2020 Grouse & Grazing Project
Vegetation Monitoring and Grazing Report
Pahsimeroi Valley Study Site

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INTRODUCTION

Livestock grazing is a common land use within sage-grouse (*Centrocercus urophasianus*) habitat, and livestock grazing has been implicated as one of numerous factors potentially contributing to sage-grouse population declines (Beck and Michell 2000, Schroeder et al. 2004). However, there are also numerous mechanisms by which livestock grazing might benefit sage-grouse (Beck and Michell 2000, Crawford et al. 2004). Livestock grazing on public lands is often restricted to limit negative effects on populations of plants and animals (including sage-grouse), but we lack experimental studies that have explicitly examined the effects of livestock grazing on sage-grouse. The objective of the Grouse & Grazing Project is to document the relationship between cattle grazing and sage-grouse demographic traits, nest-site selection, and habitat features. We focus on grazing regimes that include spring cattle grazing because spring is thought to be the time when livestock grazing is most likely to adversely affect sage-grouse (Neel 1980, Pedersen et al. 2003, Boyd et al. 2014).

Starting in 2018, we split our annual report for this project into several reports: one that summarizes field methods, sage-grouse demographic traits, and other data streams for all study sites, and a set of vegetation and grazing reports that summarize the habitat measurements and grazing metrics that we collect at each study site. Our goal in the vegetation monitoring and grazing reports (one for each study site) is to: 1) document the plant community at each site, 2) quantify the % biomass removed or utilization of forage species by cattle at each site, and 3) provide detailed data to assist BLM managers and permittees with management of their grazing and adherence to the Grouse & Grazing study design.

STUDY AREA

Pahsimeroi Valley

Pahsimeroi Valley is the newest study site for the Grouse and Grazing Project; we began work there beginning in 2017. The site is located 45 km southeast of Challis, ID at the upper end of the Pahsimeroi River Valley (Fig. 1). The study site sits between the Lemhi Range to the northeast and the Lost River Range to the southwest. This site has relatively flat topography in most locations, but includes some sloping foothills and higher-elevation hilltops. The Pahsimeroi River bisects the study area and several small creeks and irrigation ditches traverse the experimental treatment pastures. Soils in this area consist of moderately deep soils (>150 cm deep) that are composed of gravely loam and cobble with 1-40% slopes. The dominant plant community is low sage (*Artemisia arbuscula*) with Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) and three-tip

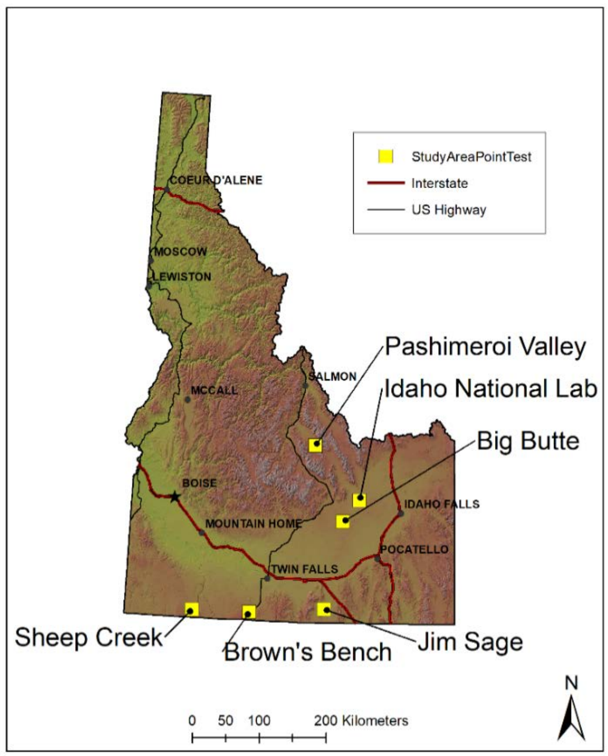
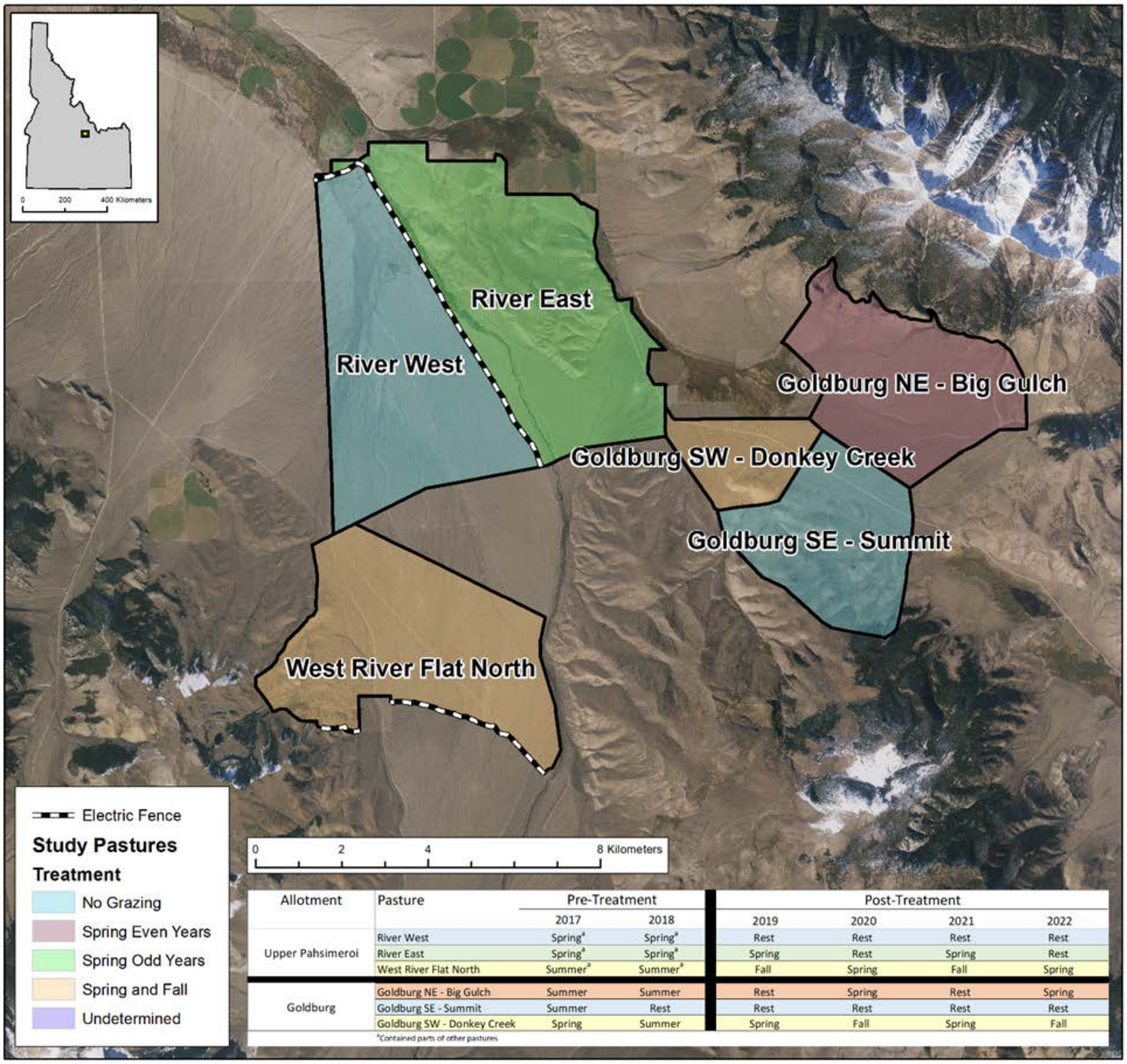


Figure 1. Six study sites in southern Idaho where field work has been conducted for the Grouse & Grazing Project 2014-2020.

sagebrush (*Artemisia tripartata*) on the deeper toe slopes and hilltops. The dominant perennial grasses include Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), and Thurber's needlegrass (*Achnatherum thurberianum*). Historical land use in the area was mining and livestock grazing (both cattle and sheep). There are some areas of center pivot irrigation just north of the experimental treatment pastures. Alfalfa, hay, and wheat are the primary agricultural crops.



Allotment	Pasture	Pre-Treatment		Post-Treatment			
		2017	2018	2019	2020	2021	2022
Upper Pahsimeroi	River West	Spring[a]	Spring[a]	Rest	Rest	Rest	Rest
	River East	Spring[a]	Spring[a]	Spring	Rest	Spring	Rest
	West River Flat North	Summer[a]	Summer[a]	Fall	Spring	Fall	Spring
Goldburg	Goldburg NE - Big Gulch	Summer	Summer	Rest	Spring	Rest	Spring
	Goldburg SE - Summit	Summer	Rest	Rest	Rest	Rest	Rest
	Goldburg SW - Donkey Creek	Spring	Summer	Spring	Fall	Spring	Fall

[a]Contained parts of other pastures

Figure 2. Map of experimental treatment pastures and timeline of treatments at the Pahsimeroi Valley study site, Idaho 2017-2020.

Elevation at the site ranged from 1,796-2,454 m (mean 1,999 m; USGS National Elevation Dataset). Precipitation comes primarily in the form of snow between November and March with 30-year normal averaging 220 mm per year (1980-2010). Monthly average temperature includes a low of -8.2° C (Dec) to a high of 18.6° C (Jul) based on the most recent

30-year normal (1980-2010). Landownership is a combination of Bureau of Land Management (BLM), State Trust, and private within the Upper Pahsimeroi and Goldburg allotments. In the Upper Pahsimeroi allotment, grazing is allowed to occur May 15 – September 30. In the Goldburg allotment, grazing is allowed to occur June 1 – August 15. Prior to the study, pastures were rested at least once every 3rd spring to allow forage species to be undisturbed during the growing season. The permittee in the Upper Pahsimeroi allotment runs approximately 500 cattle each year and the permittee in the Goldburg allotment runs 200-250 cattle each year.

Table 1. Summary of the vegetation data collected for the Grouse & Grazing Project at 6 study sites in southern Idaho, 2014-2020.

Data Stream	Time of Collection	Sample Locations	Years Collected	Purpose
Early Season Vegetation Monitoring	March - April	Nests from previous year and paired random plots	2017 – 2020	Quantify vegetation characteristics when hen is selecting nest site
Nesting Season Vegetation Monitoring	April - July	Nests from current year & random plots[1]	2014 – 2020	Quantify vegetation characteristics of current year nest sites and experimental treatment pastures
Brood Vegetation Monitoring	May - July	Locations where a hen with a brood was confirmed	2016 – 2020	Quantify vegetation at brood locations
Post-Growing Season Vegetation Monitoring	July - August	Random plots	2015 – 2020	Quantify height, obstruction, and utilization of grass
Utilization/Pattern Use Monitoring	July - August	Systematic transects throughout experimental treatment pastures	2015 – 2020	Quantify utilization and grass height
Utilization/Biomass Removal (grazing exclosure cages)	April (cages placed), August (clipped)	Random plots in spring grazed (current year) experimental treatment pastures	2016, 2018-2019	Quantify utilization and biomass removal
Plant Collections	April - August	Experimental treatment pastures and surrounding areas	2017 – 2020	Create a DNA reference database and a library of voucher specimens to confirm plant ID and use as a training guide

[1]From 2014-2017, we also measured nesting season vegetation at paired non-nest plots associated with each nest plot (100-200m away from each nest plot).

FIELD METHODS

We have written detailed field sampling protocols for all aspects of the Grouse & Grazing Project, including vegetation sampling protocols (*Sections 8-9 of* Conway et al. 2019). We are collecting the following vegetation data to help quantify sage-grouse habitat selection and cattle grazing intensity on the experimental treatment pastures associated with the Grouse & Grazing Project (Table 1):

- Early-season Vegetation Surveys
  - Nest plots from prior years
  - Paired random plots
- Nesting-season Vegetation Surveys
  - Nest plots from current year
  - Paired dependent non-nest plots
  - Random plots
- Brood Vegetation Surveys
  - Plots at sites used by hens with broods <42 days of age
- Lek Vegetation Surveys
  - Plots centered on sage grouse leks
- Post-growing Season Vegetation Surveys
  - Random plots
- Utilization Transects
  - Landscape appearance estimates along transects
  - Grass height and percent removal estimates along transects
- Grazing Exclosures (Discontinued in 2020)
  - Clipping above-ground biomass within grazing exclosure cages
  - Clipping above-ground biomass in paired grazed plots adjacent to cages
- Plant Collection Surveys

For sake of organization, we describe the nesting-season vegetation surveys first because they are the most detailed and then we describe the other types of vegetation surveys since many of them are a reduced version of nesting-season vegetation surveys.

Nesting-Season Vegetation Surveys

We measured nesting-season vegetation (at estimated hatch date for sage-grouse nests) at three types of plots: nest plots, paired non-nest plots (hereafter referred to as non-nest plots), and random plots. Nest plots were centered on sage-grouse nests. Each paired non-nest plot was associated with a specific nest plot (100-200m away in a random direction and centered on a sagebrush shrub large enough to contain a sage-grouse nest). We did not conduct surveys at non-nest plots in 2020. All random plots were within the experimental grazing pastures and were centered on a sagebrush shrub. We randomly generated 40 locations within each experimental treatment pasture that were no closer than 100 m from one another to create random locations to use for random plots.

Plot Placement in the Field

Each year, including 2020, we conducted vegetation sampling at a minimum of 20 random plots in each pasture (except at Pahsimeroi Valley in 2017-2019 because we monitored 7 pastures and did not have the personnel to complete 20 per pasture; we completed 10-15 per pasture instead). Starting in 2017, we only measured paired non-nest plots when time allowed (we placed priority on nest plots and random plots). We completed 50 paired non-nest plots in 2017, 0 in 2018, 3 in 2019, and 0 in 2020.

Nest plots were centered on the shrub (or rarely clump of grass) in which the hen built the nest. Non-nest and random plots were centered on a sagebrush shrub that was suitable for a sage-grouse nest (based on prior years' nest plot data). At each plot, we spread two 30-m tapes that intersected at the 15-m mark over the focal shrub (Fig. 3).

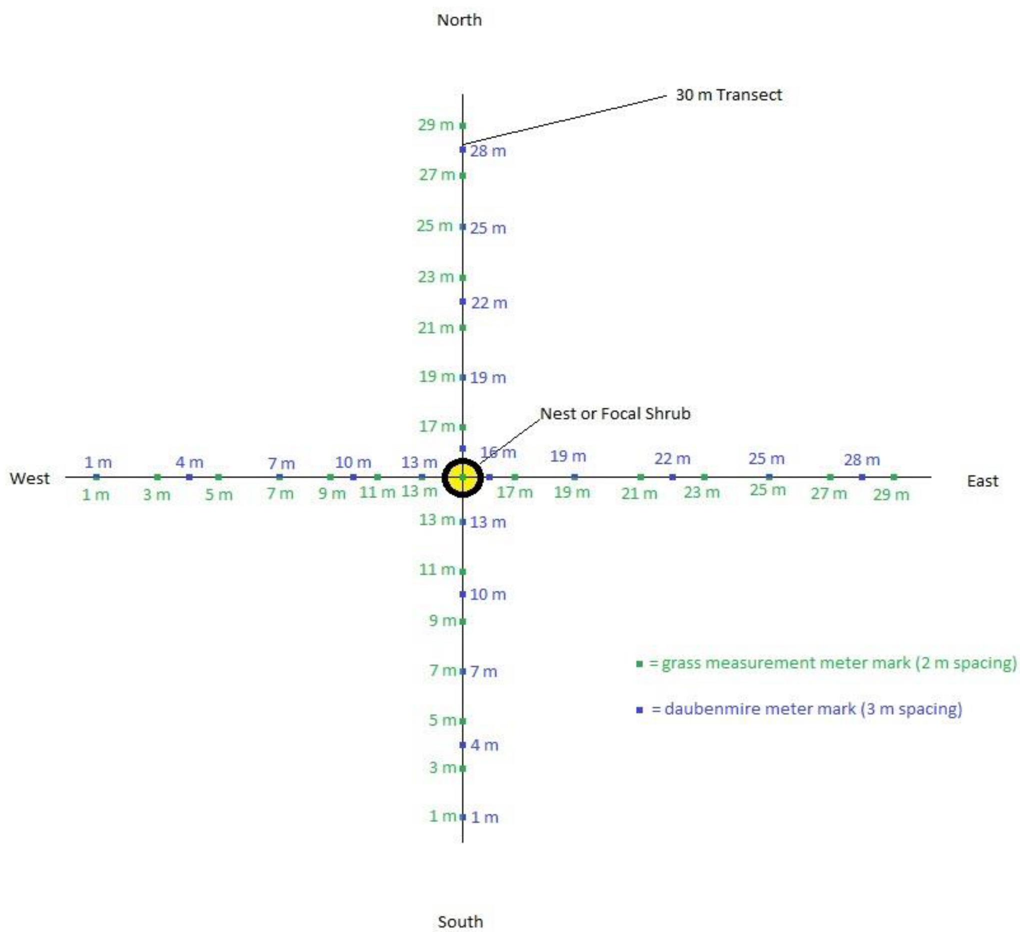


Figure 3. Visual depiction of the placement of two 30-m tapes stretched to conduct vegetation sampling at nest plots, random plots, and paired non-nest plots for the Grouse & Grazing Project in southern Idaho, 2014-2020.

Each plot (nest, non-nest, and random plots) consisted of 6 types of data collection:

1. a set of 5 photographs to estimate percent nest concealment
2. measurements of the nest or focal shrub (or the patch of shrubs)
3. two line-intercept transects to estimate percent shrub cover
4. estimates of perennial grass height (we do not measure heights for cheatgrass, *Bromus tectorum*, or other annuals) and grazing intensity (by grass species) along the line transects
5. Daubenmire plots to estimate percent ground cover
6. a count of herbivore fecal droppings along the line transects

Detailed descriptions of each of these 6 components are in our vegetation sampling protocols (Conway et al. 2019).

Landscape Appearance

We used the landscape appearance method (Coulloudon et al. 1999) to estimate utilization in experimental pastures (and potential experimental pastures at sites where the experimental pastures had not been selected yet). We used ArcGIS to randomly place a grid of north-south transects in experimental pastures and potential experimental pastures. If the pasture was grazed by livestock during spring/summer, we placed transects 300 m apart and sampled at 200-m intervals along each transect. If the pasture was not grazed by livestock during spring/summer that year, we instead placed transects 500 m apart and sampled at 200-m intervals (because we were expecting minimal utilization in pastures that did not have cows in them). At 200-m intervals along each transect, the observer stopped walking and estimated utilization according to the utilization classes in Coulloudon et al. (1999) (Table 2) within a 15-m radius half-circle in front of them. The observer also estimated the percent cover of cheatgrass and the most dominant overstory shrub and perennial grass within the same 15-m radius half-circle in front of them at each sample point along the transect (i.e., every 200 m).

Table 2. Utilization classes that we used to estimate percent utilization along landscape appearance transects (based on Coulloudon et al. 1999).

Utilization Class	Description
0-5%	The rangeland shows no evidence of grazing or negligible use.
6-20%	The rangeland has the appearance of very light grazing. The herbaceous forage plants may be topped or slightly used. Current seed stalks and young plants are little disturbed.
21-40%	The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60 to 80 percent of the number of current seedstalks of herbaceous plants remain intact. Most young plants are undamaged.
41-60%	The rangeland appears entirely covered[a] as uniformly as natural features and facilities will allow. Fifteen to 25 percent of the number of current seed stalks of herbaceous species remain intact. No more than 10 percent of the number of low-value herbaceous forage plants are utilized. (Moderate use does not imply proper use.)
61-80%	The rangeland has the appearance of complete search[b]. Herbaceous species are almost completely utilized, with less than 10 percent of the current seed stalks remaining. Shoots of rhizomatous grasses are missing. More than 10 percent of the number of low-value herbaceous forage plants have been utilized.
81-94%	The rangeland has a mown appearance and there are indications of repeated coverage. There is no evidence of reproduction or current seed stalks of herbaceous species. Herbaceous forage species are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.
95-100%	The rangeland appears to have been completely utilized. More than 50 percent of the low-value herbaceous plants have been utilized.

[a] "covered" means that foraging ungulates have passed through the area.

[b] "complete search" means that foraging cattle have spent considerable time foraging in the area and were not just passing through.

Cattle Use Metrics

Each year, we record the number and timing of cattle that graze each experimental treatment pasture and in the adjacent pastures that are near the experimental pastures. We communicated with range management specialists and permittees at each study site to document the number of cows and the dates that cattle were turned out and removed from each pasture. We collected this data for every year of the study at a given field site and ≥3 years prior to when we began field work.

SUMMARIZATION METHODS

Pasture Boundaries

The boundary of the pastures in the pre-treatment years was often not the same as the boundary of the pastures after the treatments were implemented. This was typically due to the installation of electric fences to cut existing pastures into two halves so that we could concentrate grazing pressure and allow ranchers more flexibility to meet the needs of the study while also achieving the goals of their operation (i.e., so that they only had to adhere to the study design within one half of a pasture). We used the boundary of the post-treatment pastures for all comparisons, even those that included years prior to the treatments.

Pasture Level

For comparison of grass metrics between pastures, we first calculated a mean for each sampling plot because plots were our primary sampling unit. We then used this plot mean to calculate a mean among all plots for an entire pasture. We compared mean droop height of grasses among pastures and years at each study site. For the current year (2020), we also compared grass droop heights within a pasture based on 4 categories: 1) all perennial species combined, 2) all perennial species excluding Sandberg bluegrass (*Poa secunda*), 3) all perennial grasses that were not under a shrub (out in the open), and 4) all perennial grasses that were under a shrub. For the latter two categories (under and not under a shrub), we used all perennial grass plants measured regardless of species (i.e., we included Sandberg bluegrass).

Grass Height Measurements

We measure the height of each perennial grass plant in an individual transect in 3 separate ways:

- Droop height – The tallest part of an individual perennial grass (including the flowering stalk)
- Leaf height **–** The tallest part of the grass plant excluding the flowering stalk (i.e., just the leaves)
- Effective height – A visual obstruction measurement created by placing a meter stick behind the grass plant and recording the lowest interval bar that was ≤50% obscured by the grass (Musil 2011, *detailed methods can be found in* Conway et al. 2019).

We compared these 3 different measurements between grazed and un-grazed pastures in 2020. We used the individual grass as the sample unit, not the plot, for these comparisons.

Shrub Cover

We compared shrub cover from the line-intercept transects among pastures and years. We estimated shrub cover by taking the length of the transects that were intercepted by shrubs and dividing it by the entire length of the 2 transects (60 m).

Utilization & Offtake

We estimated utilization and offtake via three different methods for this report: 1) Average of ocular estimates of biomass removed for individual grass plants on random vegetation plots, 2) proportion of grazed grass plants (i.e., proportion of grass plants with >0 biomass removed), and 3) utilization estimates via the landscape appearance method (Coulloudon et al. 1999). We compared estimates of biomass removed (via ocular estimation) and proportion of grazed plants at the pasture level for the current year (2020). These estimates were generated at the plot level from the post-growing season vegetation surveys. Those plot-level means were used to calculate pasture-level means. This was done to avoid pseudoreplication since the plot is our sampling unit.

For utilization via landscape appearance transects, we obtained pasture-level estimates by taking the mean of all points sampled within that pasture. We used the mid-point of the ranges outlined in Table 2 to represent each of the 6 categories (i.e., the “slight” category was the mid-point between 6 and 20, or 13).

We created maps of pattern use by herbivores in each pasture based on our visual estimates of utilization from the landscape appearance transects. We used the Inverse Distance Weighted (IDW) tool in ArcGIS (version 10.4) to interpolate utilization in areas between sampling points. IDW interpolation is based on the assumption that points closer together are more alike than those further apart. An advantage of using IDW interpolation is that it is an exact interpolator (i.e., the interpolated value at each point where a measurement was taken will line up directly with what was actually measured at that point). We used the 12 nearest neighbors to interpolate each pixel of the resulting raster surface. The resulting maps were then classified into the 6 utilization categories to help visualize the spatial variation in utilization (see categories in Table 2).

Stocking Rate

We calculated stocking rates in Animal Unit Months (AUMs) for all years after our treatments began at each study site. We calculated AUMs by using the following formula:

$$\frac{n_c \times (t_1 - t_2)}{(\frac{365}{12})}$$

Where n_c is the total number of cow-calf pairs turned out in that pasture, t_1 is the initial turn-out date, and t_2 is the date they were removed from the pasture. If there were different stocking rates across a given season (e.g., 100 cows were added for the first 10 days and then 100 cows were added on the 11th day), we calculated AUMs for each separate stocking rate and summed them together to report the stocking rate for the entire season.

RESULTS

Weather

Going into the 2020 growing season, overwinter precipitation at the Pahsimeroi Valley study site was below average (60 mm from Nov-Apr compared to the 30-year normal of 99 mm; Fig. 4A). Average maximum daily temperatures over the course of the 2020 growing season were within a degree or two of the average (Fig. 4B). The weather station in the area malfunctioned after the first week of April and no data was collected 8 Apr – 9 May which likely led to a lower precipitation and temperature estimate for the month of April. In general, 2020 was a drier year with roughly equivalent temperatures to what has been observed over the last 30 years.

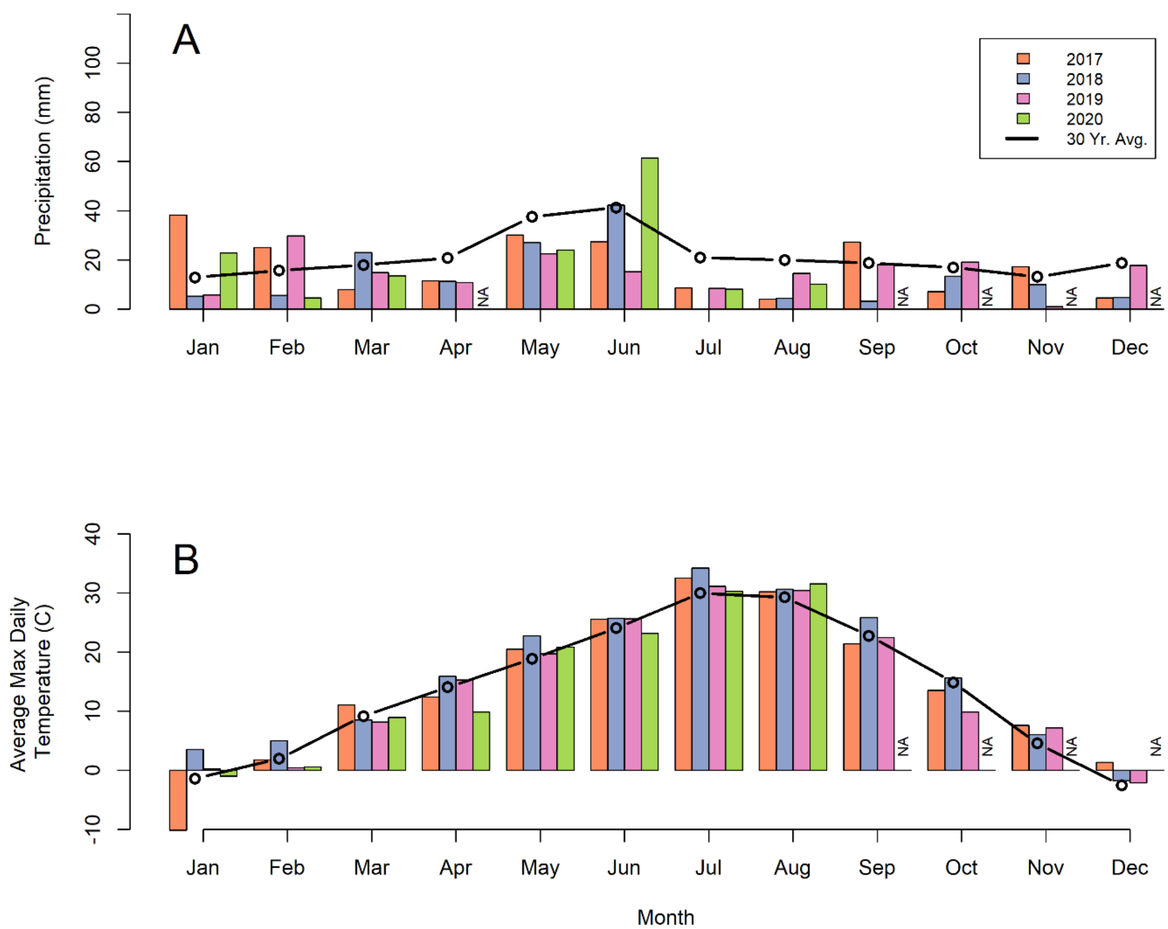


Figure 4. Monthly precipitation totals (A) and average max daily temperature (B) by month with 30-year average (dark line) at Pahsimeroi Valley, Idaho 2017-2020.

Descriptive Vegetation Characteristics

Pasture-level Comparison

Mean grass height at Pahsimeroi Valley varied among years but in general has decreased since we began our initial field work there in 2016 (Fig. 5). The decrease in grass heights likely reflects decreasing overwinter precipitation amounts before the corresponding growing season. In 2020, grass height in most pastures increased by 4-5 cm between nesting season surveys to post-growing season surveys. The West River Flat North pasture was an exception; grass heights didn't change from the two surveys in that pasture. A thesis by Janessa Julson (2017) documented the extent of variation in grass height among our study sites.

The mean grass height under shrubs (red bars) was the tallest category for all pastures in 2020 (Fig. 6). Grasses at the Pahsimeroi Valley study site were typically more stunted in height and therefore when Sandberg bluegrass was excluded (yellow bars) it did not significantly increase mean grass height. All pastures experienced a similar increase in grass height from nesting season to post-growing season in all categories except under those under shrubs (red bars). The West River Flat North pasture was an exception and only had a very slight increase in grass heights between the two sampling seasons.

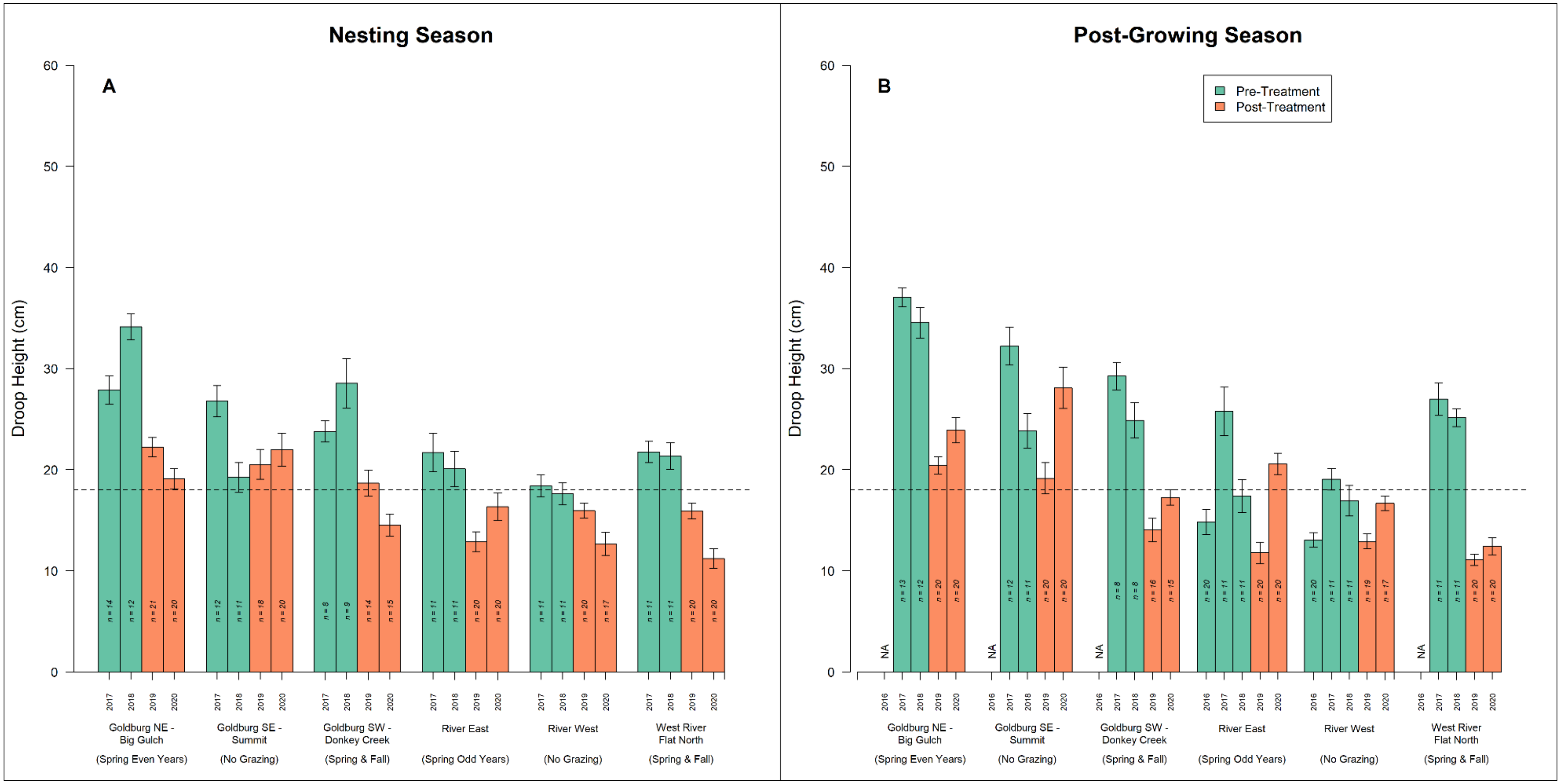


Figure 5. Mean droop height during the nesting season (A; Apr-Jun) and the post-growing season (B; Jul-Aug) for all perennial grass species combined in pre-treatment (green) and post-treatment (orange) years at Pahsimeroi Valley, Idaho 2016-2020. Error bars indicate standard errors, and means are based on random plots (excludes nest and non-nest plots). NA indicates a pasture that was not measured in that year. The dashed line represents 18 cm (7 in.), the height mentioned as a management target in the sage-grouse habitat guidelines (Connelly et al. 2000).

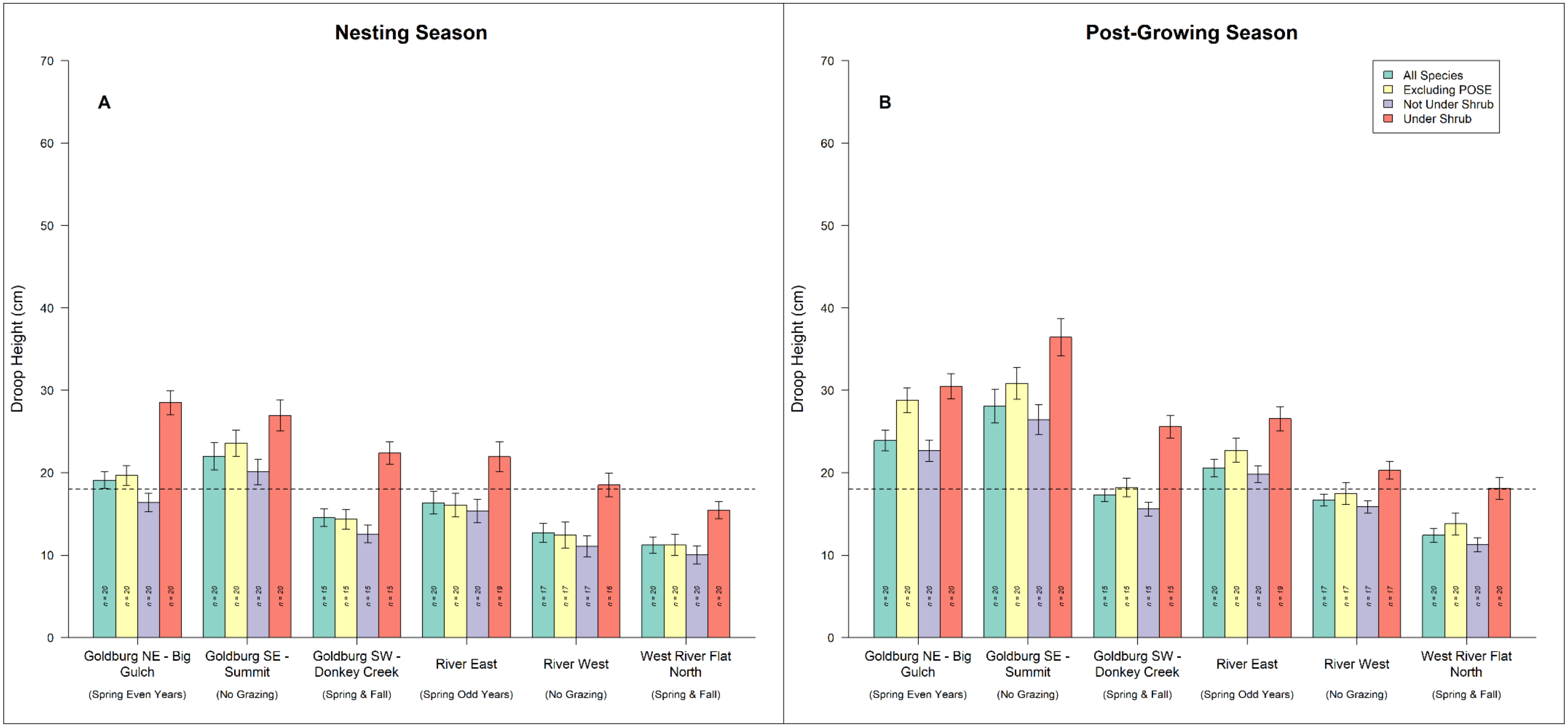


Figure 6. Mean droop height for 4 different subsets of grasses: all perennial grass species within a plot, all perennial grass species excluding Sandberg bluegrass (Poa secunda), all perennial grass plants that were under a shrub, and all perennial grass plants that were not under a shrub in both nesting season (A) and post-growing season (B) plots at the Pahsimeroi Valley study site in 2020. Error bars represent ±1 standard error. Sample sizes (n) indicate the number of plots (not the number of grass plants) used to create the mean and standard error. The dashed line represents 18 cm (7 in.), a height mentioned as a management target in the sage-grouse habitat guidelines (Connelly et al. 2000).

Grass Height Measurement Comparison

Sandberg bluegrass, bluebunch wheatgrass, squirreltail (*Elymus elymoides*), needlegrasses (*Achnatherum spp.* and *Hesperostipa spp.*), and Idaho fescue were the most abundant grasses in our post-growing season surveys at Pahsimeroi Valley in 2020. Grass height differed among species and differences were apparent for all three grass height metrics (Fig. 7). All grasses that were measured in grazed pastures were shorter than those in ungrazed pastures for the droop height measurements except for bluebunch wheatgrass which was very similar between grazed and ungrazed pastures. This differnce in height was much less pronounced for both the leaf height and effective height measurements for most species (Fig. 7).

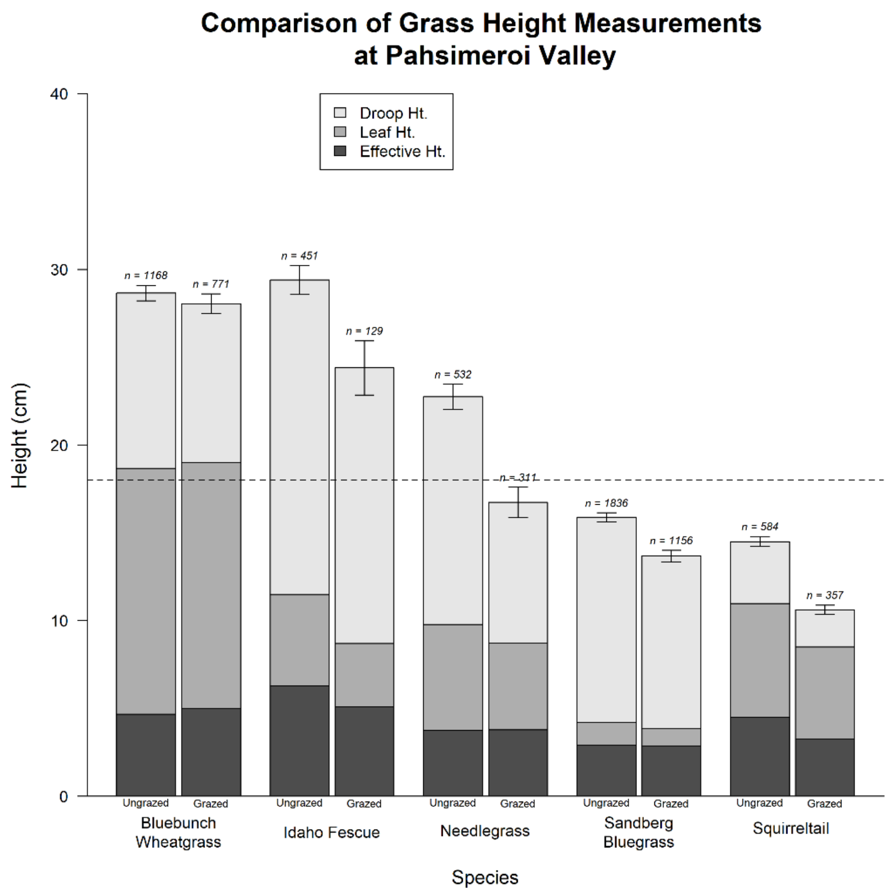


Figure 7. Mean height of the 5 most common species of perennial grasses based on 3 height metrics on post-growing season (Jul-Aug) random plots at Pahsimeroi Valley, Idaho in 2020. The 3 grass height metrics were droop height (using highest part of plant) = "Droop Ht.", droop height excluding the flowering stalk = "Leaf Ht", and effective height (modified visual obstruction for an individual plant) = "Effective Ht". Heights were compared seperately for plants in ungrazed and grazed pastures based on whether they were grazed in 2020 prior to post-nesting season surveys (denoted directly below each bar). Sample sizes are just below the top of each bar. Error bars denote ±1 standard error of the droop height only. The dashed line represents 18 cm (7 in.), the grass height mentioned as a management target in the sage-grouse habitat guidelines (Connelly et al. 2000).

Shrub Cover

Shrub cover was fairly consistent across years since 2017 (Fig. 8), but we observed slight decreases in sagebrush cover at most pastures in 2020. Sagebrush species, including low sagebrush, three-tip, and Wyoming big sagebrush, make up the majority of shrubs at Pahsimeroi Valley in all years. On all of our treatment pastures, we expect to see only small changes in shrub cover across years; changes caused by annual variation in precipition.

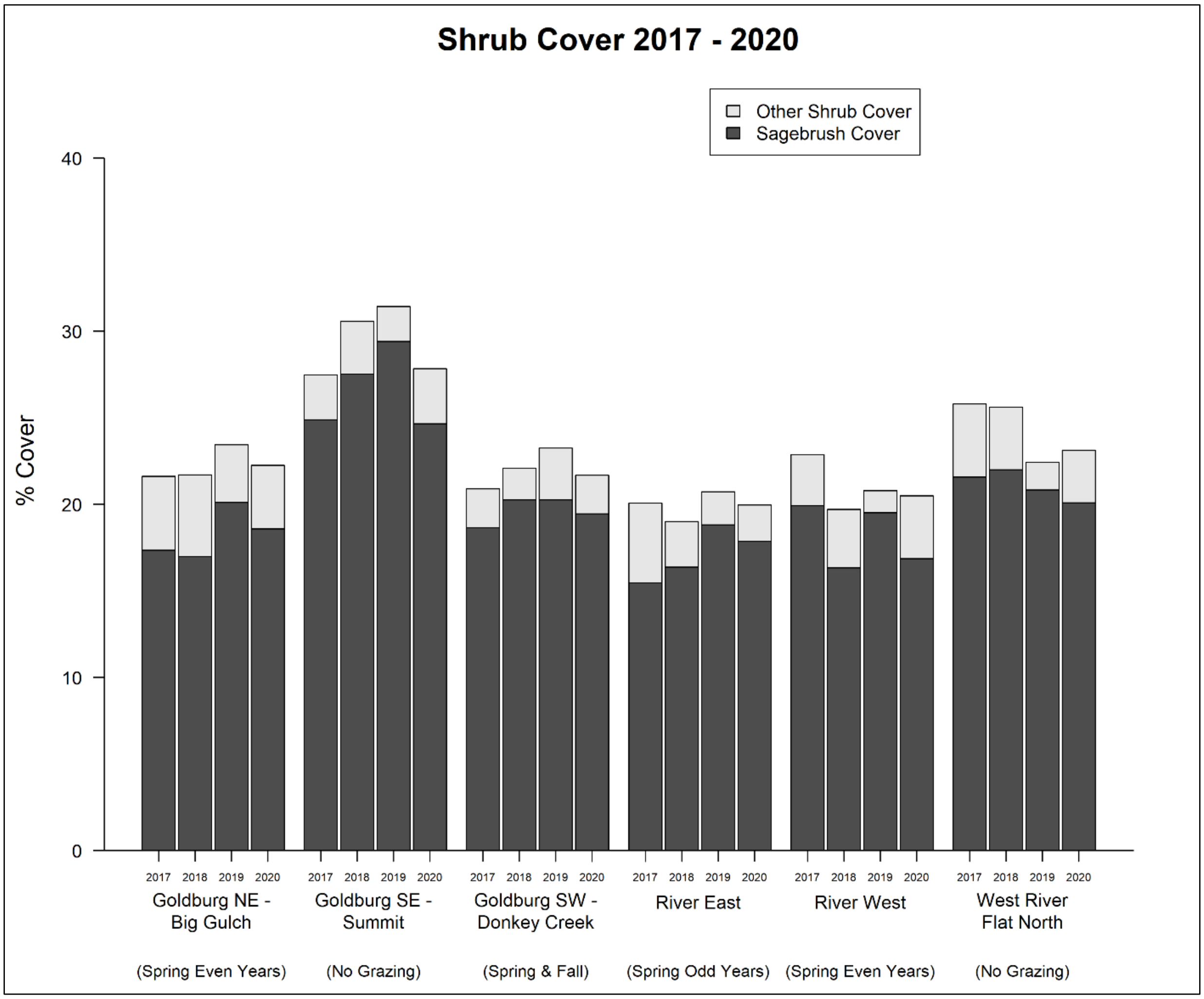


Figure 8. Shrub cover (split into sagebrush and other shrub cover) in each of 6 experimental treatment pastures at Pahsimeroi Valley, Idaho 2017-2020.

Stocking Rates and Grazing Pressure

We began treatments at Pahsimeroi Valley in 2019. In pre-treatment years, AUMs were similar, ranging from 62-782 (Fig. 9). Pastures in the Upper Pahsimeroi allotment (River and West River Flat pastures) received more grazing pressure than those in the Goldburg allotment. Cattle herd size (~205 cows in Goldburg and ~550 cows in the Upper Pahsimeroi) and pasture size (5,422-6,728 ha. in Upper Pahsimeroi and 549-1,614 ha. in Goldburg) are different between these two allotments.

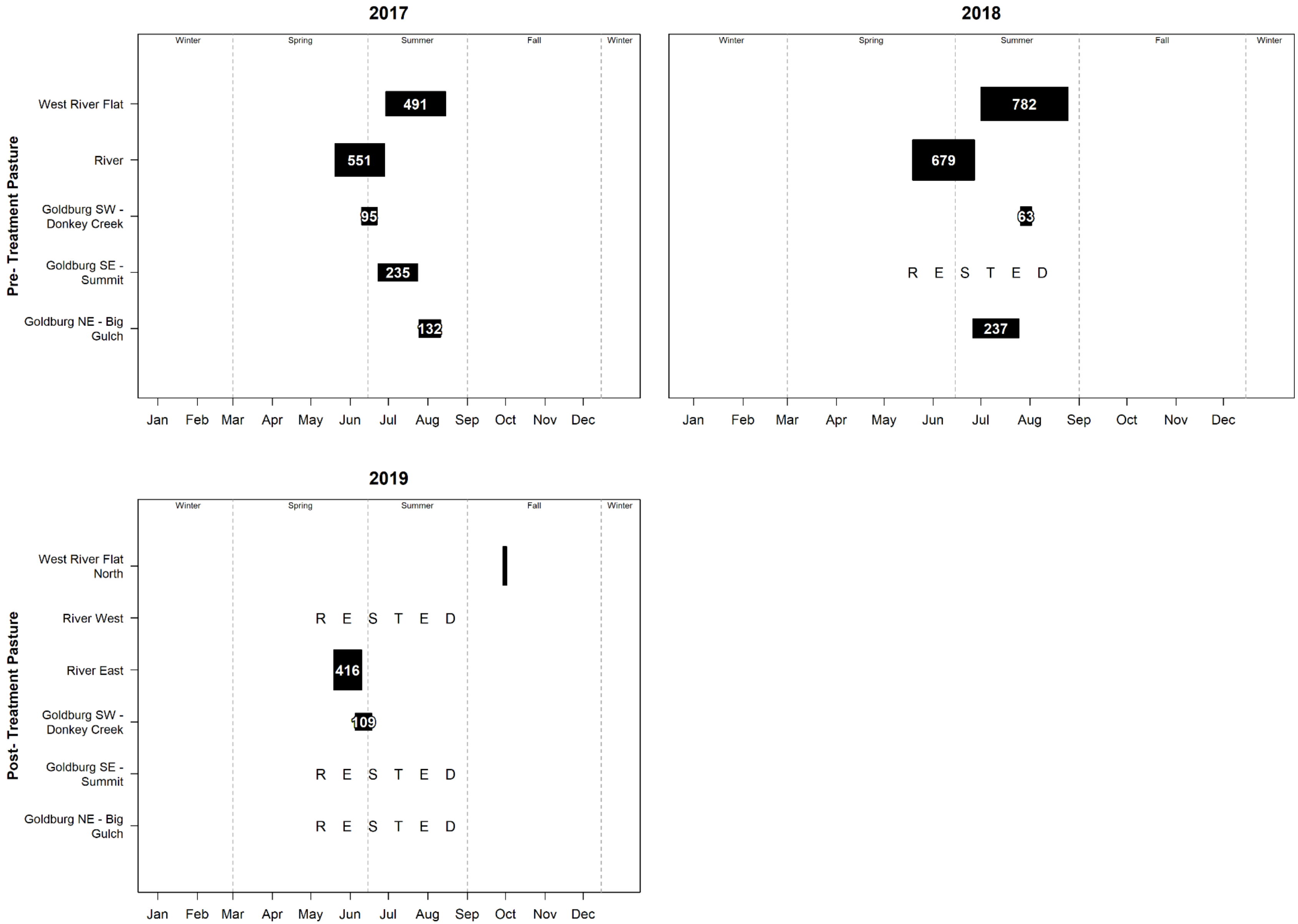


Figure 9. Timing and duration of cattle stocking at Pahsimeroi Valley during the pre-treatment period of the study 2017-2018 and the first year of post-treatment in 2019 (data for 2020 has not been reported yet at the time of this report). Width of black bars indicate the average number of cattle per day in that pasture. White numbers inside black bars represent the total Animal Unit Months (AUM) during that period.

In 2019, AUMs in experimental treatment pastures were comparable to surrounding pastures (those not part of the study; Fig. 10). 2019 was the first year that treatments were implemented at this study site, and 3 pastures were rested. We are still waiting on data from some surrounding pastures for the 2019 season. In 2020, three pastures were rested: Goldburg SE – Summit, River East, and River West.

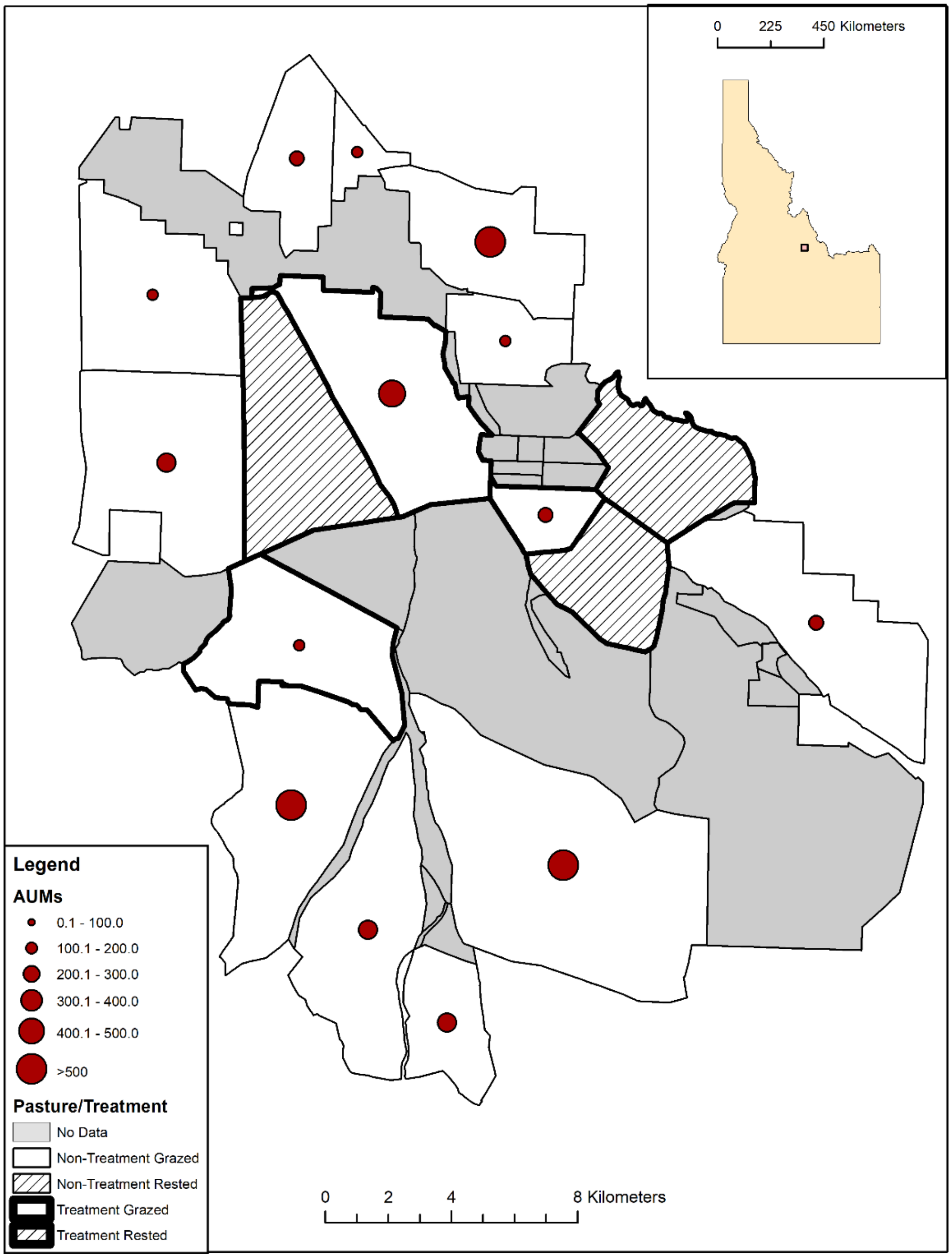


Figure 10. Stocking rate in Animal Use Months (AUMs) in treatment pastures and surrounding pastures at Pahsimeroi Valley, Idaho in 2019.

Estimates of Utilization

Utilization estimates were low in the 2 pastures that were spring grazed in 2020 (West River Flat North and Goldburg SE) based on visual estimates of individual plants (<10%, Fig. 11A). Variation among pastures in grazing pressure was more noticable based on proportion of grazed plants (Fig. 11B). Pastures at the Pahsimeroi Valley study site are much closer to summer ranges of big game animals than any of the other 4 study sites, which might explain the increase in proportion of grazed plants in pastures that were not spring or summer grazed by cattle.

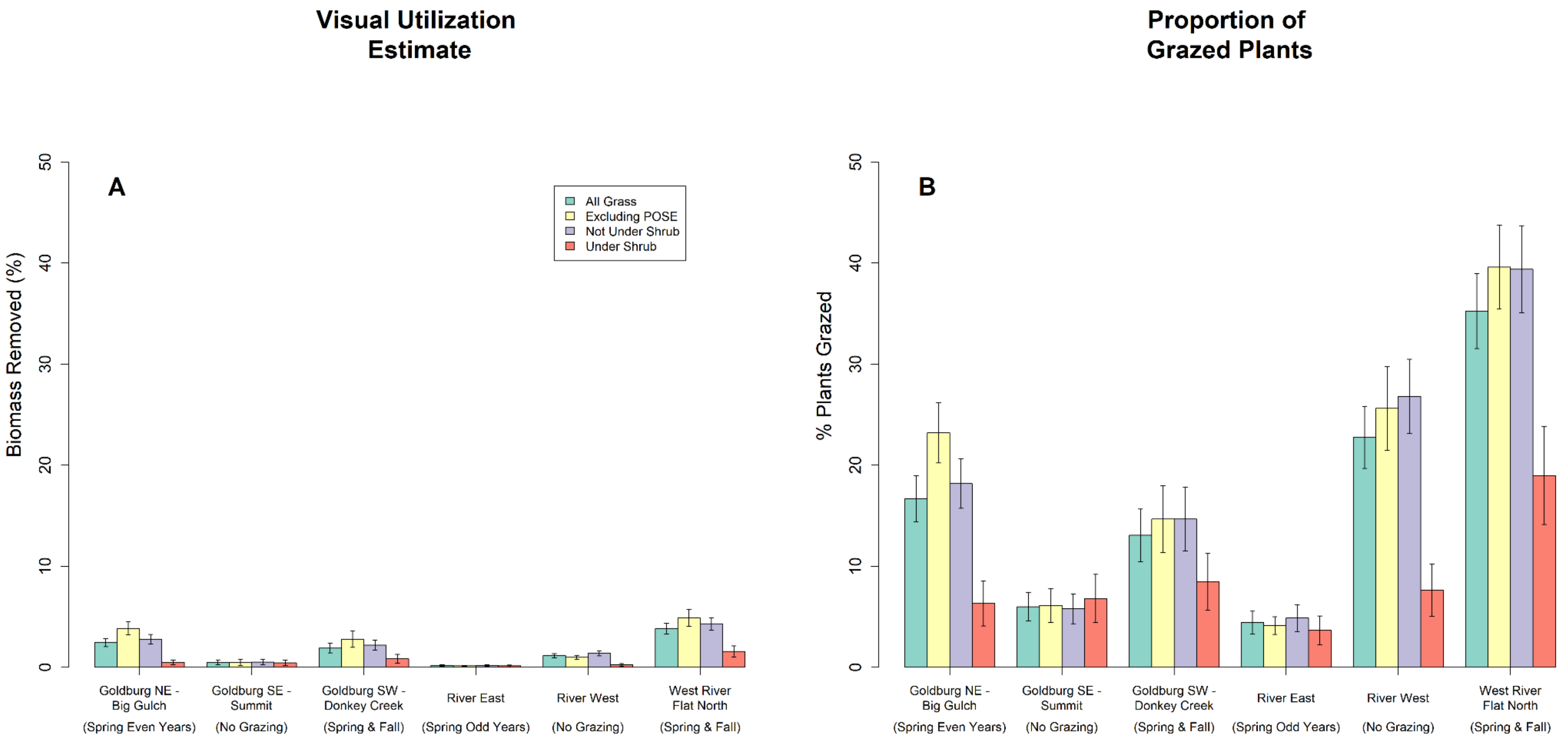


Figure 11. Grazing intensity based on visual estimates of percent biomass removed on individual grass plants (A) and the proportion of grass plants grazed (B) at random plots in 2020 at Pahsimeroi Valley, Idaho. Estimates were taken from the post-growing season surveys conducted in July – August 2020. In 2020, only the West River Flat North and Goldburg SE pastures were grazed prior to our post-growing season surveys. Goldburg SW had cattle grazing start in July during our post-growing season surveys.

Utilization estimates from the landscape appearance method varied among years (Fig. 12). Grazed pastures had more utilization than ungrazed pastures, and the West River Flat North pasture had slightly higher utilization than the other two grazed pastures. The River West pasture was rested and had a higher proportion of individual plants grazed than the other rested pastures in 2020 (Fig. 11), but utilization in the River West pastured measured via the landscape appearance method was similar to the other ungrazed pastures (Fig 12).

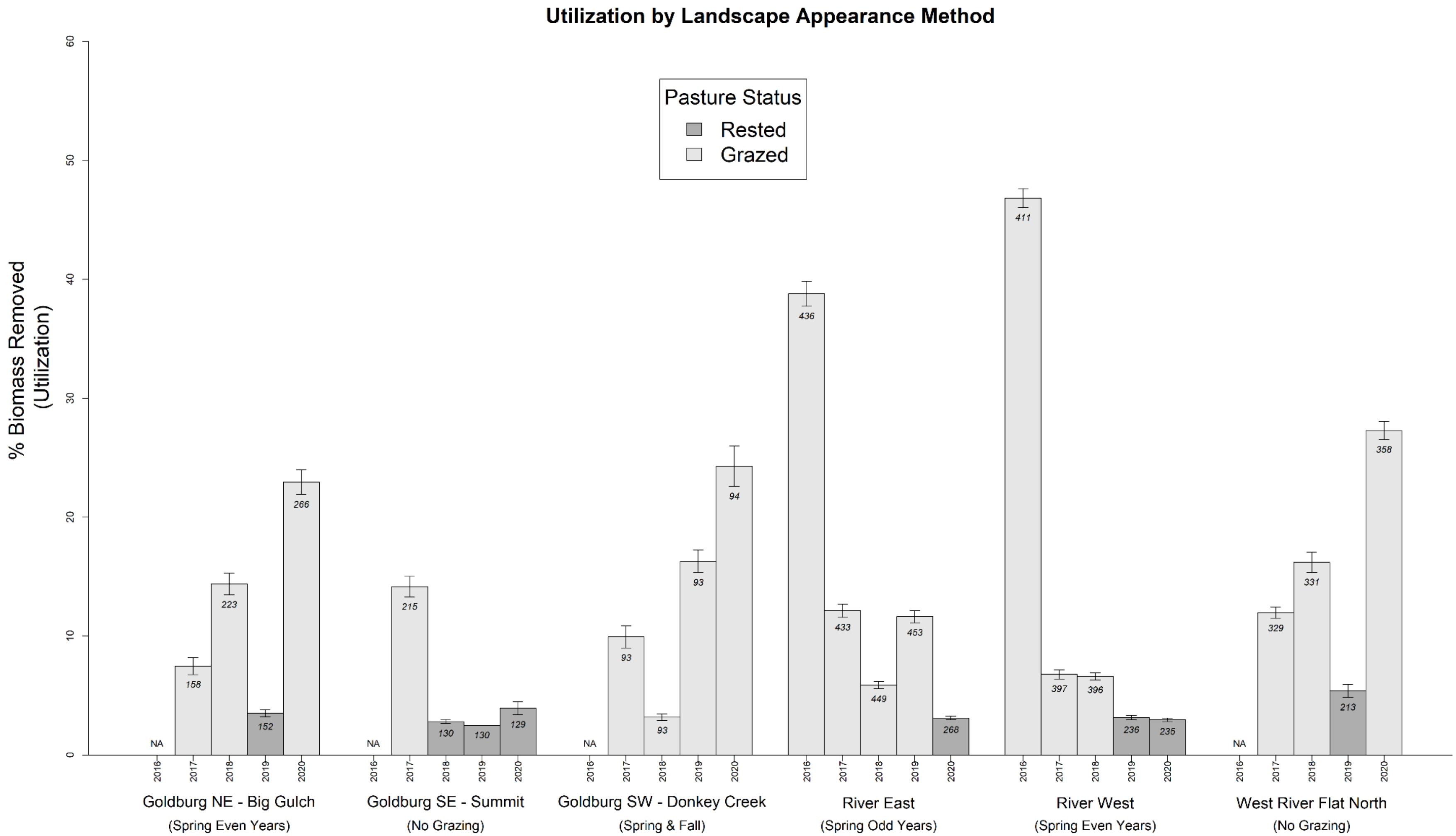


Figure 12. Utilization estimates based on the landscape appearance method for pre- and post-treatment periods at Pahsimeroi Valley, Idaho from 2016-2020. Error bars represent ±1 standard error. NA indicates that pasture was not measured in that particular year.

One of the advantages of using the landscape appearance method is that we can map spatial patterns of cattle use throughout each pasture. Not surprisingly, we found that cattle do not uniformly graze any of our treatment pastures (Fig. 13). This is likely due to lack of uniform availability of water, and grass, as well as topography. The rancher who runs cows in the Upper Pahsimeroi allotment uses riders to help distribute cattle more evenly across these large pastures and those efforts are apparent in the River West and River East pastures (2017-2019; Fig. 13C-E). Patterns of use appear to be different in that pasture each year and are less concentrated around the Pahsimeroi River (which runs diagonally NW to SE through the center of the pastures) than we would expect. In 2020, we observed slightly higher utilization estimates than in previous years.

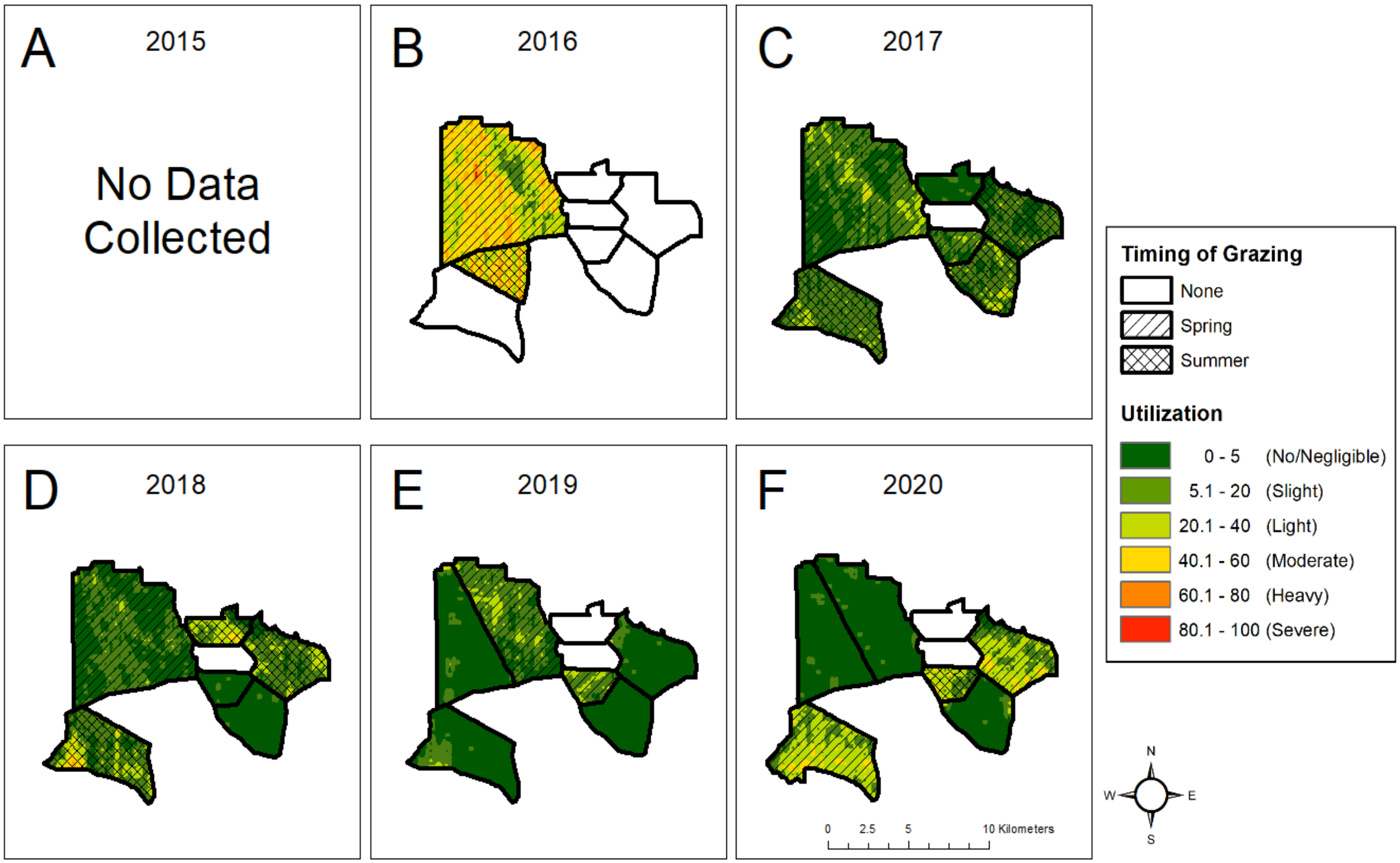


Figure 13. Pattern use mapping based on landscape appearance transects at Pahsimeroi Valley, Idaho 2016-2020.

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