



Relict Aspen Stand at Bighorn Canyon National Recreation Area, Montana

Natural Resource Report NPS/BICA/NRR—2017/1540



ON THE COVER

Mature open-grown aspen tree in Bighorn Canyon NRA surrounded by extensive stand of young aspen root suckers.
Photograph by: Joe Stevens

Relict Aspen Stand at Bighorn Canyon National Recreation Area, Montana

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Joseph E. Stevens, Karin L. Decker, Beth M. L. Morrison

Colorado Natural Heritage Program
Colorado State University
Fort Collins, Colorado, 80523

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Abstract

This report details the location, description and condition of an isolated aspen (*Populus tremuloides*) stand near Dry Head Creek in Bighorn Canyon National Recreation Area. The stand is located on the edge of a dry plateau, but is fed by a groundwater spring. The stand was discovered during vegetation inventory and mapping field sampling efforts in 2011 and was previously un-documented. It is unique in that it occurs outside of the documented range of quaking aspen in that region.

The origin of this stand is unknown, and the leaf shape suggests individuals may be rare *P. tremuloides* and *P. deltoides* hybrids. Thus, the stand is of interest for further genetic analysis. There is evidence of intense browsing pressure in the stand as well as disease and insect damage. There is minimal aspen regeneration within the stand, and Rocky Mountain juniper (*Juniperus scopulorum*) appears to be encroaching, possibly due to long-term fire suppression in the area.

This BICA aspen stand between the Bighorn and Pryor mountains is of interest because it is an isolated stand in an area not previously identified as being part of the species' distribution. Additional research is needed to document the genetic diversity and resource value of the stand and to inform appropriate management actions. Further study to document the genetic diversity of these stands could provide valuable information to genetic preservation efforts, breeding programs, or restoration efforts. Suggested near-term management considerations include managing browsers and removing competition from juniper trees within the stand.

Introduction

During the vegetation mapping effort at Bighorn Canyon National Recreation Area (BICA, Figure 1a), a small, isolated stand of quaking aspen (*Populus tremuloides*) was discovered near the western edge of the BICA boundary in a small side drainage of Dry Head Creek (Figure 1b). The aspen trees occur in a narrow band below the plateau rim, and are embedded in a wider band of Rocky Mountain juniper (*Juniperus scopulorum*). Sagebrush shrubland (*Artemisia nova*) dominates the hillsides adjacent to the woodland. This aspen stand is of particular interest because it occurs outside the recognized range of aspen in that region. One other aspen stand of approximately five to ten individuals was identified in the Park during the 2013 accuracy assessment field season¹. That patch occurs in an area dominated by Douglas fir (*Pseudotsuga menziesii*) and Rocky Mountain juniper. Further assessment of the smaller population has not been conducted, the following report is predominantly concerned with the aspen stand located near Dry Head Creek.

Stand Description

The aspen stand occurs at an elevation of 4425 feet (1349 meters). It occupies less than one acre on the upper slope of a side canyon, just below the plateau between East Pryor Mountain and Bighorn Canyon. The substrate is undifferentiated sandstone of Pennsylvanian age. Average annual precipitation for the period of record at the Hillsboro Remote Automated Weather Station (RAWS) is 7.9 inches. May and June are the wettest months. Summer months are warm, with mean daily temperatures in the mid to upper 70s, and winter mean daily temperatures are generally below freezing (Figure 2).

The stand is a mixed canopy of Rocky Mountain juniper (Figures 3a,b), with many small juniper trees also present in the understory. Other tree species present include limber pine (*Pinus flexilis*) and Douglas fir. The shrub understory is diverse, with sagebrush, serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), skunkbush sumac (*Rhus trilobata*), snowberry (*Symphoricarpos* spp.), squaw currant (*Ribes cereum*), mountain gooseberry (*R. montigenum*), common juniper (*Juniperus communis*), and poison ivy (*Toxicodendron rydbergii*) present. Subshrubs and herbaceous species present include Oregon grape-holly (*Mahonia repens*), virgin's bower (*Clematis virginiana*), wood rose (*Rosa woodsii*), lupine (*Lupinus* spp.), and creeping juniper (*Juniperus horizontalis*).

The mature aspen are all of relatively short stature (5-10 m in height), but old downed logs indicate that previous aspen stems present on the site were much taller and of greater diameter than remaining trees. Average DBH of 92 measured trees was 10.55 inches (range 4.0-41.5 in.). About 63% of the living stems are trees of mature size. Very few saplings (10%) are present in the stand, and there are no stems in the 2-4 inch size class. A number of seedling-sized stems (probably vegetative sprouts) were observed, many of which were dead or dying.

¹ Located approximately 8 miles southwest at an elevation of 6,110 feet at UTM 12N:713767 5001158 NAD 83

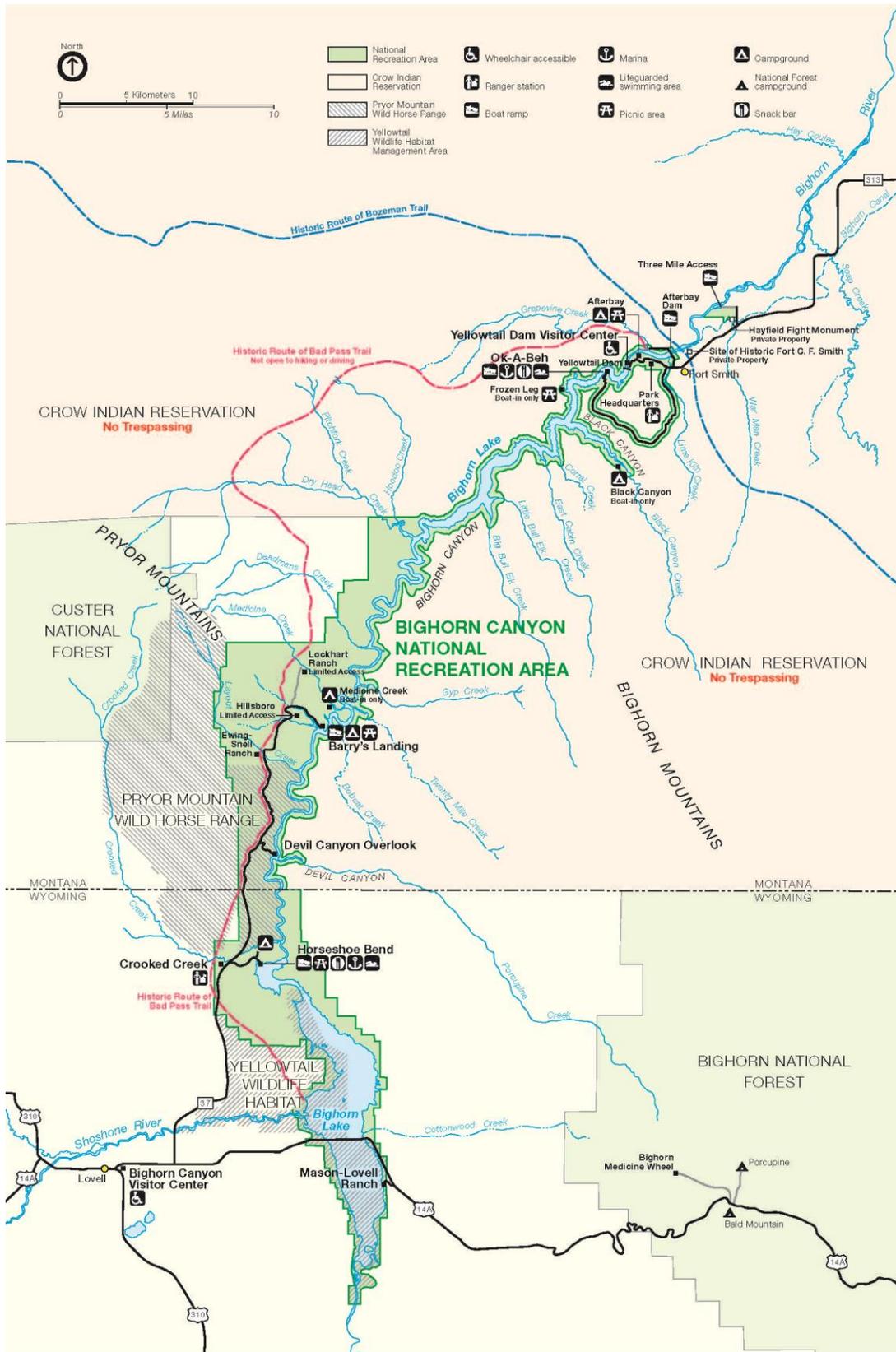


Figure 1a. NPS map of Bighorn Canyon National Recreation Area

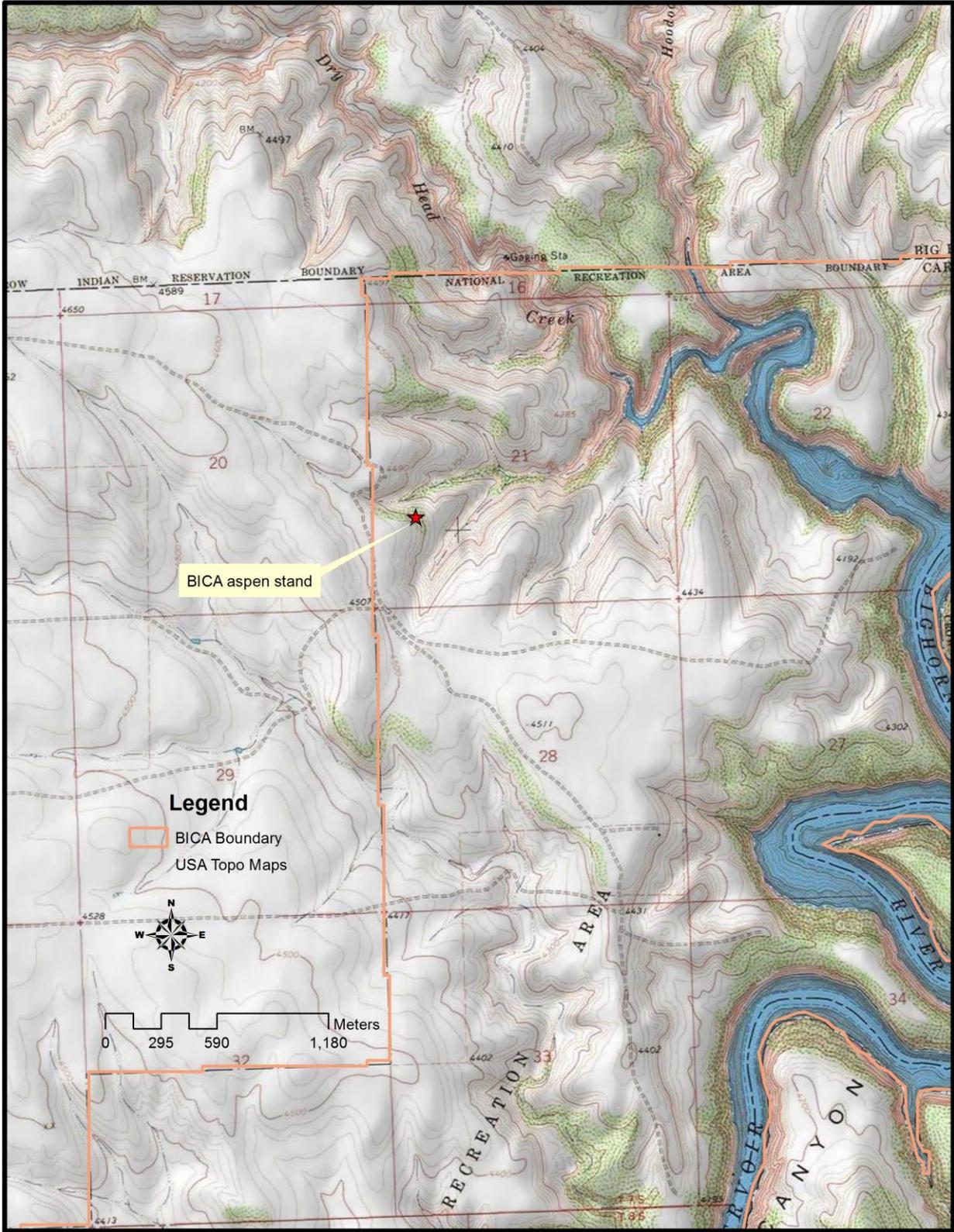


Figure 1b. Location of aspen stand in Bighorn Canyon National Recreation Area (12N:722164 5010056 NAD 83)

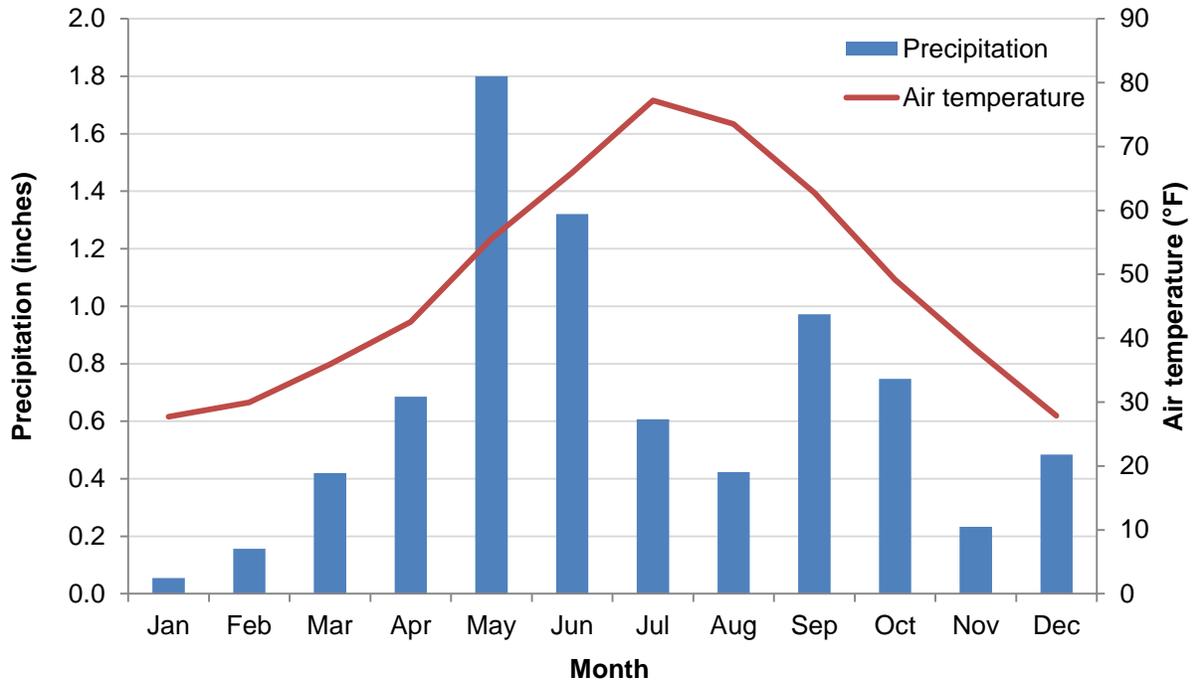


Figure 2. Average monthly precipitation and daily air temperature for the period of record (2003-2013) at the Hillsboro RAWS station (WRCC 2013)



Figure 3a. Aspen stand at BICA. Mature canopy trees are visible as lighter green patch in center.



Figure 3b. Aspen stand at BICA. Mature canopy trees are visible as lighter green patch in upper right.

Condition

The area shows signs of use by domestic livestock (cattle and horse signs present), and is probably used by native browsers as well. Deeply incised animal trails are present throughout the area (Figure 4), and seedlings on the eastern end of the stand are browsed to a height of about 2 ft. The stand appears to have little regeneration, and is undergoing an invasion of Rocky Mountain juniper (*Juniperus scopulorum*). This juniper encroachment could potentially be a result of lack of major disturbance in the area. Mature aspen trees are stunted, and some individuals show evidence of what could be cytospora infection (Figure 5) (personal communication, James Worrall USFS forest pathologist). Damage on the branches of younger trees is likely caused by treehoppers or cicadas during oviposition (Figure 6). The larvae do not feed on the branches but the mechanical damage of oviposition alone can lead to death of small branches. This mechanical damage from oviposition leaves the individual more susceptible to infections (personal communication, James Worrall).

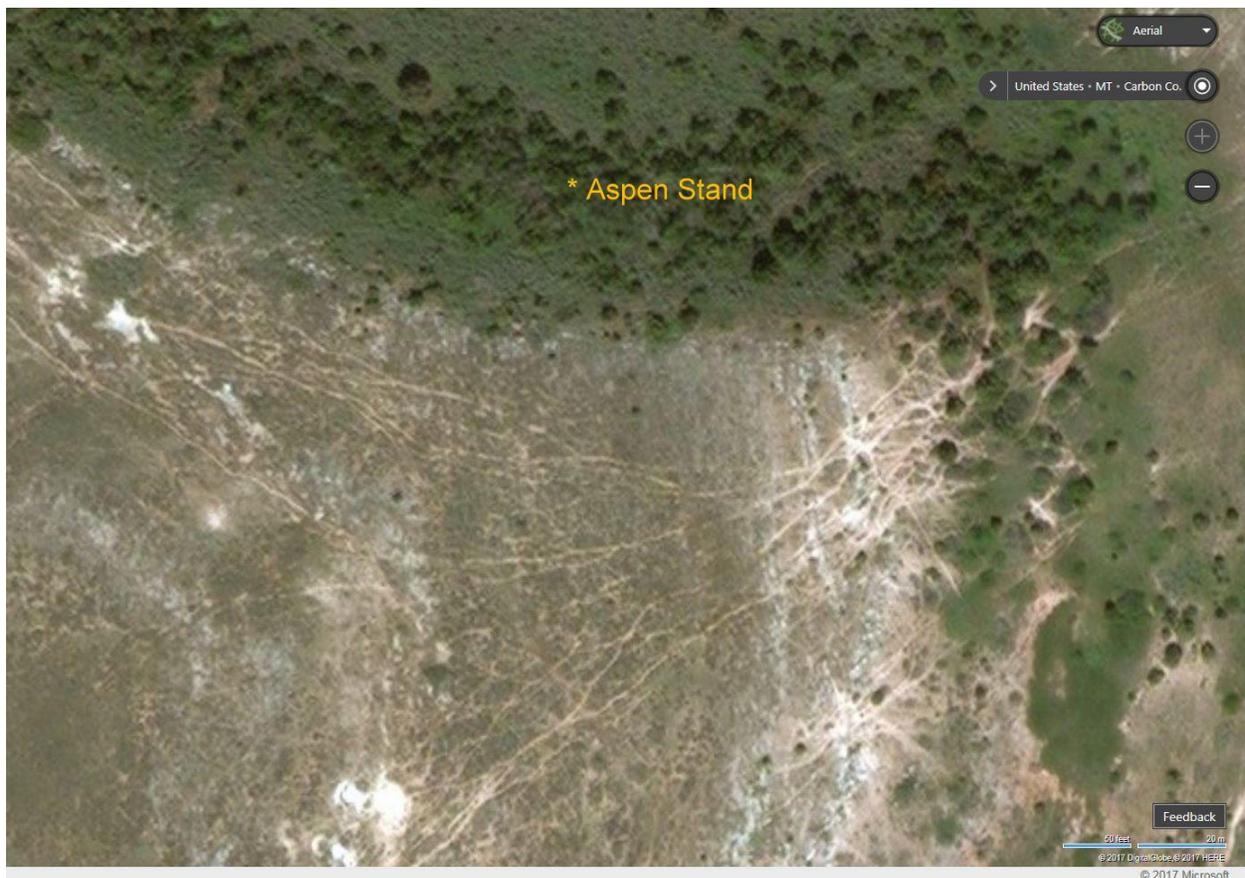


Figure 4. Image showing animal trails from domestic livestock and native browsers in the area surrounding the aspen stand.



Figure 5. Evidence of wounds and possible cytospora infection on aspen individuals



Figure 6. Evidence of insect oviposition on small aspen branch

Local / Regional Distribution

Quaking aspen has the largest distribution of any tree native to North America (Little 1971). The species is prevalent from Alaska to the eastern seaboard of Canada, and south into the Sierras, Rocky Mountains, and Colorado Plateau. Isolated populations extend as far south as central Mexico (Figure 7). Aspen density is greatest in Minnesota, Wisconsin, Michigan, Colorado, and Alaska (Howard 1996).

The generalized distribution given in the Atlas of the United States Trees (Little 1971) indicates that quaking aspen occurs in both the Pryor and Bighorn Mountains (Figure 7). Aspen-dominated forests in this region belong to the Rocky Mountain Aspen Forest and Woodland ecological system type (USNVC 2014). The small patch of aspen identified during the BICA vegetation sampling is located on a lower elevation bench between the Bighorn and Pryor Mountains. Vegetation mapping derived from satellite and aerial imagery (e.g. LANDFIRE) does not show extensive stands of quaking aspen in this region except on the eastern flanks of the Bighorn Mountains; the species may be present as part of mixed conifer forest in other areas within the region.

The range of this species has changed dramatically since the end of the last glacial maximum (LGM), during which the greater part of its current range was covered by the Cordilleran and Laurentide ice sheets. Callahan et al. (2013) sampled stands across the entire species range in order to evaluate the range-wide genetic diversity and structure of quaking aspen. They identified two primary genetic clusters, one in the north, corresponding generally to previously glaciated areas, and another in the southwest, below LGM latitudes, and bounded approximately by the continental divide to the east. A stand from the Greater Yellowstone Area, on the eastern slope of the divide (as is the BICA aspen stand) was resolved as an intermediate cluster between the Northern and Southwestern genetic clusters (Callahan et al. 2013). Additional sampling in the BICA region would provide further insight on the biogeographical history of quaking aspen.

Quaking aspen is able to grow on a wide variety of sites, both dry and mesic (Mueggler 1988). Climatic conditions, in particular minimum winter temperatures and annual precipitation amounts, vary widely over the range of the species (Howard 1996). In general, quaking aspen is found where annual precipitation exceeds evapotranspiration, and a mean annual temperature of 45°F (Perala 1990). In the central Rocky Mountains, quaking aspen distribution is highly correlated with elevation, due to its influence on temperature and precipitation patterns.

Aspen is extremely shade intolerant, but it is able to establish quickly in disturbed open areas due to its ability to reproduce by vegetative sprouting (Howard 1996). The tufted seed capsules produced by mature aspen trees are amenable to wind dispersal over considerable distances. Although quaking aspen establishment from seed is common in Alaska, northern Canada and eastern North America, this is less true in the western US, probably because germinated seedlings do not receive sufficient moisture for survival (Kay 1993). There is conflicting evidence for the frequency of seedling establishment in the western US, however, and quaking aspen may establish from seed more frequently than previously thought (Howard 1996, Romme et al. 1997).



Figure 7. Generalized North American distribution of quaking aspen (Little 1971). Inset shows the vicinity of BICA.

The BICA aspen stand that falls between the Bighorn and Pryor mountains is of interest because it is an isolated stand in an area not previously identified as being part of the species' distribution. There are two possible explanations for this: 1) the isolated stand is a remnant of a much larger, established aspen woodland that formed an essentially continuous distribution with nearby areas, or 2) the stand is the result of an isolated seedling establishment event. Factors controlling the current distribution of quaking aspen include post-glacial habitat availability, disturbance regimes, and patterns of temperature and precipitation.

There is some evidence for synchronous aspen stand establishment events over a large area of the intermountain west. Kaye (2011) identified two peak periods of establishment via sexual reproduction, the first in the period 1870-1890, and the other in 1970-1980. She speculates that the earlier establishment event may be the legacy of the last large fire events before widespread fire suppression in the intermountain west. The second establishment peak corresponds with improved moisture conditions due to a shift in the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation. The possibility exists that the isolated BICA stand is in fact a result of seedling establishment, rather than a relict of a previously larger clone. Age characterization, increased sampling, and genetic analysis may help determine the origin of the BICA stand.

The leaf shape observed in the individuals of the BICA aspen stand (Figure 8) appears to be a potential hybrid between *P. tremuloides* and *P. deltooides*. Natural hybrids between these two species have been recorded but not in this region. These two species do not typically hybridize because of differences in habitat and, consequently, hybrid distribution and occurrence is not well documented (Brayshaw 1965, Burns and Honkala 1990). Genetic analysis would be necessary to determine if these are *P. tremuloides* or rare *P. deltooides* and *P. tremuloides* hybrids (Isabel 2012).



Figure 8. Leaf shape that suggests potential hybridization between *P. deltooides* and *P. tremuloides*

Management Considerations

A primary management consideration for the aspen stand is to stop the use of the area by grazers and browsers. Aspen are quite hardy once established, so the stand would probably recover and thrive once vegetative shoots are able to grow without constant browsing and trampling (personal communication, Dan Binkley). In order for young aspen to successfully establish, the competition pressure from encroaching Rocky Mountain juniper should be eliminated as well.

It would be difficult to determine whether the stand is the result of isolated seedling establishment or if it is a relict of a larger woodland without genetic analysis. Anthropogenic establishment is highly unlikely (personal communication, Dan Binkley). Coring of mature trees would be useful in establishing the age of the stand. Genetic analysis would also determine whether this stand is composed of *P. tremuloides* or *P. tremuloides* x *P. deltoides* hybrids.

The BICA aspen stand that falls between the Bighorn and Pryor mountains is of interest because it is an isolated stand in an area not previously identified as being part of the species' distribution. Populations at the edge of a species distribution or isolated in refugia potentially harbor unique genetic attributes worth documenting and preserving (Provan and Bennet 2008, Provan and Maggs 2011, Tembrock Pers. Comm. 2017). Further study to document the genetic diversity of these BICA stands relative to other regionally proximate *Populus* stands could provide valuable information to genetic preservation efforts, breeding programs, or restoration efforts.

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1201 Oakridge Drive, Suite 150
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