



# Upland Vegetation Monitoring in Bighorn Canyon National Recreation Area

## *2024 Trip Report*



Upland vegetation and rocky terrain in Bighorn Canyon National Recreation Area.

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# **Upland Vegetation Monitoring in Bighorn Canyon National Recreation Area: 2024 Trip Report**

Science Report NPS/SR—2026/389

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## Abstract

This report summarizes findings from the 2024 Greater Yellowstone Network (GRYN) long-term monitoring of upland vegetation at Bighorn Canyon National Recreation Area (BICA). Within ten frames, 575 quadrats were sampled in 2024, with a total of 29 different vegetation species observed. Six non-native species were observed: cheatgrass (*Bromus tectorum*), smooth brome (*Bromus inermis*), saltlover (*Halogeton glomeratus*), St. Johnswort (*Hypericum perforatum*), Russian thistle (*Salsola tragus*), and Kentucky bluegrass (*Poa pratensis*). At least one invasive species occurred within six out of ten frames. Cheatgrass had the most observations and the highest cover. St. Johnswort, a non-native forb, was observed in one quadrat within Frame 70. This is the first time this species has been documented in BICA. Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*Juniperus scopulorum*), and curl-leaf mountain mahogany (*Cercocarpus ledifolius*) recruits (small trees less than 10 cm in height) were recorded in seven frames. Tent caterpillars (*Malacosoma californicum*) were detected in every frame that had curl-leaf mountain mahogany (Frames 20, 120, and 150). To learn more about this vital sign, visit GRYN's Upland Vegetation webpage ([NPS](#)).

## Introduction

The Greater Yellowstone Inventory and Monitoring Network (GRYN) conducts annual upland vegetation surveys in Bighorn Canyon National Recreation Area (BICA). These surveys began with a pilot study in 2011. The goal of long-term upland vegetation monitoring is to describe targeted vegetation community structure in the south end of Bighorn Canyon and describe the presence and distribution of targeted native and invasive plant species. Upland vegetation communities in Bighorn Canyon are affected by a variety of natural factors, such as water availability and anthropogenic or human factors including the spread of invasive species, grazing, and recreational land use. These factors, either independently or combined, can lead to changes in vegetation community composition and species abundance from historical conditions. Changes may affect wildlife by reducing available food and habitat and may impact land management such as grazing, wildfire risk, and soil erosion.

## Methodology

The focus of the Bighorn Canyon upland vegetation monitoring protocol is to describe the presence and abundance of targeted vegetation species—graminoids (grasses), shrubs, trees, non-native grasses and forbs, and soil cover attributes like bare ground and cryptobiotic crusts (living crusts that stabilize soil) over time. The upland vegetation communities of interest are sagebrush steppe, juniper-mountain mahogany, and juniper. We also consider the effects of current and past land management, such as grazing, wild horse ranges, prescribed burns, and recreation. The occurrence and abundance of targeted vegetation species may be indicators of rangeland health.

Of the 15 frames surveyed in Bighorn Canyon, seven are surveyed annually (Frames 20, 70, 80, 90, 100, 110, and 120) and eight are surveyed once every three years (Tercek et al. 2015). During the 2024 site visit, 10 frames and a total of 575 quadrats were surveyed (Figure 1). In 2024, all annual frames and Frames 50, 60, and 150 were included. Following the 2015 protocol (Tercek et al. 2015), each year a frame is surveyed, 50 or 75 quadrats are selected for survey within a frame using a GRTS draw (Generalized Random Tessellation Stratified). We record ground and targeted vegetation species cover using Daubenmire cover classes in each quadrat. When tree species—such as Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*Juniperus scopulorum*), mountain mahogany (*Cercocarpus ledifolius*), limber pine (*Pinus flexilis*)—are detected within a quadrat, the number of recruits (trees less than 10 cm in height) is counted. Recruitment, the number of individuals joining a population, is a metric used to describe vegetation population dynamics.

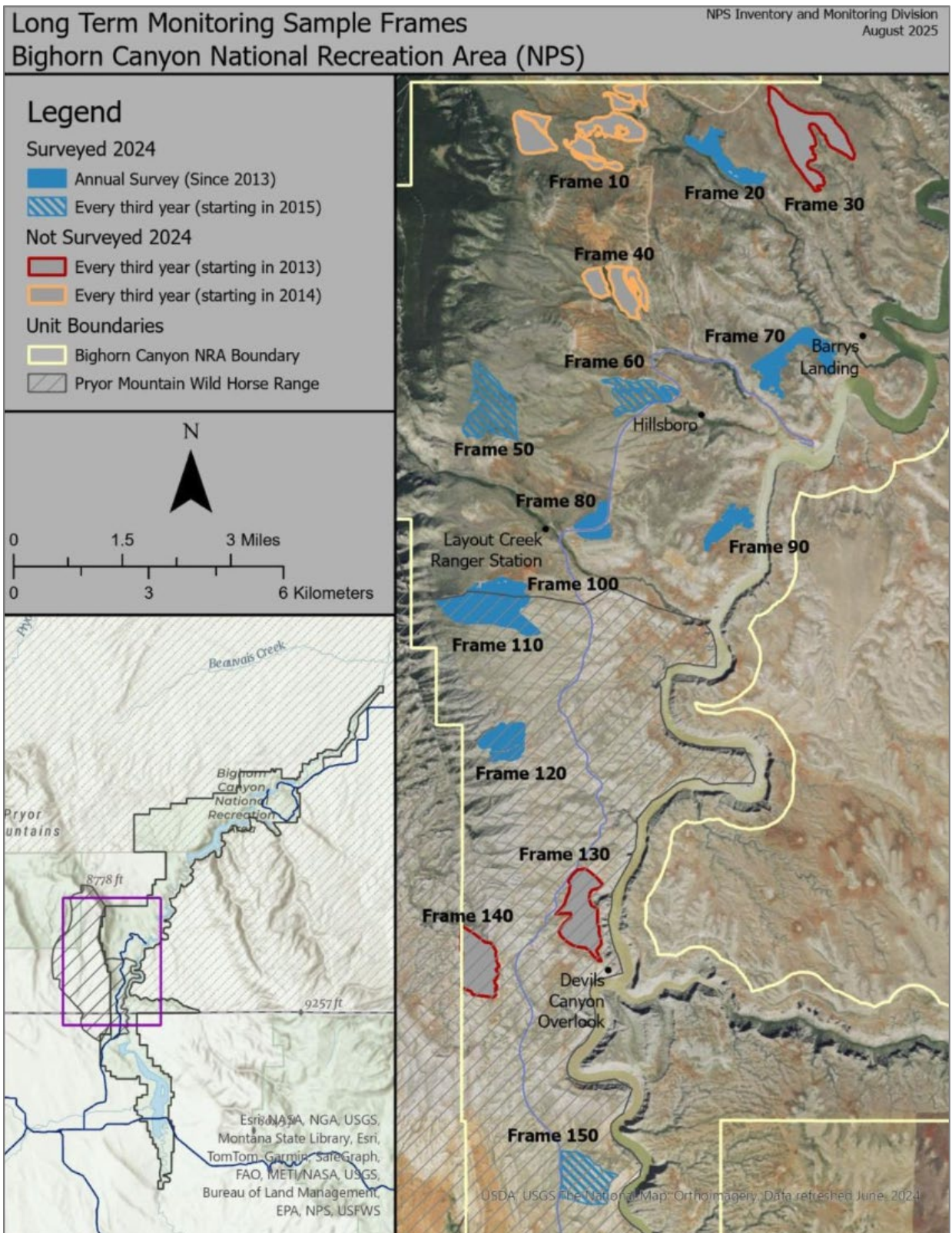


**Figure 1.** Long-term vegetation monitoring sample frames in Bighorn Canyon National Recreation Area, showing the location, survey frequency, and status of frames surveyed in 2024.

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Cover (percentage of the ground covered by a plant as viewed from above) is calculated for targeted species collected in the quadrats. This can be used to describe the abundance and distribution of each targeted species across frames and over time. Cover of bare ground, litter, cryptobiotic soil crust (living crust that stabilizes soil), and plains prickly pear are recorded within each quadrat. Increases in these cover types can be an indicator of disturbance and loss of desirable native vegetation over time. To present an absolute cover amount of each targeted species within a frame, we used a midpoint methodology (using the midpoint of Daubenmire cover observation bins to estimate cover for each species in a quadrat). These quadrat midpoints are averaged across a frame to estimate cover of a species within a frame. Targeted vegetation cover across frames for species with greater than 0.5% cover is shown in Appendix B.

## Observed Species

In 2024, 28 targeted native and non-native species were observed in Bighorn Canyon. The list of species—including litter, bare ground, and opuntia—and their corresponding functional group (a group of species that share traits and roles in an ecosystem, such as grasses or shrubs) is shown in Appendix A. For each targeted species, the frequency of observations (the number of quadrats in which this species was observed) was determined. While frequency alone cannot provide information on species abundance, it can, when coupled with absolute cover, help describe species abundance within the survey area. Frequency of observations for species observed in 2024 and their corresponding functional group are shown in Figure 2.

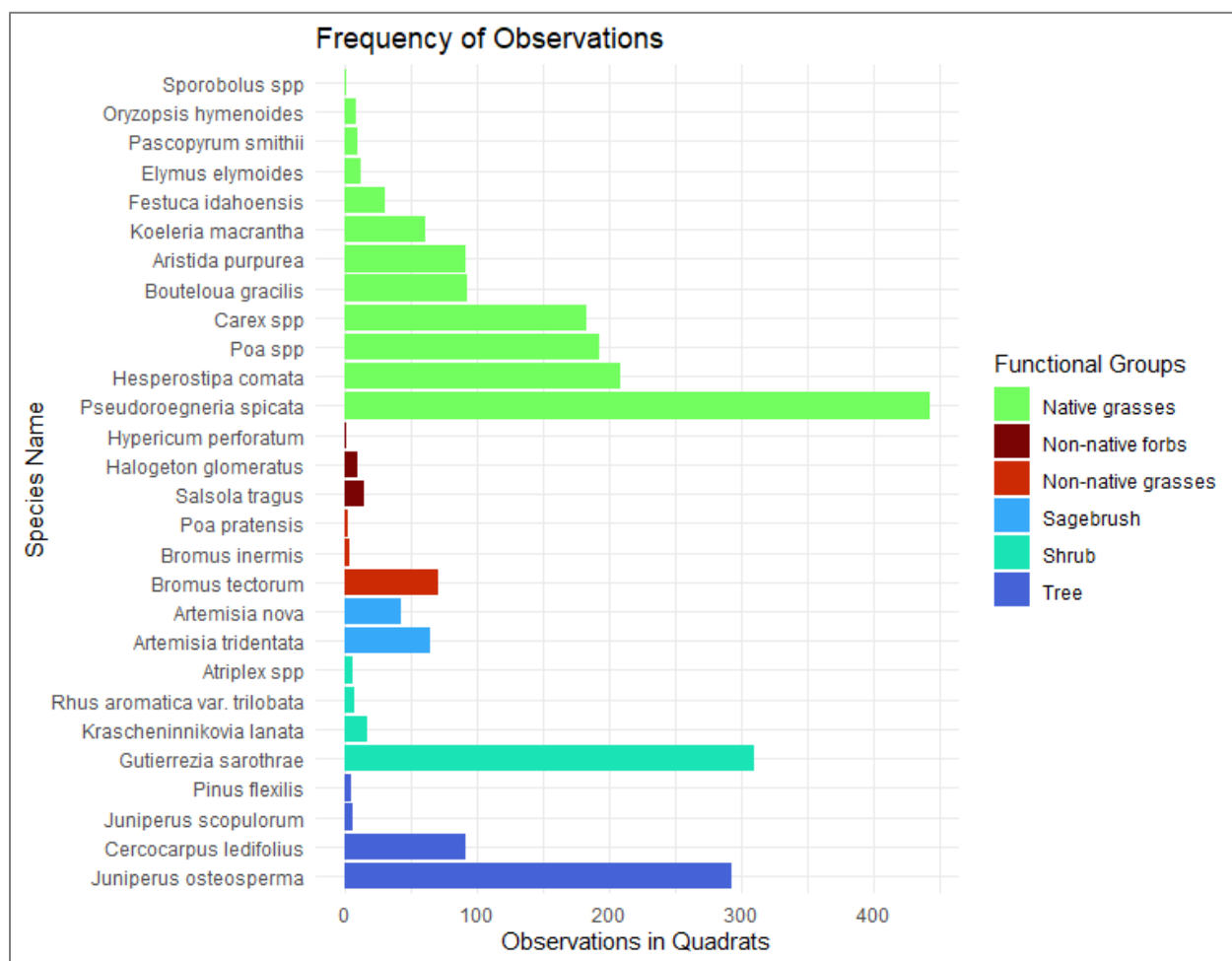


**Figure 2.** Frequency of observations for each species recorded in 2024, arranged by functional group, across the 575 quadrats surveyed in 10 frames in Bighorn Canyon National Recreation Area. Bluebunch wheatgrass (*Pseudoroegneria spicata*) was documented in the greatest number of quadrats.

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As outlined in this protocol, cover of cryptobiotic soil crust, plains prickly pear, bare ground, and litter is recorded in every quadrat, whether present or not. Therefore, a record of observation exists

for each of these within the 575 quadrats surveyed in 2024. These records are not shown in Figure 2, since there is record for all 575 quadrats.

## Vegetation Cover

Vegetation absolute cover (hereafter referred to as “cover”) can be used to track changes in targeted plant species abundance and occurrence within vegetative communities over time for each of the frames. For example, Frames 50 and 60 were selected to target juniper woodland vegetation communities. Data collected in 2024 showed the continued presence of Utah juniper and relatively low cover of other shrubs and grasses.

It is important to consider both cover and frequency (the number of quadrats a species was observed) of targeted species to gain an understanding of vegetation composition within the frames. For instance, in many of the quadrats the most prevalent species by cover are mountain mahogany, Utah and Rocky Mountain juniper, and species of Big sagebrush (*Artemisia tridentata*) and black sagebrush (*Artemisia nova*). The growth form of these species typically results in them covering more ground in a quadrat and therefore have higher cover class values than individuals of other functional groups such as native grasses. The most frequently observed species was bluebunch wheatgrass. It was also the native grass with the highest cover across all frames. So, while the species with the highest cover across all frames and functional groups is Utah juniper, it occurred less frequently than bluebunch wheatgrass.

## Recruitment

A total of 182 juniper recruits (179 Utah juniper recruits and 3 Rocky Mountain juniper recruits) were detected in Frames 20, 50, 60, 90, 100, 110, 120, and 150 (Figure 3). A total of 167 mountain mahogany recruits were detected in Frames 120 and 150 (Figure 4). Mountain mahogany was observed in Frame 20; however, no mountain mahogany recruits were detected in Frame 20 in 2024.

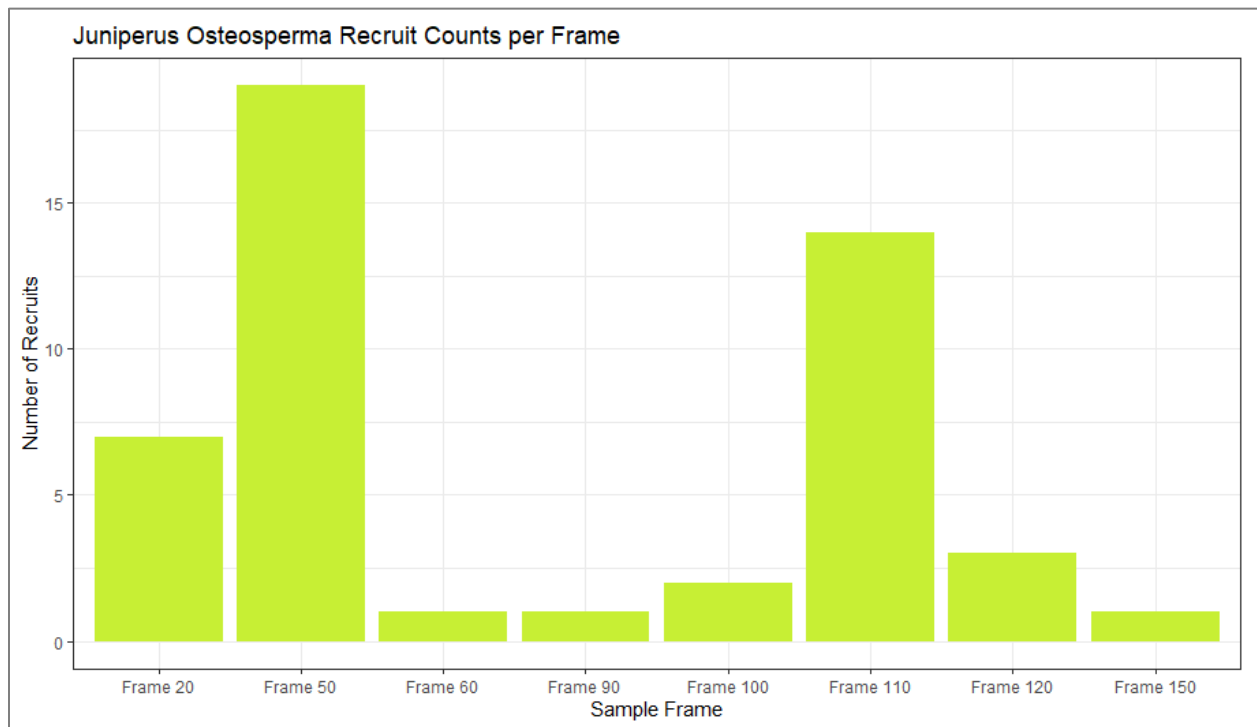


**Figure 3.** Number of Utah juniper recruits detected per frame in 2024.

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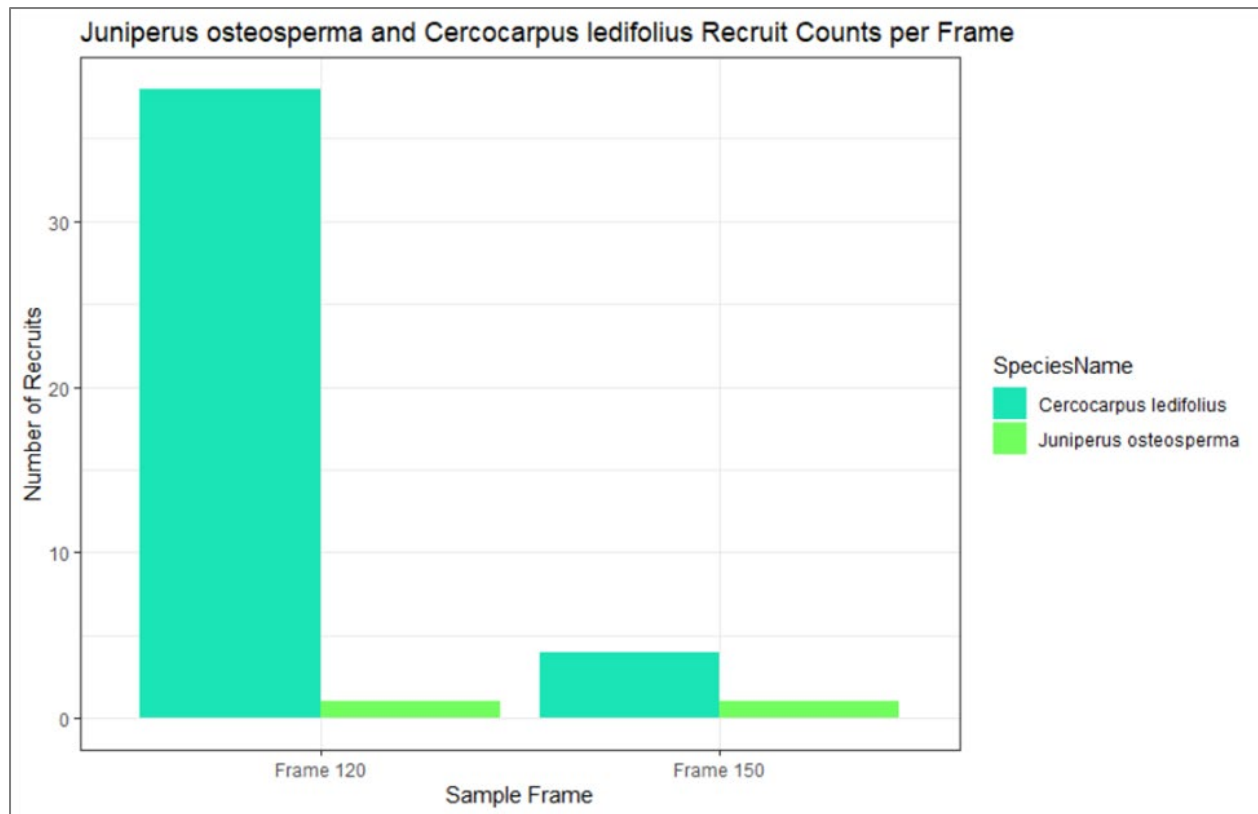


**Figure 4.** Number of mountain mahogany and Utah juniper recruits detected in Frames 120 and 150 in 2024, the only frames where mountain mahogany recruits were observed.

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## Invasive Species

Invasive species in both the non-native grass and non-native forb functional groups were observed during 2024 surveys and include cheatgrass (*Bromus tectorum*), smooth brome (*Bromus inermis*), saltlover (*Halogeton glomeratus*), St. Johnswort (*Hypericum perforatum*), Russian thistle (*Salsola tragus*), and Kentucky bluegrass (*Poa pratensis*). Invasive species were observed in Frames 50, 60, 70, 80, 90, and 150 (Figure 5).

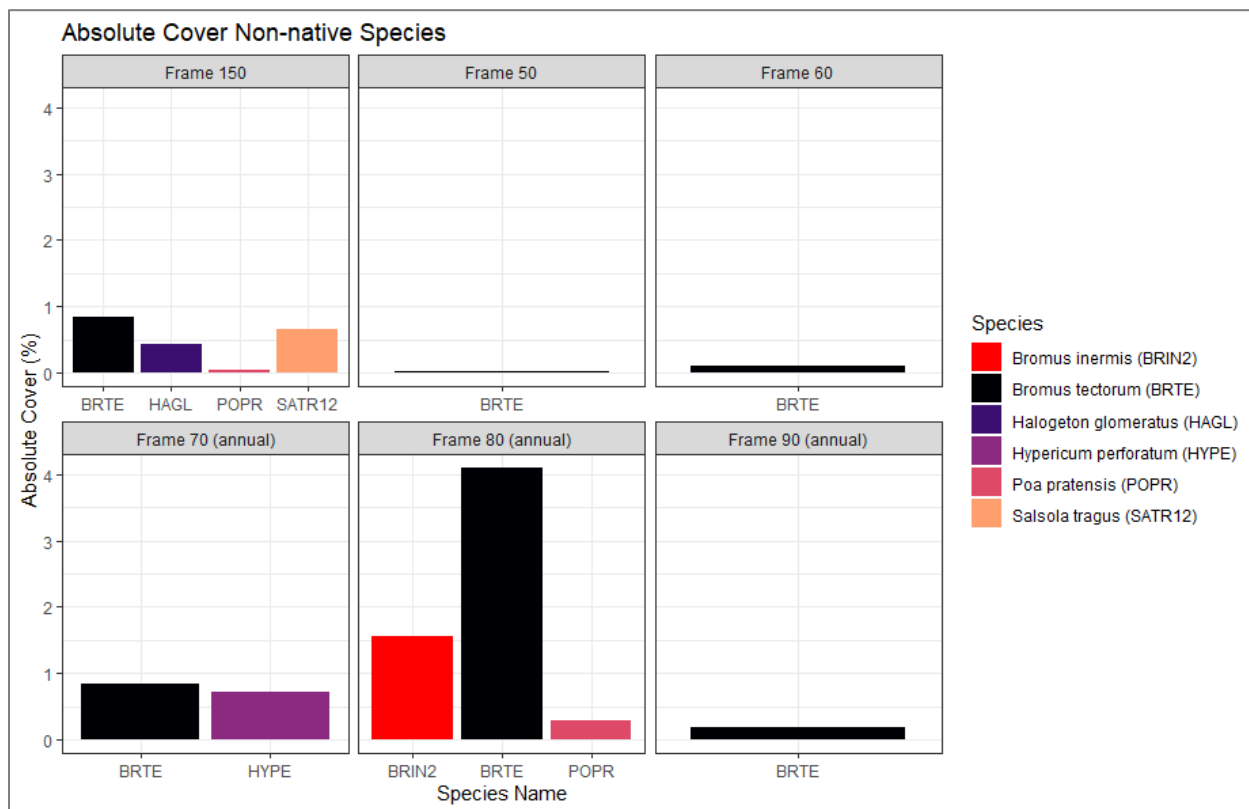


**Figure 5.** Absolute cover (%) occupied by invasive species observed in six of ten monitoring frames at Bighorn Canyon during the 2024 surveys. Frames 70, 80, and 90 are surveyed annually, and Frames 50, 60 and 150 are surveyed on a three-year rotation. Cheatgrass was the most widespread invasive species and had the highest cover across all frames.

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Invasive species were detected in 6 out of the 10 frames surveyed in 2024. The invasive species observed with the greatest frequency, highest absolute cover, and in 6 frames was cheatgrass. Frame 80 had the highest absolute cover of invasive species including cheatgrass, smooth brome, and Kentucky bluegrass. The frame with the greatest number of invasive species was Frame 150 with four different species detected including cheatgrass, saltlover, Russian thistle, and Kentucky bluegrass. Prior to 2011, a prescribed burn was conducted within this frame to reduce juniper to improve habitat for bighorn sheep. St. Johnswort was observed in Frame 70. This is the first time this species has been detected in Bighorn Canyon. This new detection is one example of the benefit of

this long-term monitoring program and an opportunity to remove this invasive plant before it becomes more difficult to manage. Invasive species, including cheatgrass, are a management concern because they can affect fire regimes (patterns of wildfire occurrence), compete with native plants.

## Tent Caterpillars

Curl-leaf mountain mahogany provides forage for many species of ungulates including Bighorn Canyon's namesake, the Rocky Mountain bighorn sheep (*Ovis canadensis*). A recent study (Kissell et al. 2025) modeled the vulnerability and potential changes in distribution of mountain mahogany to warming temperatures and changes in precipitation at Bighorn Canyon. Shifts to the range or abundance of mountain mahogany may cause impacts on ungulate forage behaviors. Mountain mahogany was observed in three frames in 2024 (Frames 20, 120, and 150). When mountain mahogany is observed within a quadrat, it is examined for the presence of tent caterpillars (*Malacosoma californicum*)—insects that strip leaves from broadleaf trees and shrubs. In 2024, tent caterpillars were present in each frame with mountain mahogany (Figure 6). The impact of tent caterpillars on mountain mahogany in Bighorn Canyon is not well understood; however, caterpillar-caused leaf loss could further impact growth of plants already stressed by the environment (Ciesla and Ragenovich 2007). Understanding the vulnerability of mountain mahogany and potential impacts from tent caterpillars can enhance management of this species.

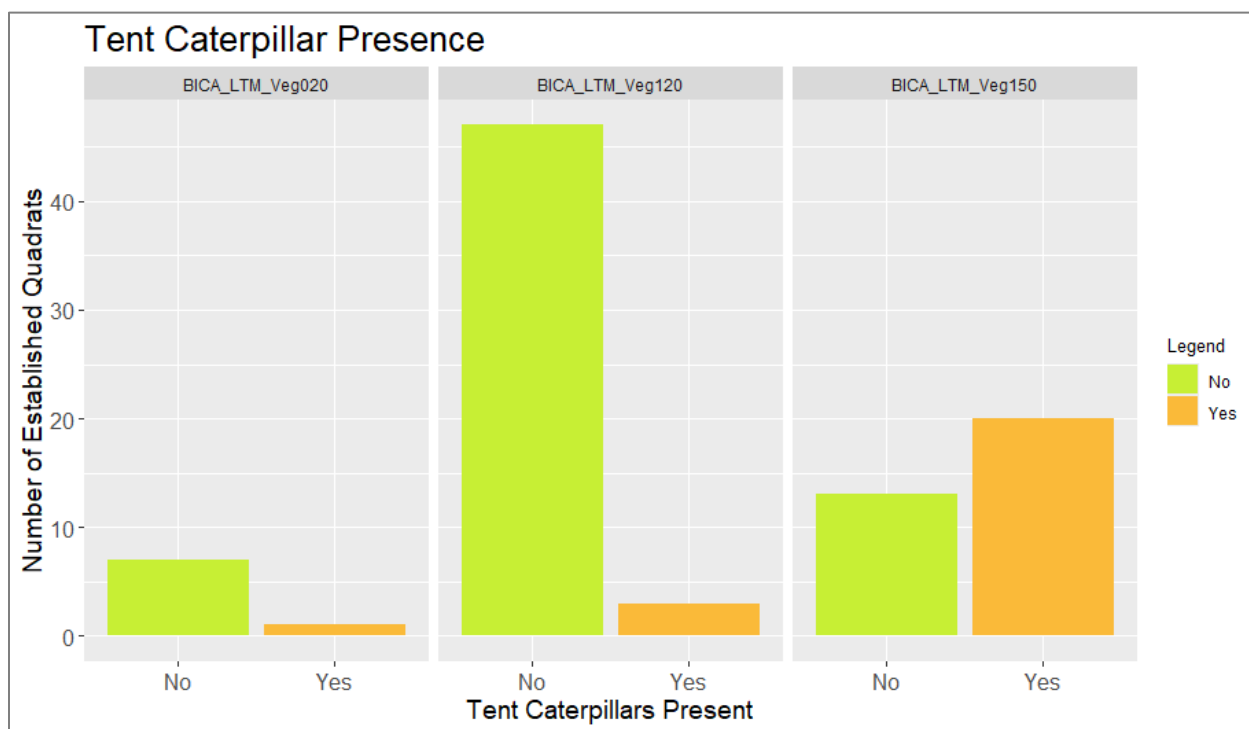


**Figure 6.** Number of established quadrats with and without tent caterpillars in frames where Rocky Mountain mahogany was present (Frames 20, 120, and 150).

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## **Photo Points**

Each frame has one or more photo points. At each photo point, pictures are taken in cardinal directions (north, east, south, west). Photo point images are available upon request. Appendix B includes one photo point image to illustrate the vegetation composition for each frame.

## **Conclusion**

Annual upland vegetation surveys have been conducted by GRYN since 2011. Future work includes continuing annual data summary reports and analyzing past data to determine whether vegetation community structure and cover have changed during this long-term monitoring program, with a focus on the introduction and spread of invasive species within Bighorn Canyon. This includes confirming the presence of St. Johnswort during subsequent surveys.

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## Appendix A

This appendix provides a complete list of species recorded in Bighorn Canyon in 2024 along with their functional group classifications (Table 1).

**Table 1.** All species in Bighorn Canyon observed in 2024 surveys and their corresponding functional group.

| Scientific Name                             | Common Name                 | Functional Group   |
|---------------------------------------------|-----------------------------|--------------------|
| cryptobiotic soil crust                     | cryptobiotic soil crust     | crust              |
| <i>Opuntia polyacantha</i>                  | plains prickly pear         | forb               |
| bare ground                                 | Bare ground                 | ground             |
| litter                                      | litter                      | litter             |
| <i>Aristida purpurea</i>                    | three awn                   | native grasses     |
| <i>Bouteloua gracilis</i>                   | blue grama                  | native grasses     |
| <i>Carex</i> spp.                           | sedges                      | native grasses     |
| <i>Elymus elymoides</i>                     | squirreltail                | native grasses     |
| <i>Festuca idahoensis</i>                   | Idaho fescue                | native grasses     |
| <i>Hesperostipa comata</i>                  | needle-and-thread           | native grasses     |
| <i>Koeleria macrantha</i>                   | Junegrass                   | native grasses     |
| <i>Achnatherum hymenoides</i>               | Indian rice grass           | native grasses     |
| <i>Pascopyrum smithii</i>                   | western wheatgrass          | native grasses     |
| <i>Poa</i> spp.                             | bluegrasses                 | native grasses     |
| <i>Pseudoroegneria spicata</i>              | bluebunch wheatgrass        | native grasses     |
| <i>Sporobolus</i> spp.                      | dropseed                    | native grasses     |
| <i>Hypericum perforatum</i>                 | St. Johnswort               | non-native forbs   |
| <i>Salsola tragus</i>                       | Russian thistle             | non-native forbs   |
| <i>Halogeton glomeratus</i>                 | saltlover                   | non-native forbs   |
| <i>Bromus inermis</i>                       | smooth brome                | non-native grasses |
| <i>Bromus tectorum</i>                      | cheatgrass                  | non-native grasses |
| <i>Poa pratensis</i>                        | Kentucky bluegrass          | non-native grasses |
| <i>Artemisia nova</i>                       | black sagebrush             | sagebrush          |
| <i>Artemisia tridentata</i>                 | big sagebrush               | sagebrush          |
| <i>Atriplex</i> spp.                        | saltbush                    | shrub              |
| <i>Gutierrezia sarothrae</i>                | broom snakeweed             | shrub              |
| <i>Krascheninnikovia lanata</i>             | winterfat                   | shrub              |
| <i>Rhus aromatica</i> var. <i>trilobata</i> | fragrant sumac              | shrub              |
| <i>Cercocarpus ledifolius</i>               | curl-leaf mountain mahogany | tree               |
| <i>Juniperus osteosperma</i>                | Utah juniper                | tree               |

**Table 1 (continued).** All species in Bighorn Canyon observed in 2024 surveys and their corresponding functional group.

| Scientific Name             | Common Name            | Functional Group |
|-----------------------------|------------------------|------------------|
| <i>Juniperus scopulorum</i> | Rocky Mountain juniper | tree             |
| <i>Pinus flexilis</i>       | limber pine            | tree             |

## Appendix B

This appendix includes the absolute and vegetation ground cover charts and corresponding frame photographs presented in Figures 7–26. Vegetation and ground cover of species with over 0.5% cover across Frames 20, 50, 60, 70, 80, 90, 100, 110, 120, and 150. Frames surveyed annually include 20, 70, 80, 90, 100, 110, and 120. This protocol is designed to target the specific functional groups of graminoids, shrubs, trees, and non-native species.

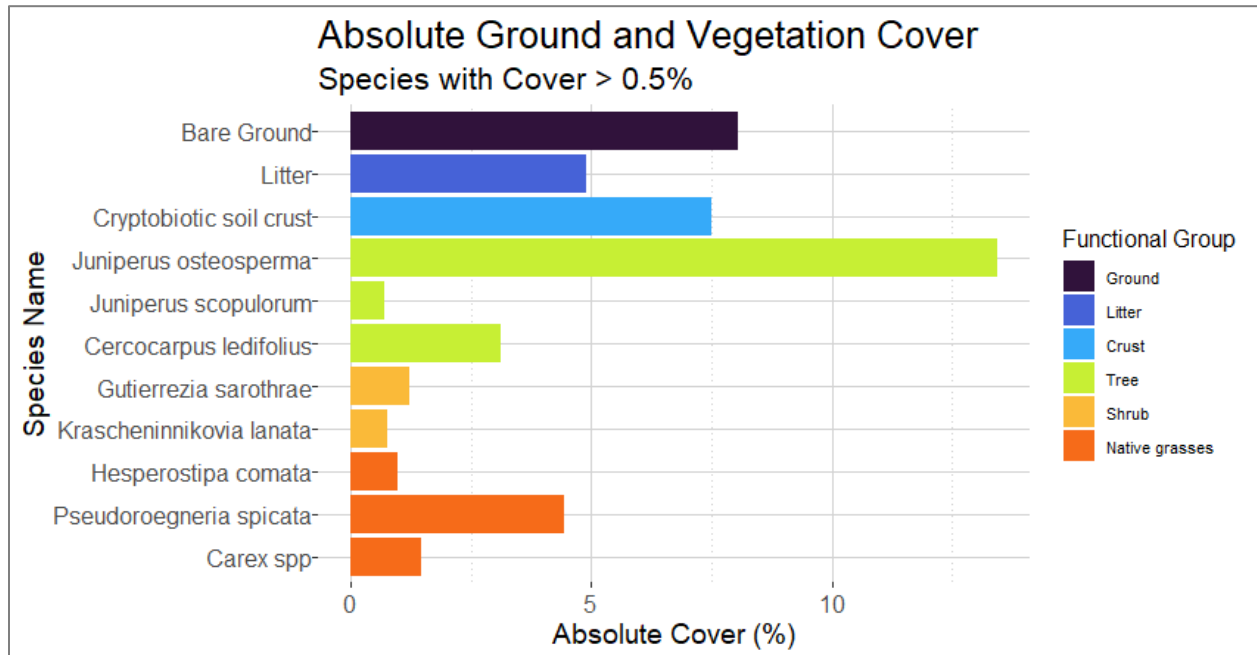


**Figure 7.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 20 (surveyed annually), categorized by functional group.

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**Figure 8.** Frame 20 (surveyed annually). Photo point 1, facing south, showing a landscape dominated by Utah juniper.

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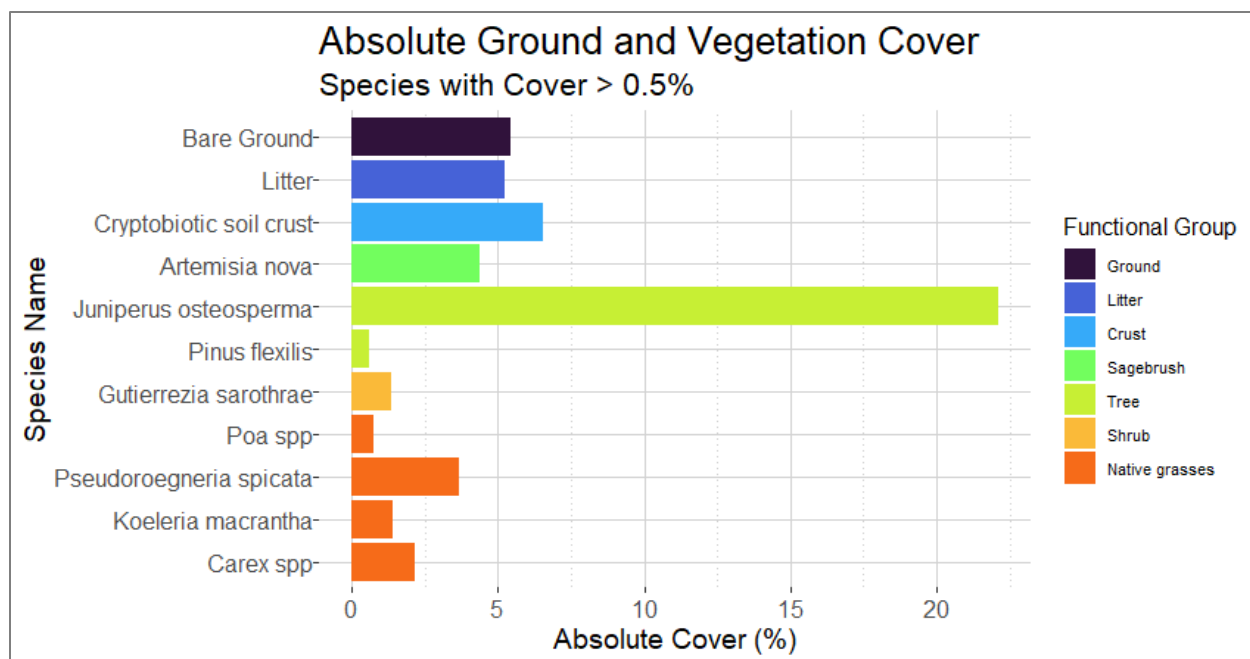


**Figure 9.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 50 (surveyed on a three-year rotation), categorized by functional group.

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**Figure 10.** Frame 50 (surveyed on a three-year rotation). Photo point 1, facing east, showing extensive dominance of Utah juniper across the landscape.

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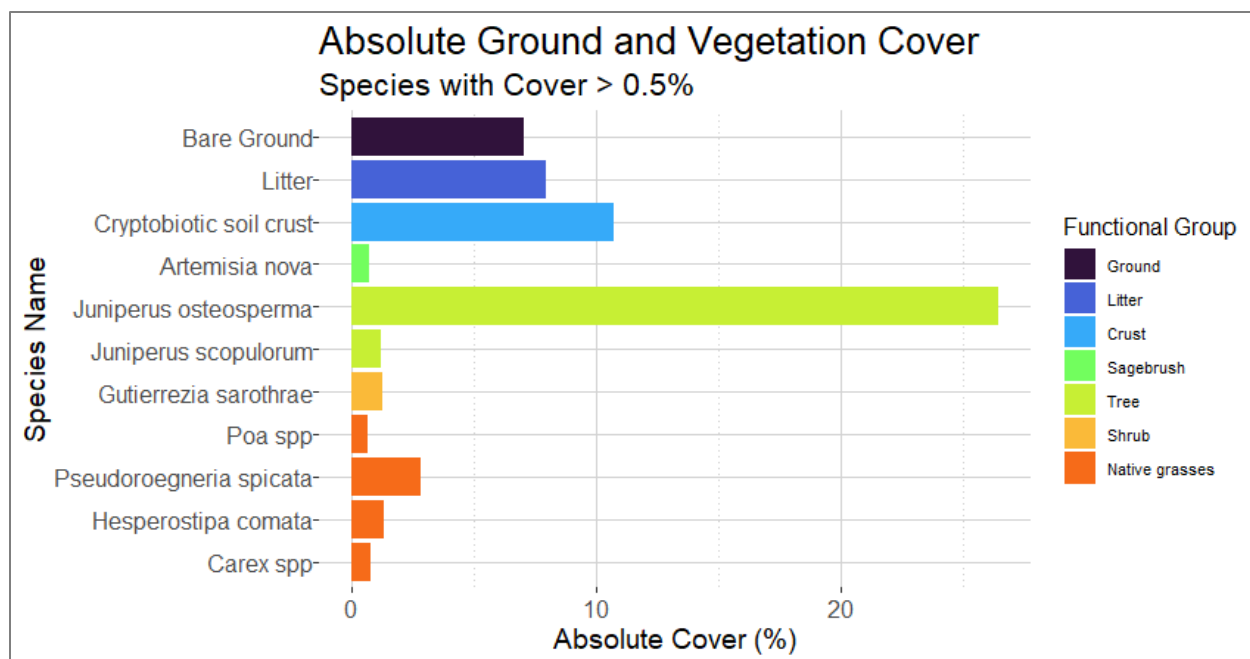


**Figure 11.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 60 (surveyed on a three-year rotation), categorized by functional group.

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**Figure 12.** Frame 60 (surveyed on a three-year rotation). Photo point 1, facing east, showing dominance of Utah juniper with scattered associated vegetation.

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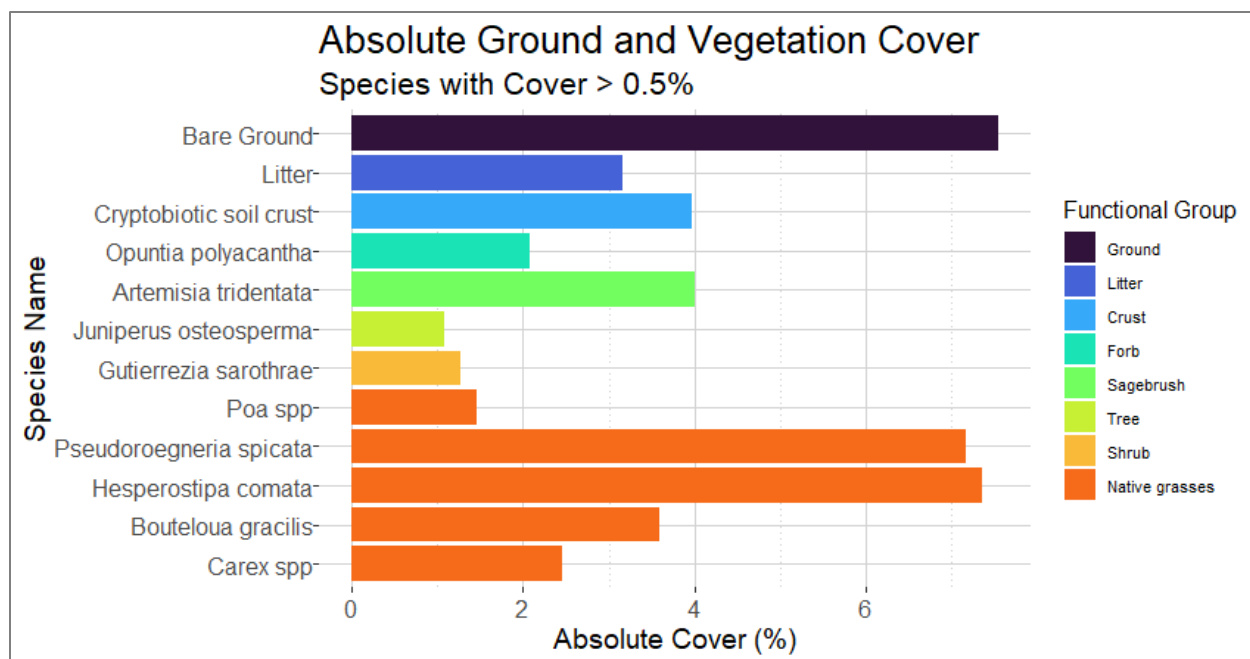


**Figure 13.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 70 (surveyed annually), categorized by functional group.

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**Figure 14.** Frame 70 (surveyed annually). Photo point 1, facing west, showing grass-dominated vegetation across the landscape.

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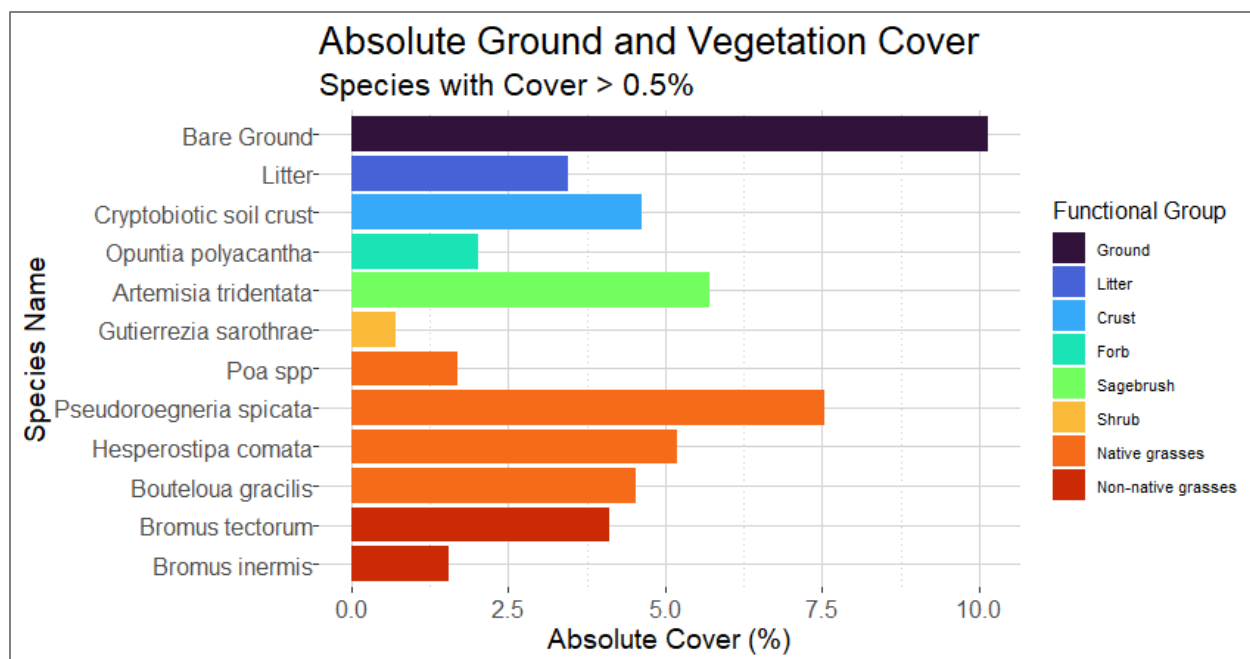


**Figure 15.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 80 (surveyed annually), categorized by functional group.

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**Figure 16.** Frame 80 (surveyed annually). Photo point 1, facing east, showing a mixed vegetation community with bare ground.

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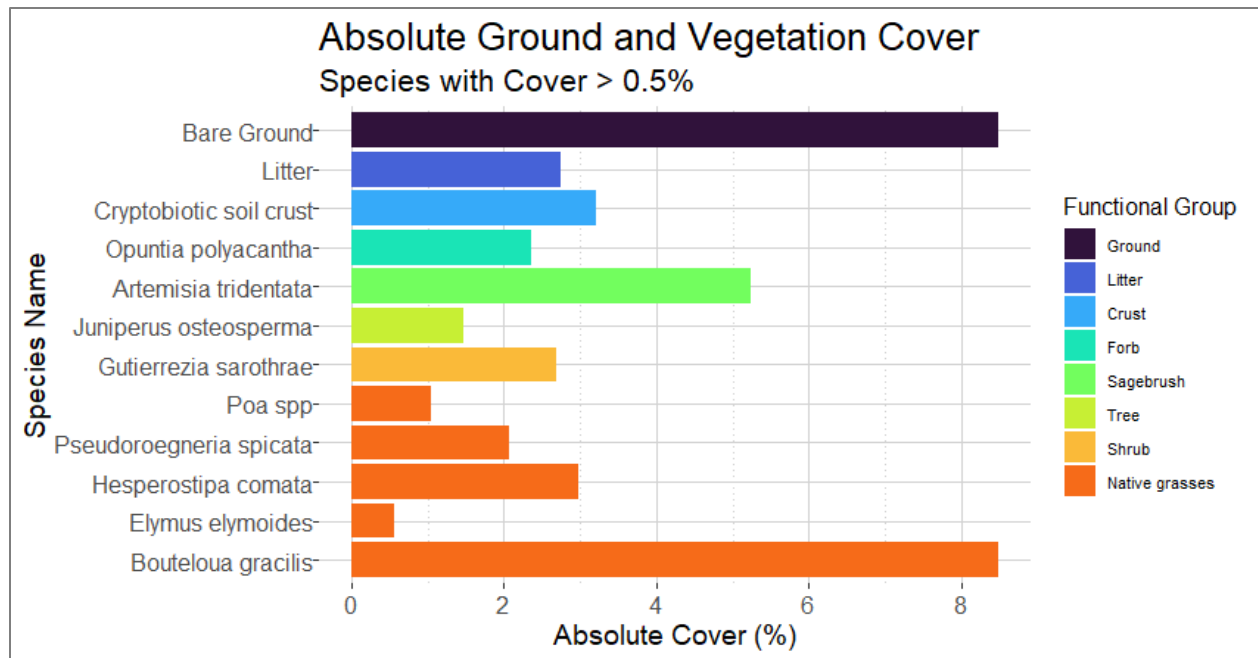


**Figure 17.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 90 (surveyed annually), categorized by functional group.

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**Figure 18.** Frame 90 (surveyed annually). Photo point 1, facing north, showing dominance blue grama and spaces of bare ground intermixed with big sagebrush.

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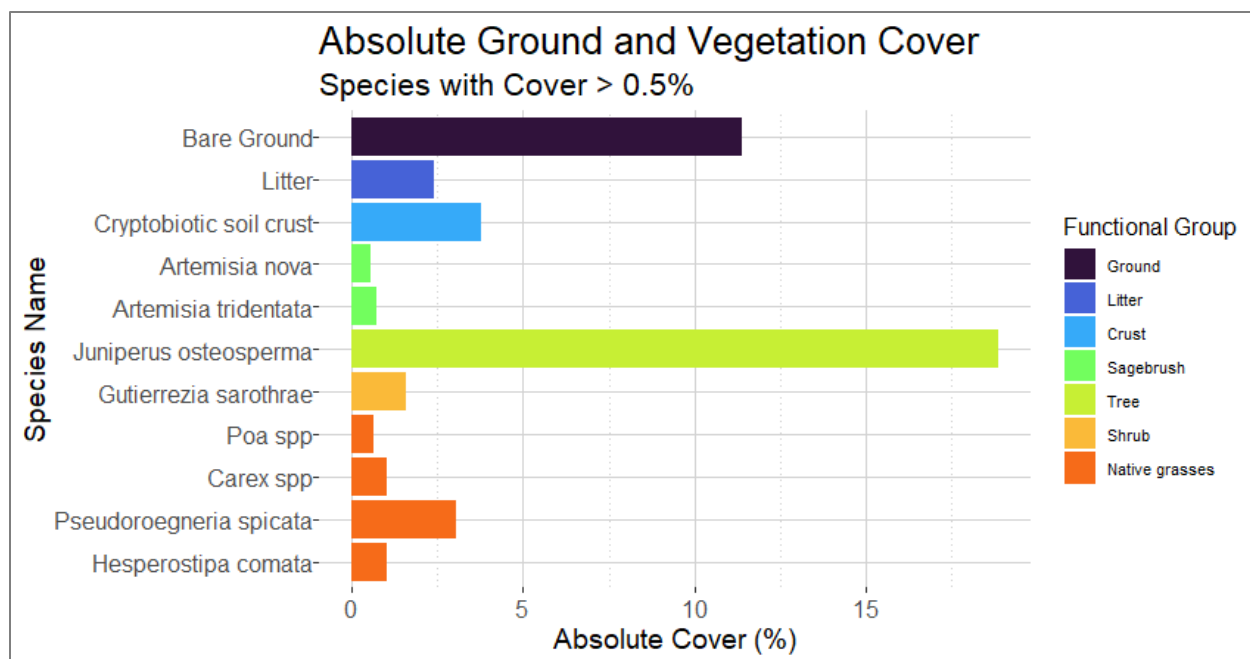


**Figure 19.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 100 (surveyed annually), categorized by functional group.

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**Figure 20.** Frame 100 (surveyed annually). Photo point 2, facing east, showing mixed vegetation with Utah juniper present.

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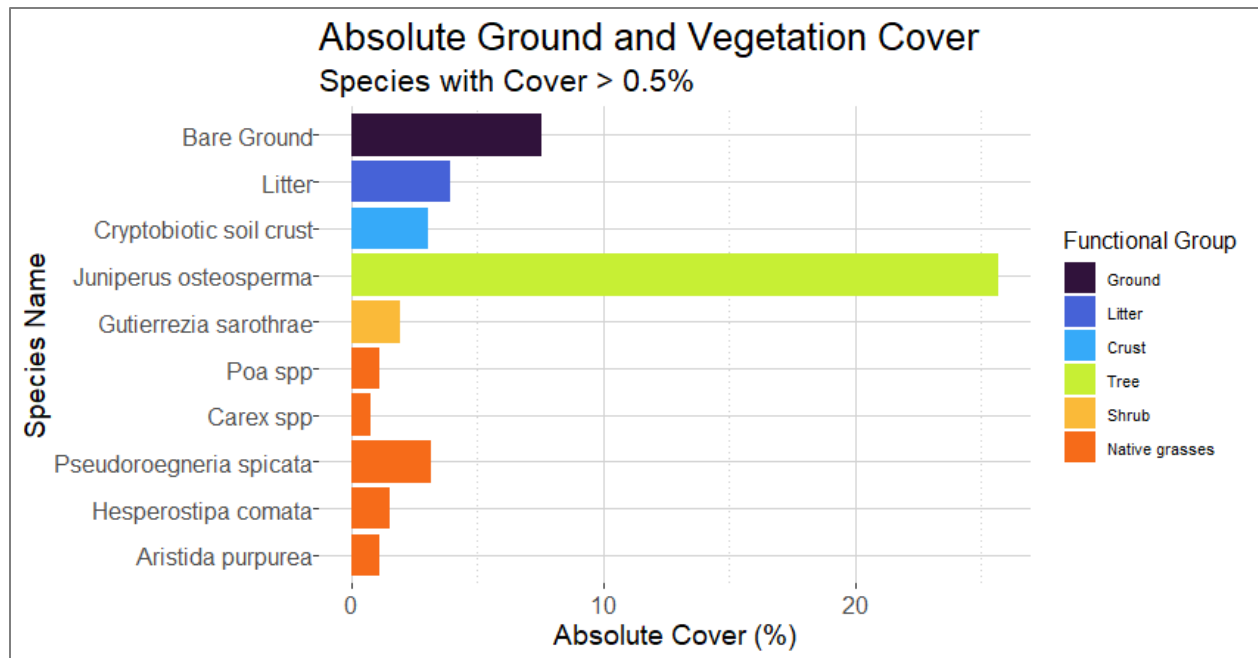


**Figure 21.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 110 (surveyed annually), categorized by functional group.

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**Figure 22.** Frame 110 (surveyed annually). Photo point 3, facing north, showing sparse vegetation with Utah juniper present.

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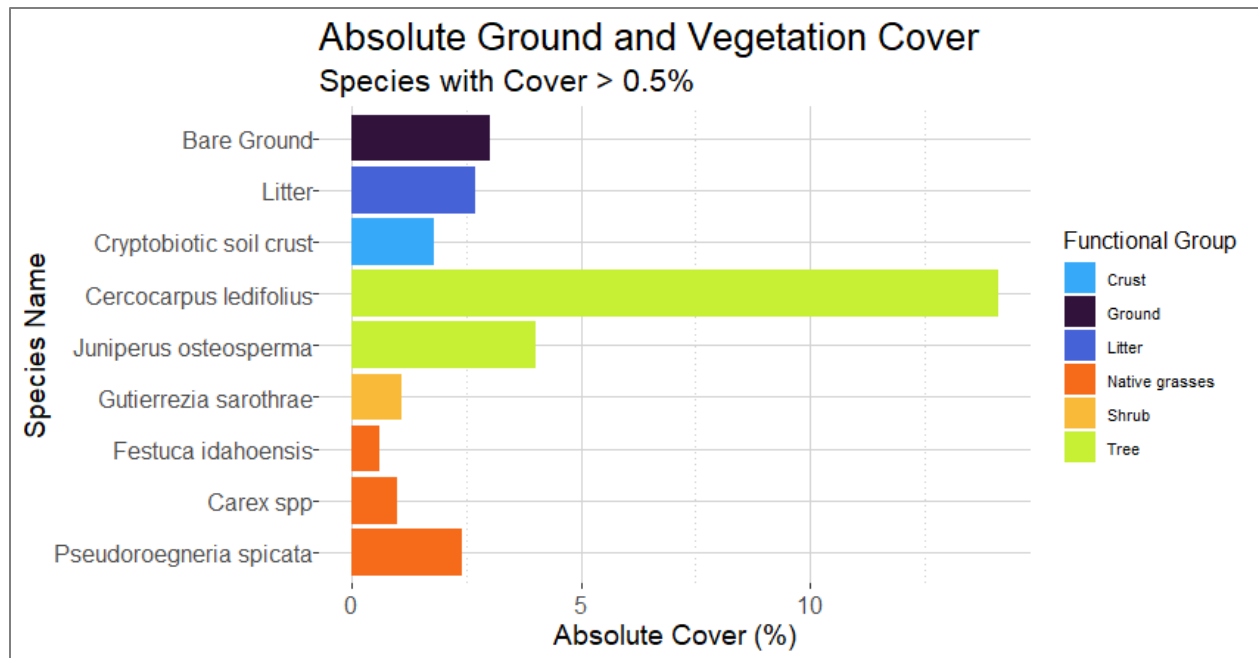


**Figure 23.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 120 (surveyed annually), categorized by functional group.

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**Figure 24.** Frame 120 (surveyed annually). Photo point 2, facing north, showing high cover of Utah juniper with limited graminoids.

*NPS*

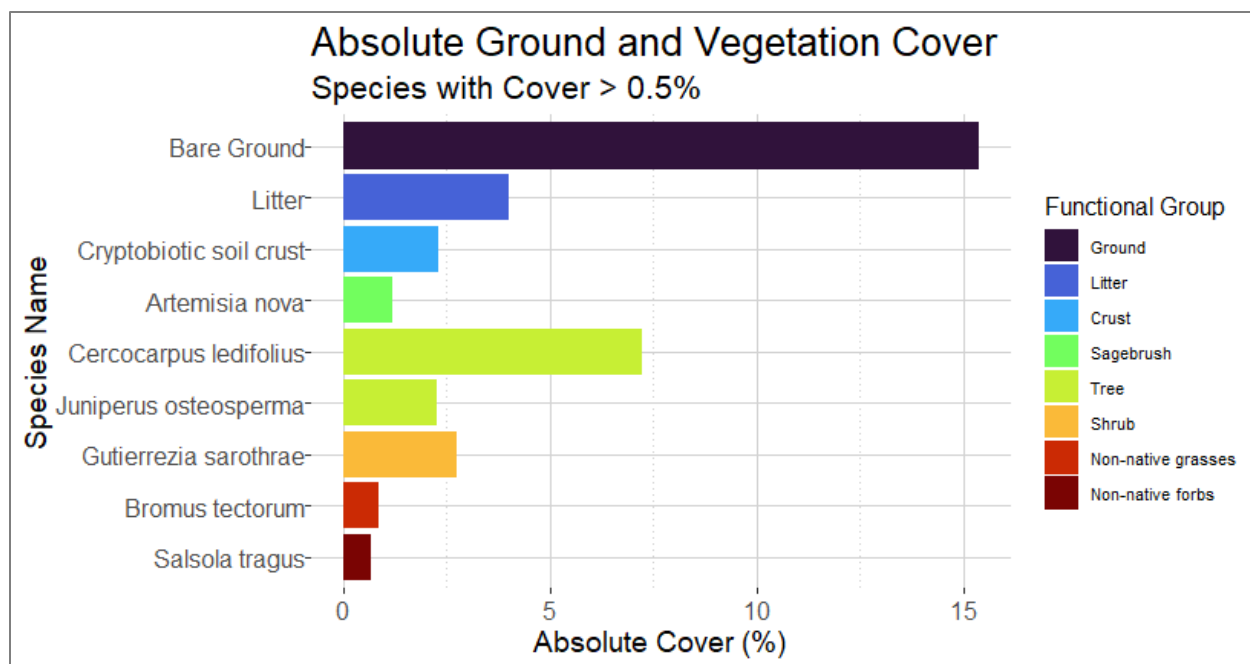


**Figure 25.** Absolute percent cover of ground components and plant species with cover > 0.5% in Frame 150 (surveyed on a three-year rotation), categorized by functional group.

NPS



**Figure 26.** Frame 150 (surveyed on three-year rotation). Photo point 2, facing west, showing extensive bare ground with scattered mountain mahogany.

*NPS*

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**Natural Resource Stewardship and Science**

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