PANDO'S LESSONS: RESTORATION OF A GIANT ASPEN CLONE

WAA Brief #4: April 2017

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Overview
A 106 acre (43 ha) aspen clone lives in the Fishlake National Forest in south-central Utah. Clones are comprised of multiple aspen stems, called ramets, which are genetically identical. This particular colony of ramets was named "Pando" (Latin for "I spread") by researchers believing it to be the largest living organism on earth. Recently, forest managers have noted an accelerating rate of dying mature stems without recruitment of younger trees. This unsustainable situation has galvanized restoration efforts at Pando. Past management likely caused this imbalance; effective restoration will involve protection and a course reversal. As a laboratory, this forest icon may provide insights for much broader human-nature interactions.

Background

In the 1970s, researchers Kemperman and Barnes (1976) examined relationships between leaf physiology, clone size, and regional biogeography of quaking aspen. These scientists discovered a very large aspen clone near Fish Lake in south-central Utah. Based on leaf shape, color, and timing of senescence he described a genetically identical stand of aspen 106 acres (43 ha) in size. Later, biologist Michael Grant (1993) estimated the weight of this giant clone, including above and below ground mass, to be 13 million pounds (5.8 million kg) and gave it the name Pando. DeWoody et al. (2008) conducted systematic genetic work using modern microsatellite techniques and confirmed the area covered by Pando almost exactly as earlier researchers had mapped it based on physical traits 25 years prior. Unlike precise measures of size, there is not an accurate method for aging the entire Pando clone; it is certainly hundreds, possibly thousands, of years old. Tree coring places mature individual stems at 100-120 years.

Fig. 1 *Mule deer outside fence at Pando*

Concurrent with scientific measures of Pando's size, managers noted dying canopy trees and an absence of new recruits. While mature aspen commonly die-off, the cause of missing recruitment was crystalized when small clear-fell coppice harvests in the late 1980s resulted in complete loss of forest cover. All regeneration, which was initially abundant, was consumed by herbivores; most likely mule deer or cattle based on current scat counts. After a 1992 harvest operation eight foot (2.4 m) fencing was erected and the flush of regrowth survived. Unfortunately, the area fenced after disturbance was only a small portion of the total Pando clone. In the early 2000s, even casual observers were hard-pressed to find more than a handful of surviving young trees. This type of "stable" aspen is unlikely to experience catastrophic disturbance (see Rogers et al. 2014), which makes Pando more dependent on continuous recruitment to maintain long-term resilience. Meanwhile, during the 25 years since the clearfell-fence operation, a dense stand of 20-30 foot (6-9 m) tall saplings remain, whereas the bulk of Pando has experienced accelerating mortality of large trees. The vast majority of Pando, where not protected by fencing, is collapsing under the weight of rapid die-off without successful regeneration.

Experimental Restoration at Pando

In 2013, a 15 acre (6 ha) fenced area was installed at Pando to conduct experiments to better understand protection from herbivores alongside three treatments—burning, common juniper removal, selective tree cutting—known to stimulate vegetative (from root suckers) regeneration.

After three years we found a clear increase in new aspen suckers inside the fence (Fig. 2), whereas little change occurred in heavily browsed suckers outside. Moreover, stems progressed from primarily short regeneration in Year 1

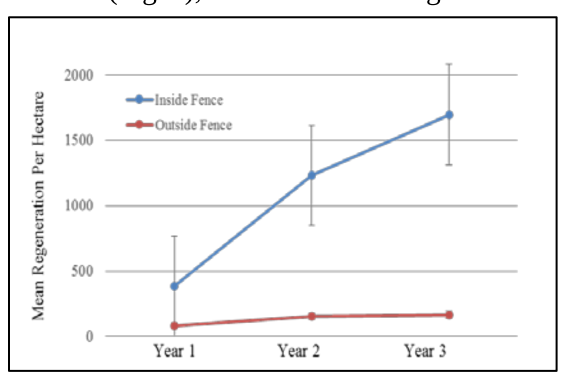

Fig. 2 *Aspen regeneration after three years of fencing*

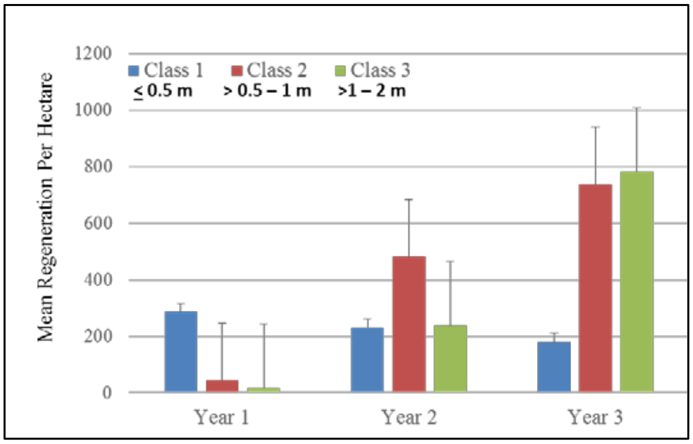

Fig. 3 *Regeneration change by height class over three years*

to much taller growth forms in Year 3 (Fig. 3). Many stems were reaching the height of 6 feet (2 m); considered safe from future browsing (with notable exceptions) and a hopeful sign that fencing may be cautiously removed in within a few years. Additional findings were that no treatments were found to be significantly better than others in terms of sucker production and all treatments combined resulted in better regeneration than fencing without treatment. Somewhat surprisingly, fencing alone did provide ample reproduction to replace the quickly dying aging stems (Fig 4).

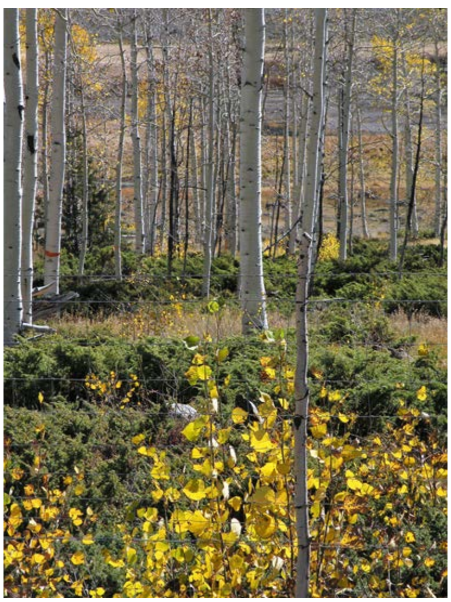

Fig. 4. Three *years post-fencing sustainable levels of regeneration were documented at the Pando clone*

Restoration activities to date show promising signs, however there is considerable work to be done. The experimental area entails less than a sixth of Pando's immense reach. Even at this relatively small scale, it is not clear that fencing is the ultimate answer to the difficulties of both domestic and wild ungulate herbivory. A solution that addresses these base causes of browser numbers and movement patterns, perhaps in combination with fencing, is expected to yield the most lasting positive results.

Management Recommendations

The lessons learned at Pando are instructive at larger scales, though there are obvious limitations to consider. Obstructing browsers from eating young aspen suckers using fencing is not economically feasible, even if it were desirable, at larger scales. Even where fencing is affordable, regular checking for breaches and making repairs is essential, though costly as well. Another consideration: interventions used here do not necessarily have natural analogs, however, the dire situation at Pando required immediate action in tandem with clear documentation of outcomes. A valuable lesson is, that where treatments are used to rejuvenate aspen subject to excess herbivory, it is essential have a plan for protection in place. At Pando, initial success was achieved with both active (treatment) and passive (fencing only) approaches. Before specific actions are taken a keen understanding of functional differences in aspen communities (Rogers et al. 2014) will provide a clear basis for management actions grounded in established science.

Solutions aimed at causal agents of aspen failure at Pando and elsewhere will involve state and federal cooperation in wildlife, forest, and range management, but likely a better understanding of social science and natural resource economics, as well. A clear research need is to more fully understand "sustainable" levels of herbivory for domestic and wild ungulates. An adaptive strategy—action, monitoring, adjustment—is likely to yield desirable and demonstrable endpoints for restoration at Pando and aspen at-large.

Key Findings:

1. At the Pando clone, we found that chronic herbivory was the overarching causal factor threating persistence of this iconic aspen community.
2. Findings suggest that protection from browsing ungulates are more important than actual treatments in terms of successful aspen recruitment.
3. While fencing to keep herbivores out provided a short-term recruitment window at Pando, similar situations at broader scales will require interdisciplinary solutions besides fencing to combat causes of non-sustainable browse levels.

Sources

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