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Pando Clone (World's Largest Living Organism?) History and Evaluation : Case Study for Revalidation

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Allen V. Henningson, Certified Silviculturist

Introduction and Background

My first exposure to the area where the Pando Clone exists came in 1988 when I started working on the Fishlake National Forest. The Loa Ranger District was in the process of implementing the Coots Slough Fuelwood Sale within the area. One to two acres had been cut in the area during 1987 and again in 1988. These areas were treated using the clearcut method, where all of the trees were cut by District crews using chainsaws. When I visited these area in the Fall of 1988 there were abundant aspen sprouts in both of these cutover areas.

Figure 1 – The Pando Clone can be seen in the center of the above picture. The 1992 cut is also visible.

Approximately fifteen acres were clearcut in the Spring of 1992. The May 6, 1992 issue of The Richfield Reaper ran an Editorial that in part read, "There's more to the forest than the trees. This week trees on one of the world's oldest known grove of quaking aspen trees were cut down by the U. S. Forest Service in the Fishlake National Forest." The editorial explained that the trees were along the highway leading into Fishlake and that the users of the area were shocked to see the treatment.

With the public's attention drawn to the area we needed to assure that the area would successfully regenerate to aspen. By 1992 the earlier cuts had lost most of the aspen sprouts that originally sprouted. The sprouts were heavily browsed mostly by deer. It was determined that

deer use the area as they travel to obtain water. An eight foot fence was constructed around the area during the Fall of 1992. The fence enabled the area to successfully regenerate to aspen.

Figure 2 – An aerial view of the Pando Clone. The 1987 cut with no trees is located in the lower right, the 1988 cut with no trees is located in the center and the 1992 cut with regeneration is just above the 1988 cut.

Figure 3 – Shows regeneration in the area cut in 1992.

Figure 4 – Taken shortly after the cutting in 1992.

The Pando Clone is located in Township 26 South, Range 1 East, Sections 24 and 25 about 1 mile southwest of the Lakeside Resort on State Highway 25 and about 1 mile due east of Mallard Bay at the southwest corner of Fish Lake (see map).

Mature trees in this clone are dying due to insects and disease and the regeneration outside the fenced area within the clone are not surviving. Of the treated areas, only the portion of the clone within the fenced area is showing healthy regeneration. The first two areas have experienced poor shoot survival due to herbivory, recreation use, and other factors.

The remainder of the clone outside of the three treated areas is primarily mature aspen trees with significant signs of mortality from insects and disease. The clone with the exception of the area cut over in 1992 contains few young trees (5 to 15 feet tall) to replace the old dying ones. The clone is no longer sustainable in its current condition and without management action is in danger of dying completely or becoming sharply reduced in size. The understory of the clone is comprised of common juniper and sage brush as well as a variety of shrubs, forbs and grasses.

The Pando Clone has a density of just over 400 stems per acre, or a total of around 43,000 stems within its 106 acre area (Discover, 1993). In order for regeneration to be successful without herbivory, researchers indicate that a few hundred to a few thousand aspen suckers per acre are needed. Then at 6-foot height, the desired condition would be to have 2,000-5,000 stems per acre over 70% of the treated area and at the 10-15 foot height having at least 1,000-1,500 stems per acre with 1.5 inches diameter at breast height (Ferguson, 2004). Research has shown that for effective aspen regeneration to occur, “actions to induce suckering must not be initiated before relief from excessive browsing (herbivory) is obtained”. The desired condition for aspen as stated in the Fishlake National Forest Land and Resource Management Plan is to “manage seral aspen stands for a diversity of age classes” (p. IV-12) and to “improve timber age-class

distribution" and "integrate aspen management into the timber management program to perpetuate the species and improve aspen quality" (p. IV-4).

Researchers suggest that this organism will provide valuable opportunities to study important biological processes such as clonal growth, somatic mutation, and scenescence (DeWoody, et al, 2008).

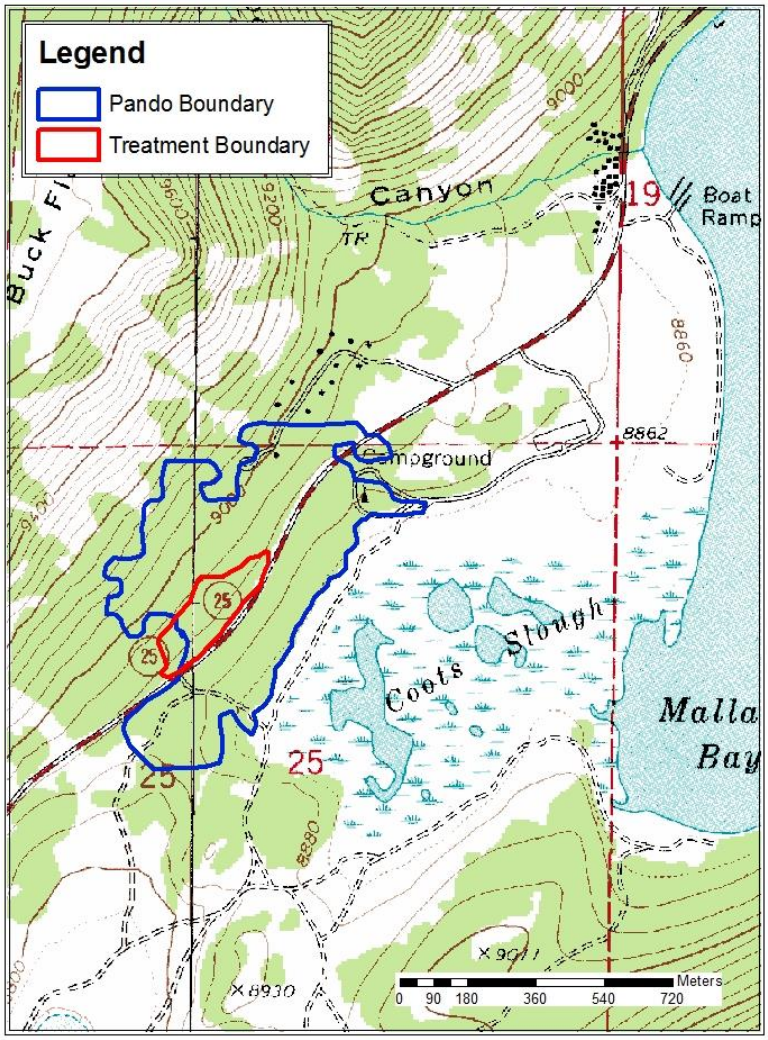

Figure 6 – Location of the Pando Clone adjacent to Fish Lake on the Fishlake National Forest, Utah. Clone boundaries are approximations derived from recent genetic mapping conducted by Dr. Karen Mock and colleagues (Mock et. al., 2008; DeWoody et. al., 2008).

The October 1993 issue of Discover Magazine contained an article by Michael C. Grant entitled The Trembling Giant. It contained the first reference that I remember concerning the

massiveness of the Pando Clone. Quoting from the article, "We therefore recently nominated one particular aspen "individual" growing just south of the Wasatch Mountains of Utah as the most massive living organism in the world. We nicknamed it Pando, a Latin word meaning "I spread." Made up of 47,000 tree trunks, each with an ordinary tree's usual complement of leaves and branches, Pando covers 106 acres and, conservatively, weighs in excess of 13 million pounds, making it 15 times heavier than the Washington fungus and nearly 3 times heavier than the giant sequoia." He goes on to explain that the clone is a connected organism due to its nature of vegetative sprouting from its roots. He also suggests that aspen clones in the western US may reach an age of one million year or more.

An October 25, 1995 article in The Richfield Reaper stated that "While trees in the Pando Clone appear to be basically the same as other aspen at Fish Lake, some scientific literature suggests that it may have been as much as a million years since the seed first germinated, starting some of the clones found in the Fishlake Basin." It reported that the age of the individual aspen trees in the Pando Clone was 130 years. The article also reported that researchers for the Intermountain Research Station and Utah State University have established 24 permanent transects in the Pando Clone which will be monitored over time to help explain what effects livestock and/or wildlife have on aspen sucker survival.

The May/June 1993 issue of American Forests Magazine also referenced the Pando Clone in an article called "Romancing the Clone". The article gives a brief history of some of the fame of the Pando Clone. It stated that late last year The New York Times ran an editorial concerning the Pando Clone. In addition "Good Morning America, Time, the Denver Post, and a string of U.S. and Canadian radio stations also hearkened to breaking news there." It was reported that three University of Colorado professors Michael Grant, Jeffry Mitton and Yan Linhart had written a letter that appeared November 1992 in the British publication Nature. They had nominated the Pando Clone as the largest living organism whether measured by area or mass. They had used a 1975 scientific article by Dr. Burton Barnes of the University of Michigan to gain information to nominate the clone. Dr. Barnes had described the 106 acre stand as a clone based on its characteristics. Michael Grant the senior author of the letter to "Nature" that nominated the clone stated "Scientifically, this isn't particularly important, but this clone gets before the public in a way it wouldn't otherwise. And besides, we were just making a nomination. Someone else can come up with something larger if they can find it." No one has come up with a larger organism. The Kemperman and Barnes article from 1976 suggests that there are larger clones in the Fishlake Basin with some being over 200 acres. They do not specify the location of the larger clones. They also state that clone size is probably correlated to clone age. However, no method exists by which the age of individual clones can be determined. It has been suggested that the age of the Pando Clone could be as much a one million years old. Under the right circumstances clones should be able to live indefinitely.

A postage stamp was issued in 2006 honoring the Pando Clone. The U. S. Postal Service in May 2006 issued a set of 40 postage stamps "Wonders of America" The last stamp of the series honored the "Largest Plant" the quaking aspen or specifically the Pando Clone.

Figure 5 – Postage stamp honoring Pando Clone.

The Deseret News on October 7, 2010 reported that scientists say that Central Utah's Pando, world's largest living thing, is threatened. Utah scientists are trying to organize an emergency rescue effort to save the largest living thing ever discovered, anywhere on Earth. It's known as Pando, a single organism living in central Utah, that some scientists say could also be the world's oldest living thing. But Pando is dying and may have only a few more years of glory. It's a grove of quaking aspen trees spanning 106 acres near Fish Lake. Scientists call it an aspen clone, which is essentially a single plant comprised of thousands of trees connected by underground roots.

When Pando was discovered a few decades ago, scientists named it with a Latin word that means "I spread." An aspen clone starts with a single seed and spreads by sending out underground sprouts that emerge to become trees. In the 1970s, scientists tentatively mapped Pando's boundaries. More recently, Utah State University geneticist Karen Mock wondered if Pando's reputation as the world's largest known organism was overblown. "So we set out to either confirm or deny that," she said. Mock took DNA samples from 209 trees, mostly within that boundary. Her testing verified what was long suspected. "Genetically, in fact, Pando is one enormous clone over 100 acres," Mock said, "probably over 40,000 individual trees." In all, Pando weighs about 13 million pounds, which makes it by far the most massive organism ever found. "There may well be some larger clones than Pando out there," Mock said. "But it's the largest organism that's been described" by scientists.

As Pando's fame spread, the U.S. Postal Service honored the Utah curiosity as one of "40 Wonders of America." A postage stamp issued in 2006 may have set some sort of a record for making something very small out of something very big. But now, Pando is in serious trouble, according to ecologist Paul Rogers of Utah State University. "I would call it a crisis, yes," Rogers said. When he visited Pando two years ago, the clone seemed reasonably healthy. But

when he went back with a team of forestry experts three weeks ago, he was shocked. "We're looking at a situation," Rogers said, "where the whole clone could crash pretty quickly here, within the next few years." The bark of Pando's mature trees shows they're dying from drought and beetles. That's typical of aspen stands throughout the West and, by itself, is not especially worrisome. What is more disturbing is that small trees and sprouts have vanished from the area spanned by Pando. "There was no regeneration and there was no mid-story tree," Rogers said. "So if you might think of those as the young ones and the juveniles, there's no young ones to replace those dying trees. So this set off alarm bells."

Rogers said there is an overabundance of deer and elk in the area, and he believes the wildlife is feeding on the young sprouts. He also said a small amount of livestock grazing in the area is playing a minor role. Rogers wants to fence out the deer and elk. A small portion of Pando, less than 10 percent, is already fenced and is thriving and regenerating. Some government agencies are looking into the emergency fencing proposal, but that strategy is sure to be controversial. Fences would have to be quite high to be effective in holding out deer. Another complication is that recreationists may have concerns about a high fence in such a scenic area.

A U.S. Forest Service campground adjacent to Fish Lake is actually within Pando's biological boundaries. If Pando does die out, or becomes sharply reduced in size, it would be particularly poignant because of the clone's presumed age. Pando is conceivably the oldest living thing ever studied. A recent study pegging Pando's age at 80,000 years led to media coverage in Europe. But other scientists are skeptical because there's no reliable way to determine the age of an aspen clone. "People's estimates go from, you know, perhaps, low-thousands, up to even a million years old," Mock said. "Nobody really knows, and we don't have a very good way of asking that at this point, unfortunately." Rogers believes that if nothing is done, Pando may shrink to become an ordinary, unspectacular remnant of its former glory. "So we really need to hold on to this international treasure," Rogers said. "But it's slipping away very quickly."

Insects and Diseases

The Pando Clone has many of the insects and diseases typical of aspen clones in the Western United States. DeByle describes them in Aspen: Ecology and Management in the Western United States. He states that there are 33 insect species that use aspen as a food source. Some are quite damaging and may kill otherwise healthy stands of aspen; others feed on weakened or dying trees; and still others have incidental impacts. Those causing major damage include the western tent caterpillar, the poplar borer, the poplar twig saperda and several species of leafhoppers. Specifically found in Utah included leafminers, sawflies and leafhoppers. Aphids, thrips and parasites were moderately abundant.

Although many diseases attack aspen, relatively few kill or seriously injure living tress. The common leaf diseases, in general, are widely distributed throughout the range of aspen, whereas there are subtle differences in distribution between the important decay fungi and their distribution. Many fungi are capable of attacking aspen leaves. Because these fungi kill areas of leaves, they often cause premature defoliation; their damage is usually confined to reduced tree growth of severely infected trees. Tree decay has long been recognized as important to aspen management. The most reliable external indication of decay in aspen is the appearance of

fruiting bodies called sporophores or conks, which usually project from branch stubs or old wounds. More than 250 species of wood-decaying fungi have been recorded in North America. Trunk canker is the most obvious disease problem of aspen in the West. Because the bark is soft and living, the tree is extremely susceptible to damage and subsequent attacks by canker-causing fungi. Perennial canker are the most important, because they gradually enlarge until they girdle and kill the trees. Sooty-bark canker, is the most lethal canker of aspen in the West.

DeWoody and Mock reported in 2008 that trees in the Pando Clone were succumbing to sooty-bark canker a fungal infection that typically kills stems within 3-10 years. Rogers in 2010 said, the bark of Pando's mature trees shows they're dying from drought and beetles. Liz Hebertson (Entomologist) and John Guyon (Pathologist) visited the Pando Clone in 2010. They documented the insects and diseases that they found in a report prepared in 2011. Their examination of aspen stems in the Pando Clone revealed signs and symptoms of dieback typical of those observed elsewhere throughout the type. These included insect borer attacks, canker diseases, bark beetle attacks, branch dieback, discolored foliage and bark, bole wounds, and scars.

They reported that the first insect of note infesting aspen in the Pando Clone was the bronze poplar borer, *Agrilus granulatus liragus*. The bronze poplar borer is a flatheaded, metallic beetle. The larvae of this beetle initially feed in the cambium creating tightly zig-zagging tunnels that later can turn long and winding. This cambial mining can girdle the branches and trunks of infested trees. Up to 75% of aspen with only a few attacks can experience mortality as a result of this larval feeding. The larvae then bore into the sapwood and heartwood to complete their development. This activity weakens the tree structurally and allows for the introduction of decay fungi. In recreation sites, affected trees can present a hazard. Damaged trees, and those attacked by other borers are most susceptible to attack.

The poplar borer, *Saperda calcarata*, a roundheaded, longhorn beetle had also infested several stems. This beetle typically attacks trees stressed by disease, drought and other damaging agents. Females lay eggs in bark crevices during the early summer. Once the eggs hatch, developing larvae feed first in the inner bark then move into the sapwood. Numerous larval tunnels can weaken tree trunks making them susceptible to snow and wind breakage. Woodpecker excavations and decay fungi further weaken trees.

The role of eastern poplar borer *Dicerca tenebrica* is less well understood, but damage from this insect is common in many aspen stands experiencing dieback. The gallery pattern of this insect is intermediate in between poplar borer and bronze poplar borer with some cambial mining before the insect bores into the wood to complete its' life cycle.

Two bark feeding beetles, *Trypophloeus populi* and *Procryphalus mucronatus* were also common in the Pando Clone, and appeared to be associated with much of the current mortality. These two beetles were not common in the Intermountain Region until recently, but were commonly associated with aspen dieback and decline in Colorado. It has been noted that *Trypophloeus* attacks trees that still have a large component of "green bark", while *Procryphalus* is found in trees in which the bark is almost entirely dead.

Figure 7. Fruiting body (conk) of aspen trunk rot.

Figure 8. Sooty bark canker on aspen.

Figure 9. Aspen leaf spot.

They commonly observed several serious canker diseases infecting stems in the Pando Clone. Sooty-bark canker (*Encoelia pruinosa*), black canker (*Ceratocystis fimbriata*,, and Cytospora canker (*Cytospora chrysosperma*) commonly infect aspen in Intermountain forests. Some canker diseases are lethal to healthy trees, while others kill stressed trees. Cankers can also create infection sites for decay fungi. Wood boring insects and wounding often predispose trees to a number of serious canker diseases.

The fruiting bodies present on the boles of trees were indicative of infection by white trunk rot (*Phellinus tremulae*). This fungus infects trees through branch scars and wounds and decays the heartwood. In advanced stages, the central decay column is characterized by soft, yellow-white wood ringed by black zone lines. The fruiting bodies are perennial, woody, hoof-shaped conks often associated with old branch scars. The presence of a single conk usually indicates considerable decay, and aspen with up to two conks have the potential for stem breakage.

They also found a few fruiting bodies of Ganoderma (*Ganoderma applanatum*) root disease. This fungal disease commonly infects the root collar and roots of aspen, particularly in more mesic sites. Windthrow often occurs with extensive root decay. The root wads of windthrown trees often exhibit a "ball and socket" appearance. Wood tissue at the root collar appears yellowish and stringy, and in some cases, pocketed. Fruiting bodies may occur at the base of diseased trees. Insects also usually attack infected trees.

Aspen leaf spot (*Marssonina populi*) is the most common foliar disease infecting aspen. This disease causes dry, brownish lesions with yellowish borders. The most serious infections generally occur during exceptionally wet springs and result in extensive defoliation.

Other insect agents can cause significant aspen damage although Hebertson and Guyon found no evidence of them in the Pando Clone. Aspen leaf tier (*Sciaphila duplex*) and aspen twoleaf tier (*Enargia decolor*) have recently caused defoliation in Utah. Populations of the forest tent catepillar (*Malacosoma disstria*) and large aspen tortrix (*Choristoneura conflictana*) have historically reached outbreak levels. The duration of these outbreaks, however, has been relatively short (2-3 years). Weather factors and natural enemies likely kept populations at fairly low levels. With suitable climate conditions, episodes of defoliation caused by aspen leaf spot were also probable.

Finally, depending on their severity, wounds can seriously stress trees predisposing them to attack by insects and decay fungi. The activity of these agents also structurally weakens wood tissues increasing the likelihood of wind damage. Extensive colonization by wood boring insects can ultimately result in tree mortality. Structurally weakened, declining and dead trees also create hazards that pose a threat to recreationists.

Browsing by wildlife and domestic livestock

DeByle in 1985 said that browsing has a direct impact on aspen trees. Through the early sapling stage, browsing reduces aspen growth, vigor, and numbers. Heavy browsing can eliminate aspen sucker regeneration. Elk can be particularly damaging where they are concentrated. Both browsing and grazing have seasonal impacts; browsing is seasonal by animal species, whereas grazing is seasonal because of forage availability. Domestic livestock browse the aspen with increasing pressure though summer and early fall. This browsing can be very severe, especially on young and succulent sprouts. An aspen forest provides an important forage area for domestic livestock. They also provide important habitat for many species of wildlife. A primary value of the aspen ecosystem in the West during the past century has been production of forage for both wildlife and domestic livestock.

Campbell reported in 2000 that unwanted utilization of aspen suckers by livestock and wildlife in treated areas is a major reason why many actions fail to rejuvenate and sustain aspen stands. The following statement underscores this situation: Heavy browsing of suckers can deplete aspen root reserves, jeopardize successful regeneration, and threaten the very survival of the aspen stand. Coordinated and difficult decisions are needed before suckering will be successful. Actions to induce suckering must not be initiated before relief from excessive browsing is obtained. Examples of both successful aspen regeneration and failures following treatment in areas with

aspen present are plentiful. Exclosures and fence line contrasts provide ample evidence that success or failure is often keyed to the absence or presence of domestic and/or wild ungulates.

Cattle use of the Pando Clone area is limited to the late fall. Cattle use is during a two week time period when the cows are trailing through the area. Deer and elk are also found and use the area. Deer are the most prolific user of the area. They travel through the Pando Clone as they go to obtain water from the lake. The areas of the Pando Clone that were treated by clearcutting in 1987 and 1988 initially sprouted abundantly. Those two areas were small in size and were overwhelmed by heavy browsing pressure from mostly the deer in the area. The area treated in 1992 was fenced with an eight foot high net wire fence to keep the wildlife and cattle from impacting the new sprouts. The sprouts in this area were able to survive and are now mostly over twenty feet tall. It is known that a few deer were able to slip under the fence and cause some damage. The young aspen trees have a high lined appearance today typical of a browse height.

The portion of the Pando Clone within the Doctor Creek Campground has a fence that keeps the cattle out the entire year. The area within the campground is having the same poor regeneration response as the area outside the campground. Since cattle are excluded from the campground area, it can be concluded that cattle are not the major cause of the regeneration failure of the Pando Clone. Further studies are needed to determine the exact cause of the regeneration failure. It is difficult to determine and measure the effects of browsing on the clone.

Recreation Impacts

DeByle in 1985 reported that aspen is valued for its scenic beauty. One indication of this is the trips to the "high country" that many forest visitors make to view the autumn color changes. Aspen fits well into management for dispersed recreation activities; but it does not tolerate concentrated use, such as that often found in established campgrounds. Although aspen groves are attractive, encouraging concentrated recreation or developing campgrounds within them can lead to serious damage to the trees, including carving and vandalism, destruction or removal of young suckers, and trampling and disturbance of the soil.

The Doctor Creek Campground a popular developed campground of the Fishlake Basin is found in the north end of the Pando Clone. The heavy developed use in the campground has had effects on the clone. In the early 1980's over mature hazard trees were removed from the campground area. This treatment resulted in sprouting in the campground. Don Okerlund the manager of the campground at that time reported to me that the new sprouts were popular in the campground and were used as sticks to roast marshmallows and hotdogs. Don stated that he educated the users and protected the sprouts. There are younger trees in that area of the campground today as a result of the 1980's treatment and Don's education.

Aspen hazard trees are constantly being identified in the campground. These trees are removed for the safety of the campground users. Forest Highway 25 a paved highway that accesses the Fishlake Basin dissects the Pando Clone. Forest Roads 1483 and 0651 also go through the Pando Clone to provide access to a communications site, sewer lagoons and provides access for dispersed recreation use within the Pando Clone. A foot and horse trail leaves the Doctor Creek

Campground and transverses the Pando Clone to the south. A buried sewer line that serves the Fishlake Basin recreation facilities also traverses the area as well as an overhead power line. The area is used in the fall by hunters. There are several summer homes located in the northern portion of the clone as well. These recreational impacts are having a major effect on the health and vitality of the clone.

Lack of Disturbance

The lack of disturbance in the Pando Clone is similar to that occurring in many of the aspen forests in the west. Bartos and Campbell in 1998 explained it best. They said that quaking aspen are unique because, in contrast to most western forest trees, they reproduce primarily by suckering from the parent root system. Generally disturbance or dieback is necessary to stimulate regeneration of aspen stands. These self-regenerating stands have existed for thousands of years. If they are lost from the landscape, they will not return through normal seeding processes as do other tree species.

Aspen landscapes in the West provide numerous benefits, including forage for livestock, habitat for wildlife, watershed protection, water yield for downstream users, esthetics, sites for recreational opportunities, wood fiber, and landscape diversity.

Loss, or potential loss, of aspen on these lands can be attributed to a combination of successional processes, reduction or elimination of fire, and long-term overuse by ungulates. Existing conditions indicate that most aspen stands will eventually be replaced by conifers, sagebrush, or possibly other shrub communities. The decline of aspen results in loss of water, forage, and biodiversity. Numerous landscapes throughout the West that were once dominated by aspen are in late successional stages dominated by mixed-conifer. If restoration treatments are to be successful, action must be taken soon.

The Pando Clone is in its late successional stage as described above. Any new sprouts that are produced are browsed as soon as they appear or are trampled by the heavy recreational use. Lack of disturbance in the clone is leading to its demise. It has also been suggested that other factors such as drought and climate change may also be leading to the demise of aspen in the West as well as for the Pando Clone.

Existing fenced area. Effectiveness of exclosures. When to remove.

There are two aspen exclosures that exist in the Pando Clone. The first area fenced was the area treated in the spring of 1992. The area, approximately ten acres, was fenced in the fall of 1992 by the district project crew. It was fenced to an eight foot height with net wire. The fence was quite effective in keeping wildlife and domestic livestock from the area for the first few years. This allowed the sprouts to become established. Eventually some of the deer learned to slip under the fence. The second exclosure was constructed in the fall of 2006. This two acre exclosure was designed to test the ability of the clone to send up sprouts without treatment. It was evident that sprouts were being produced and not surviving. This exclosure was adjacent to the one that was built in 1992 and to the north. Deer coming down the slope to water were still able to jump into the fenced area and then could not get out. The height of the upslope portion

was increased by placing barbed wire on top of the eight foot net wire portion. This seemed to help but deer were still observed in the fenced area. It was believed they were getting through from the adjacent exclosure.

Figure 10 – Exclosure constructed in 1992.

Figure 11 – Exclosure constructed in 2006. The 1992 exclosure can be seen in the background.

The first exclosure was very effective in protecting the aspen sprouts from the 1992 treatment. A healthy young aspen stand exists there today. It has a high lined appearance resulting from the

browsing pressure of deer that slipped under the fence in later years. The exclosure that was constructed in 2006 has not been effective. It was evident that deer were able to get inside the exclosure. There was some evidence of increased sprout survival within the untreated exclosed area. It shows what has been known, that aspen sprouts better when there is a disturbance.

The question of how long an exclosure should remain to protect the aspen sprouts is often asked. The answer varies for each particular exclosure. The exclosures in the Pando Clone have remained in place due to the ongoing research that is being conducted within the clone. An exclosure must remain in place until the sprouts get tall enough to be out of reach of the various animals that use the aspen. Wayne Shepperd a Rocky Mountain Forest and Range Experiment Station research silviculturist warned that even when the sprouts seem to be high enough, from his observations elk can push over and break the sprouts so they can be eaten. Brian Ferguson, former Regional Siliviculturist wrote a paper that contains many of the answers for effective aspen regeneration. He stated, in the development of new aspen stands, how many suckers are required to result in an acceptable regeneration event and how much grazing impact from ungulates, both wild and domestic, should be allowed that would result in an adequate regeneration component are important questions to consider. The answer to the first question is highly dependent upon the response to the second. If herbivory will have no impact on the affected stand or landscape, then several hundred to a few thousand suckers per acre should be adequate. A major consideration is the type of aspen community being treated. There are two basic aspen types recognized in the Intermountain Region, seral and stable. A distinct desired condition or target stand should be defined for each, during the development of the vegetation prescription. Seral aspen is defined as those stands where aspen are actively replaced over time by conifers. Stable aspen are those areas where aspen remain dominant with little or no conifer replacement over at least one generation (approximately 70-100 years).

Ferguson also said the general health of the stand must be determined prior to prescribing a need for regeneration. If there are indications of declining health of individuals within the clone or holes in the canopy, and if regeneration is not obvious in the understory then the regeneration treatment should be implemented. Since the lower canopy levels do not require the mass suckering event characteristic of a stand replacement treatment, only a few hundred suckers per acre (500+) at 6 feet in height may be required for that event to be adequate. It is obvious that with this low number of suckers, there would be a lower percentage of grazing hits allowed before adverse impacts would occur. When looking at canopy gaps in stable clones, watch for indications of root rots that would adversely affect aspen suckering. If suckers are not present and root rot is not suspected, then look for indications of grazing impacts. Treatments in seral aspen tend to favor the development of a single cohort with the initiation of the suckering event resulting in tens to hundreds of thousands of suckers per acre. The most critical time for herbivory impacts is between the regeneration disturbance event and when the suckers grow to the desired 6 foot height. During this time it is important to have as many new suckers as possible, depending on site conditions. The fewer suckers per acre present at initiation would dictate that fewer stems could be impacted by ungulates or disease. The objective, depending on habitat type would be to have 2000-5000 stems per acre at 6 feet height over 70% of the area treated. This means that 2000-5000 stems must maintain a strong terminal leader with no grazing hits. The goal from one year to the next is to see a net gain in stand height growth.

Another critical monitoring point is to see at least 1000-1500 stems per acre when they are 10-15 feet tall and 1.5 inches DBH.

Grazing impacts can be caused by wild ungulates (moose, elk, deer and antelope) or permitted livestock (sheep and cattle), and in some areas by other small mammals (hares, rabbits, gophers, mice, etc.). Some areas with heavy wildlife use show aspen treatment areas converting to grassland types (White Ledges Timber Sale on the Fishlake NF). Wild ungulates are difficult to control, however some types of fencing provide adequate protection. Another method is to implement large treatment areas to disperse impacts to allow the acceptable development of the new cohort. Where adverse wildlife populations are known to exist; if the treatment areas cannot be protected then the treatments should not occur. Where wildlife and domestic livestock may both impact the treatment areas, uncontrolled grazing is almost certain to create an unfavorable outcome. In this situation, as well as where domestic livestock is the primary concern, we would have the best opportunity for success by controlling livestock movements. The key in this area is to coordinate vegetation treatments and livestock control between the range permittee, range vegetation staff and the silviculturist. If there is a lack of commitment or a problem with assuring adequate protection for the treatment area then the treatment should not be implemented.

As Brian Ferguson has recommended in his paper, the aspen exclosures should not be removed until the aspen are at least six feet tall and there are 2000-5000 stems per acre. A better time may be when they are 10-15 feet tall and there are 1000-1500 stems per acre.

Each exclosure should be evaluated separately by all of those concerned. The exclosure may be part of a research study and its existence would need to be maintained throughout the life of the study. The area within the exclosure is important to permittees as a source of forage. It would not be economical to maintain the exclosures in place for long periods of time. One should expect the aspen exclosures to remain in place for at least three to five years to assure that the aspen sprouts have reached the height that is out of reach of the animals that are using it for forage. There should not be a reason to maintain an exclosure for more than ten years unless it is needed for an ongoing study.

Declining nature of clone

The lack of disturbance is a primary cause of the declining nature of the Pando Clone as was previously described. As Bartos and Campbell described in 1998 the decline is attributed to a combination of successional processes, reduction or elimination of fire, and long-term overuse by ungulates. I have seen a big change occur within the Pando Clone over the past twenty-four years. The Pando Clone is comprised primarily of aspen with a few conifer species present including Engelmann spruce, Douglas-fir and subalpine fir. The conifer species have not increased that much over the time I have watched them. It is the density of the aspen trees that has seen a significant change. Grant in 1993 stated that there were over 400 trees per acre found in the clone. Today there are probably less than a third of the numbers of trees remaining. In 1988 the summer homes could not be seen from Highway 25. At that time the clone was more dense and healthy looking. Today you can see the summer homes from the highway. There are

many trees that have died over the past twenty-four years, some of which have fallen and some that are still standing.

The condition of the Pando Clone is currently reaching a critical state as it relates to its survival. Actions need to be taken to assure the "the world's largest living organism" can survive. The Fishlake National Forest has a unique challenge to protect this iconic resource. At least a portion of the clone was saved and regenerated during the 1992 treatment.

The Clones Notoriety

The notoriety of the Pando Clone is described in detail in the introduction section of this case study. The Pando Clone was nominated by Grant, Mitton and Linhart in 1992 as the most massive living organism in the world. Since then the clone has received a lot of attention and publicity, even to the point of having a postage stamp issued in its honor. Today the clone still holds its title. The Fishlake National Forest wants the clone to be able to retain its claim to great fame. As was previously described a group of scientists are trying to organize an emergency rescue effort to save the clone.

Recommendations

The Fishlake National Forest is very concerned about aspen management on the Forest. The decline of the Pando Clone is especially concerning. The Fremont River Ranger District has proposed a project to study and restore portions of the clone.

The Utah Forest Restoration Working Group has developed "Guidelines for Aspen Restoration on the National Forest in Utah. The Forest has asked the working group to use the Pando Clone as one of their test areas for their new guidelines. The guidelines outline a menu of 18 possible responses that may be taken for aspen types. It also includes seven general recommendations to help select the appropriate response option. The group visited the area in the Fall of 2010 and made some recommendations for saving the clone as is evidenced by the Hollenhorst article in the Deseret News on October 7, 2010.

The Fishlake National Forest has formed an interdisciplinary team to propose a project using recommendations from the Utah Forest Restoration Working Group. The Resource Advisory Council for the Forest has agreed to provide some funding for fencing portions of the clone.

The proposed action as outlined by the interdisciplinary team states that the Fremont Ranger District of the Fishlake National Forest proposes to implement management actions to stimulate new growth within the Pando Clone. These actions include the following 3 phases:

1. Construct an 8-10 foot high fence around approximately 67 Acres of the clone to prevent herbivory from ungulates. This will include two separate fenced areas, one on the northwest side of highway 25 and one on the southeast side. Construction of the fence southeast of highway 25 will be completed first. Funds from the Fishlake National Forest Resource Advisory Council for Secure Rural Schools Title II will be available for this project in early 2012.

All fencing will be constructed to prevent herbivorous animals from going under or over the fence. Trees having the potential to fall on the fence will be cleared prior to fence construction. Areas to be excluded from fencing within the clone include the Doctor Creek Campground and the recreation residences. The non-motorized trail that presently goes through part of the clone southwest of the campground will be rerouted outside of the fenced area to the east and will lie parallel to the fence. The fence will be maintained and kept functional in years subsequent to its construction. The dispersed camping area to the southeast of highway 25 on forest road 1483 will be closed. Access to the communication site from Forest Roads 1483 and 2604 (southwest of the project area) will remain open. Access to the sewer lagoons will also remain open.

2. This phase includes treatments that are designed to encourage regeneration of young aspen. These treatments include:

   a) Burning—this treatment will include burning of common juniper understory, which exists as discrete ground-cover layers throughout the clone. No burning will occur in the northwest portion of the clone near the recreation residences or the Doctor Creek Campground.

   b) Cutting—in addition to clearing the trees and vegetation close to the fence line, selected areas will be cut to remove overstory, allowing additional sunlight for new shoots, and stimulate regeneration of young sprouts.

   c) Combination of burning and cutting, and

   d) Ripping of aspen roots—this involves mechanically severing aspen roots using a dozer-mounted riper with a single line, single pass pattern over the selected areas. Severing lateral aspen roots has been shown to effectively stimulate aspen suckering.

   All of the above-mentioned treatments will be completed on plots no larger than five contiguous acres.

3. This phase will include monitoring results of phase 2 to determine the most effective treatment(s) for regeneration within the clone. These treatments will then continue to be implemented on other plots within the fenced portion of the clone.

The decision for the project has not been made, but the first phase will probably be implemented first and then the other phases will be considered based upon the success of the first phase.

It is hoped that treatments in the Pando Clone can be implemented in such a way that the clone can regenerate and be able to retain its claim to being the “world’s largest living organism”.

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Outline

Problem Statement. The Pando Clone located on the Fishlake National Forest near Fish Lake has gained notoriety for being the world's largest living organism. I have worked with the clone over the last twenty three years and have information concerning the clone that would be beneficial to document. There are several issues going on in the clone that would be explored and suggestions given for implementation.

Issues.

1. Insect & disease
2. Browsing by wildlife and domestic livestock
3. Recreation impacts
4. Lack of disturbance
5. Existing fenced area. Effectiveness of exclosures. When to remove.
6. Declining nature of clone
7. The clones notoriety
8. Other

Documentation and recommendations

Citations