylor Elm, Randy Walsh, Tim Garvey, Bill Romme, and Dan Binkley.
For more information, contact Dan (dan@cnr.colostate.edu) or Bill (william.romme@colostate.edu).

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