



Sagebrush Steppe Vegetation Monitoring in Grand Teton National Park

2013 Data Summary

Natural Resource Data Series NPS/GRYN/NRDS—2014/680



ON THE COVER

Sagebrush Steppe in Grand Teton National Park
Photograph by: National Park Service

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MS

The 2013 field crew at Grand Teton National Park. Not shown are Laura Fraz and Nicholas Jew.

Introduction

In 2010, the Greater Yellowstone Network (GRYN), the Rocky Mountain Network (ROMN), and the Upper Columbia Basin Network (UCBN) began collaborating on a monitoring strategy aimed at detecting changes in high-elevation parks due to accelerated climate change (Bingham et al. 2010). Sagebrush steppe monitoring was identified as a key component of this strategy and the UCBN sagebrush steppe protocol (Yeo et al. 2009) was adapted for use at Grand Teton National Park (GRTE; Yeo and Rodhouse unpublished) and Bighorn Canyon National Recreation Area (BICA; Tercek et al. 2013).

GRTE covers about 310,000 acres (excluding the John D. Rockefeller, Jr. Memorial Parkway) with the Teton Range rising dramatically along the western half of the park. Expansive flats dominated mostly by sagebrush communities extend south and east of Jackson Lake (Figure 1). Elevations range from about 6,300 feet to over 6,800 feet on these flats. Sagebrush communities (or areas that were once sagebrush) occupy almost a quarter of the land area of the park. On the eastern side of Blacktail Butte (Figure 1), historic hayfields occupy flats that once were sagebrush. GRTE managers are now in the process of restoring some of these former farmed lands to native sagebrush steppe. Since the middle of the 1990s, fire has burned about 10% of existing or former sagebrush steppe habitat. Except for the old hayfields, most of the vegetation in the sagebrush ecosystem is native. As anywhere within sagebrush steppe across the western United States, however, invasion by non-native plants is an ongoing concern.

The sagebrush steppe ecosystem in GRTE is comprised of five principal plant associations. Sagebrush dry shrubland, dominated by mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) with diverse perennial native grasses and forbs, occupies about 61% of sagebrush steppe habitat in GRTE. Rangeland dominated by herbs, including the historic hayfields, occupies about 18% of sagebrush steppe.

Communities dominated by mountain big sagebrush and antelope bitterbrush (*Purshia tridentata*) cover about 11% of sagebrush steppe. Two other associations, low sagebrush (*A. arbuscula*) and mountain big sagebrush-shrubby cinquefoil (*Dasiphora floribunda*) occupy about 4% and 5%, respectively, of the remainder of sagebrush steppe in the park. Sagebrush steppe vegetation monitoring is focused in sagebrush dry shrubland and mountain big sagebrush-antelope bitterbrush associations. An additional focus is to provide reference conditions for hayfield restoration.

This report describes results from the second year of monitoring in GRTE following the Yeo and Rodhouse (unpublished) protocol. This represents an important step forward for the park in establishing baseline quantitative descriptions of sagebrush steppe community patterns that can be used to evaluate long-term changes resulting from climate change, fire, biological invasions, park development, and wildlife and human use patterns. The monitoring approach for GRTE has been adapted from the UCBN protocol (Yeo et al. 2009) to address principal threats and disturbances to sagebrush steppe habitat in GRTE. Tercek et al. (2013) provide an additional reference for similar monitoring efforts underway in BICA.

Objectives

One of the park's long-term resource management goals is to maintain and restore native ecosystems and ecological processes (i.e., ecosystem integrity/health). The extent and severity of exotic plant invasion, altered community composition, and altered species abundances in GRTE sagebrush steppe can be used to measure changes in these native ecosystems. Sagebrush steppe vegetation monitoring in GRTE adapted from the Yeo et al. (2009) protocol will provide managers with the information necessary to evaluate current conditions and trends in native shrub steppe communities, including changes in non-native species composition and abundance.

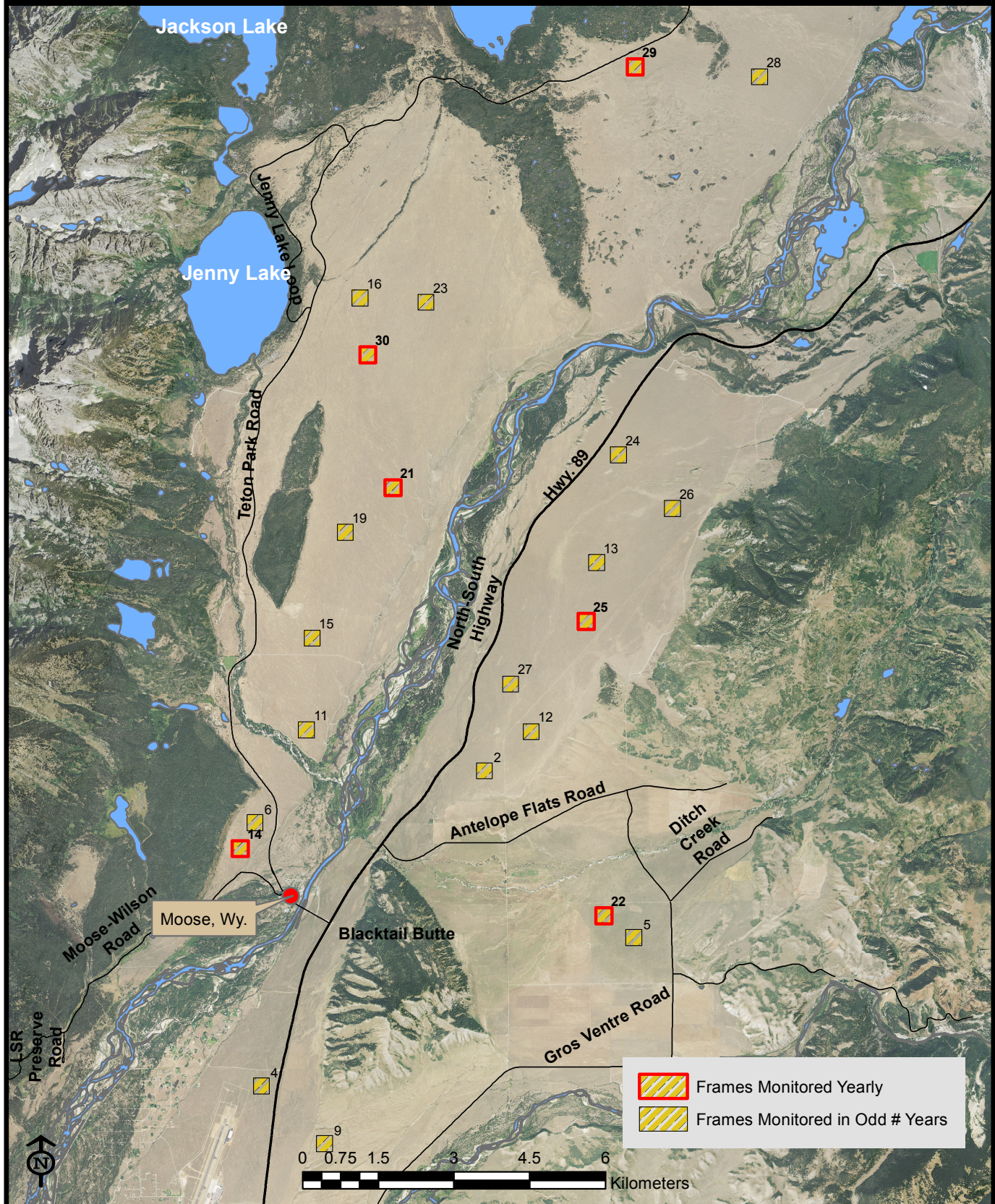


Figure 1. Map showing the sample frames that were monitored in 2013.

The foundation of the sagebrush steppe monitoring protocol is a view of ecosystem health sustained by natural succession or natural variability within native plant communities. Divergence of sagebrush steppe communities from these natural states (e.g., invasion of non-native plants, increased fire frequencies, long-term trends of increasing cover of exposed soil, declines in cover of principal native plants) signifies a loss of health and provides the feedback to park managers for effective adaptive management strategies. Simple monitoring objectives that focus on the status and trends of key indicators of biotic integrity, soil stability, and hydrologic function follow directly from this view:

Determine the status (current condition) and trends (change in condition over time) in the:

- The composition and abundance (cover) of principal native plant species.
- The composition and abundance (cover) of principal invasive plant species, including annual grasses.
- The amount of exposed soil (cover), a fundamental indicator of soil stability.

Specific to GRTE, these objectives will be pursued through regular monitoring in the two most widespread and important sagebrush steppe communities (Figure 2) in the park: sagebrush dry shrubland and sagebrush-bitterbrush steppe. Additionally data from this monitoring effort will be used as baseline plant community data to inform park restoration efforts.

Routine data collected on these key features of plant community composition and abundance will assist with the detection of long-term changes resulting from climate change and fire, as well as changes initiated from human use, such as the effects of historic homesteads and biological invasions. Results from 2013, the second year of data collection, document baseline conditions and consequently readers are cautioned not to draw wide-reaching conclusions. Status and trend assessments are more meaningful after many years of monitoring as comparable data accumulate over time (Witwicki 2012).



Figure 2. Plant communities selected for long-term monitoring include those dominated by mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) as pictured here.

Study Area and Methods

Thirty 10-ha (316 m x 316 m) sampling frames, six of which are a priority for sampling annually, were placed within sagebrush dry shrubland and sagebrush-bitterbrush steppe plant associations (Yeo and Rodhouse unpublished, Figure 1) and data collection began in 2012 (Rodhouse 2013).

The monitoring design uses random temporary 1 m² (refer to Figure 3) quadrats within permanent sampling frames (see a “never revisit” design [1-n] *sensu* McDonald 2003). In this design, quadrat locations change from year to year, but the areas of inference (the sample frame) remain constant.

During July, 2013, twenty-two of these frames were surveyed. Table 1 provides a list of the 22 frames surveyed in 2013. Within each frame, cover estimation of bare ground and principal native and non-native plant species were made in fifty 1 m² quadrats, following Yeo et al. (2013).

Appendix A lists the principal species targeted for monitoring. Cover estimation was done using ocular estimation of cover in Daubenmire cover classes (Table 2). Plant cover was defined as the natural spread of current year’s growth outlined using a minimum convex polygon with small gaps included in the cover estimate. Exposed bare ground was defined as soil surface not overlain by plant cover, non-vascular species, litter, or rock (e.g., gravels > ¼”).

Table 1. Sample size and sample dates for each frame sampled during the 2013 field season.

Sample Frame	Sample Size	Sample dates
GRTE_02	52	July 9 and 10
GRTE_04	52	July 15
GRTE_05	53	July 11
GRTE_06	52	July 8 and 9
GRTE_09	49	July 12
GRTE_11	52	July 19
GRTE_12	52	July 9 and 10
GRTE_13	52	July 17 and 18
GRTE_14	51	July 9
GRTE_15	52	July 9
GRTE_16	47	July 10 and 16
GRTE_19	53	July 11
GRTE_21	52	July 11
GRTE_22	53	July 11
GRTE_23	50	July 18 and 19
GRTE_24	52	July 17
GRTE_25	51	July 10
GRTE_26	52	July 10
GRTE_27	52	July 12
GRTE_28	52	July 19 and 22
GRTE_29	51	July 22
GRTE_30	51	July 10 and 16
Total	1133	

Table 2. Daubenmire cover classes used during the 2012 sampling and analysis year.

Cover Class	Cover Range
0	0%
1	>0-5%
2	>5-25%
3	>25-50%
4	>50-75%
5	>75-95%
6	>95%

Figure 3. The 1 m² quadrat sample unit used to measure species cover. Dashed white lines depict 5% area (smallest square in lower portion of quadrat), and 25% areas (larger four squares covering quadrat).



A spatially-balanced sampling design (the generalized random-tessellation stratified [GRTS] design described by Stevens and Olsen [2004]) was used to locate quadrats. The sample size of 50 was determined through a combination of power analysis and ad hoc practical considerations to ensure sufficient power to estimate status and trend with adequate precision within sampling frames (Yeo et al. 2009, Irvine and Rodhouse 2010).

Field crews recorded survey data directly into a portable tablet computer with built-in database and quality controls that was backed up frequently throughout the day. This largely eliminated the need to write down observation data and later enter the values manually into the database.

Following the field season, data were evaluated for quality, documented with metadata, and certified prior to analysis. Routine summary statistics involved calculating the frequency and standard error of quadrats in each Daubenmire cover class and reporting the results in graphical, spatial, and tabular formats. Analyses were performed in Microsoft™ Excel and with the spsurvey GRTS package using the R statistical platform (R Development Core Team 2011). Margins of errors, computed with a GRTS local variance estimator were calculated with the spsurvey package.

Climate water balance metrics were calculated using the Thornthwaite-Mather (1955) method described in Dingham (2002). These calculations were performed in Microsoft™ Excel using National Weather Service Cooperative data from Moose WY (#486428) Weather and Climate.

Weather patterns for 2013 at Moose, Wyoming National Weather Service Cooperative Network station (COOP station #486428; Figure 4) show that monthly precipitation was mostly below the 1981-2010 average, except for April, July, September, and October. Maximum temperatures tended to be above average during the late spring and summer months of May, June, July, and August; whereas minimum temperatures were below average from January through August.

Climate water metrics for the 2013 season show a brief water deficit or drought at the Moose COOP station during the month of August. A water deficit (D) is the evaporative demand not met by available water and is a measure of drought stress that has direct physiological importance to plants (Stephenson 1990, 1998). Depending on the frequency and duration, drought can cause changes in species composition and abundance and will be followed as a climate response variable in the Grand Teton Sage Steppe Monitoring Protocol.

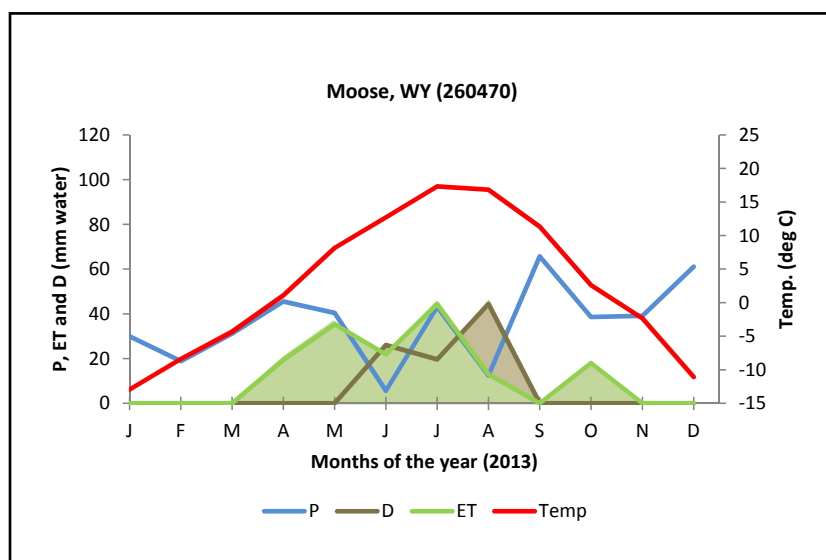


Figure 4. The seasonal climate water balance at Moose COOP weather station in Grand Teton National Park during 2013. The right axis shows monthly mean temperature (red line); the left axis shows millimeters (mm) of water for accumulated monthly precipitation (P, blue line), evapotranspiration (ET, green line and shading), and water deficit (D, brown line). The brown shaded area shows the period dominated by a climate water deficit.

Results and Discussion

In 2013, GRTE completed annual monitoring of twenty-two sample frames; all dominated by sage steppe vegetation. Surveys occurred during the weeks of July 9 and July 22, which was good timing of field work relative to plant phenology.

No quadrats were dropped due to safety or other considerations, and in general, the reconnaissance of frames indicated that all were in relatively good positions and no changes to frame placement were needed. All frames but two, 9 and 16, met or exceeded the desired sample size of 50, resulting in a total achieved sample size of 1,133.

Summary statistics are calculated for each sample frame and the results displayed in graphical and tabular formats in Appendix B. The summaries indicate that each of the sample frames contains a diverse suite of

native plants, and despite the presence of non-native species, native plant communities prevail.

Nine non-native invasive species were found in the sample frames (Table 3). Dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*) were the most frequently encountered non-native forbs, and bluegrasses (*Poa* spp.) was the most frequent non-native grass. Two aggressive non-native forbs were reported: musk thistle (*Carduus nutans*) and yellow toadflax (*Linaria vulgaris*). These both can spread quickly, are persistent, and have persistent propagules. Musk thistle occurred in one quadrat in frame GRTE-05 at 1-5% cover and yellow toadflax was found in GRTE-28 at 1-5% cover.

Table 3. Non-native species found in sample frames during surveys in 2013.

Frame #	<i>Bromus inermis</i>	<i>Bromus japonicus</i>	<i>Cardus nutans</i>	<i>Linaria vulgaris</i>	<i>Phleum pratensis</i>	<i>Poa</i> spp.	<i>Poa bulbosa</i>	<i>Taraxacum officinale</i>	<i>Tragopogon dubius</i>
2						X		X	
4	X					X		X	X
5	X		X			X		X	X
6						X	X	X	X
9	X	X				X		X	X
11	X					X		X	X
12						X		X	X
13		X			X	X		X	X
14						X		X	X
15						X	X	X	
16						X			
19						X			
21						X		X	X
22	X				X	X		X	X
23						X			
24						X		X	
25						X		X	X
26						X		X	
27						X		X	
28				X		X		X	
29						X			
30						X			

Non-native invasive grasses, other than bluegrass, were relatively uncommon. Smooth brome (*Bromus inermis*) was found in five sample frames, mostly in association with bitterbrush. In total, smooth brome was detected in only nine quadrats (mean cover at the quadrat level was 26.4%; S.E. 7.9)

Timothy (*Phleum pretense*) and Japanese brome (*Bromus japonicus*) were detected in two frames each, all occurrences were in the 1-5% cover class; bulbous bluegrass (*Poa bulbosa*) was found in two frames, three quadrats total.

Diversity of native grasses and forbs was high in all frames, with more than a half dozen principal grass species (as many as 12 in some frames) and more than a dozen principal forbs found in every frame. Buckwheats (*Eriogonum* spp.) were typically the most dominant forbs, often being recorded with >25% cover. Balsamorhiza (*Balsamorhiza sagittata*), conspicuous where it occurs, was recorded with >25% cover. Bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*) were the most dominant grasses.

Sedges (*Carex* spp.) and needlegrasses (*Stipa* spp.) were also abundant.

Mountain big sagebrush (*Artemisia tridentata*) was abundant and the dominant overstory shrub in all frames. Mountain big sagebrush and low sagebrush (*A. arbuscula*) co-occurred in 15 of the 22 sampled frames (68%). In five of those 15, low sage was relatively rare, occurring in 14% or fewer of the sampling quadrats in the frame. Three-tip sagebrush (*A. tripartita*) was relatively rare and was encountered only in one sample frame, GRTE-09.

Bitterbrush (*Purshia tridentata*) occurred in five frames and represented a substantial overstory component (e.g. having >10% mean cover) in three of the five sample frames (Figure 5).

These patterns represent an important early step in the development of baseline sagebrush steppe ecological information that will inform future comparisons and enable GRTE staff to recognize changes in the shrub-steppe communities and consider these in management decisions.

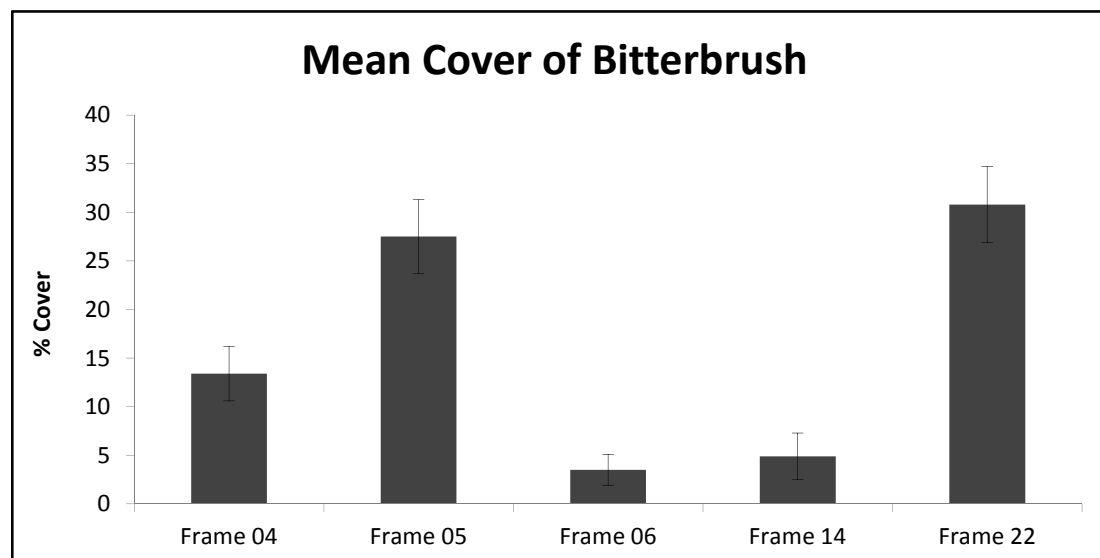


Figure 5. Mean cover of bitterbrush calculated using mid-points of Daubenmire cover classes.

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Appendix A Plant Species and Ground Cover Attributes

Table A1. Vascular plants and ground cover attributes targeted for monitoring in the Grand Teton National Park Sagebrush Steppe Vegetation Monitoring Protocol in 2013 (Rodhouse 2013).

Scientific Name	Common Name
Ground Cover	
Bare ground	Bare ground
Sagebrush	
<i>Artemisia arbuscula</i>	low sagebrush
<i>Artemisia cana</i>	silver sagebrush
<i>Artemisia frigida</i>	fringed sagebrush
<i>Artemisia tridentata</i>	big sagebrush
<i>Artemisia tripartita</i>	threetip sagebrush
Shrubs	
<i>Alnifolia</i>	serviceberry
<i>Chrysothamnus viscidiflorus</i>	green rabbitbrush
<i>Ericamerica nauseosa</i>	grey rabbitbrush
<i>Mahonia repens</i>	creeping barberry
<i>Dasiphora floribunda</i> (<i>Potentilla fruticosa</i>)	shrubby cinquefoil
<i>Prunus virginiana</i>	chokecherry
<i>Purshia tridentata</i>	antelope bitterbrush
<i>Ribes</i> spp.	gooseberry
<i>Symphoricarpos</i> spp.	snowberry
Grasses and Grass-like Plants	
<i>Achnatherum hymenoides</i> (<i>Oryzopsis hymenoides</i>)	Indian ricegrass
<i>Achnatherum nelsonii</i> (<i>Stipa nelsonii</i>)	Nelson's needlegrass
<i>Bromus marginatus</i>	mountain brome
<i>Carex</i> spp.	sedges
<i>Danthonia unispicata</i>	onespike danthonia
<i>Elymus elymoides</i> (<i>Sitanion hystrix</i>)	squirreltail
<i>Elymus trachycaulus</i>	slender wheatgrass
<i>Festuca idahoensis</i>	Idaho fescue
<i>Hesperostipa comata</i> (<i>Stipa comata</i>)	needle-and-thread grass
<i>Koeleria macrantha</i> (<i>Koeleria cristata</i>)	prairie junegrass
<i>Melica</i> spp.	oniongrass
<i>Poa secunda</i>	Sandberg bluegrass
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass
Persistent Native Forbs	
<i>Achillea millefolium</i>	yarrow
<i>Antennaria</i> spp.	pussytoes
<i>Arenaria</i> spp.	sandwort
<i>Aster</i> spp.	aster
<i>Astragalus</i> spp.	milkvetch
<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot
<i>Castilleja</i> spp.	paintbrush
<i>Clematis hirsutissima</i>	clematis
<i>Comandra umbellata</i>	bastard toadflax
<i>Crepis</i> spp.	hawksbeard
<i>Erigeron</i> spp.	daisy

Table A1. Vascular plants and ground cover attributes targeted for monitoring in the Grand Teton National Park Sagebrush Steppe Vegetation Monitoring Protocol in 2013 (continued).

Scientific Name	Common Name
Persistent Native Forbs (continued)	
<i>Eriogonum</i> spp.	buckwheat
<i>Frasera speciosa</i>	green gentian
<i>Geranium viscosissimum</i>	sticky geranium
<i>Helianthella</i> spp.	helianthella
<i>Lithospermum ruderae</i>	western stoneseed
<i>Lomatium</i> spp.	lomatium
<i>Perideridia montana</i>	yampah
<i>Lupinus</i> spp.	lupine
<i>Penstemon</i> spp.	penstemon
<i>Phacelia hastata</i>	phacelia
<i>Phlox</i> spp.	phlox
<i>Potentilla</i> spp.	cinquefoil
Other Native Forbs	
<i>Agoseris</i> spp.	agoseris
<i>Arabis</i> spp.	rockcress
<i>Geum triflorum</i>	prairie smoke
<i>Sedum</i> spp.	stonecrop
<i>Viola</i> spp.	violet
Non-native Invasive Grasses	
<i>Agropyron cristatum</i>	crested wheatgrass
<i>Bromus inermis</i>	smooth brome
<i>Bromus japonicus</i>	Japanese brome
<i>Bromus tectorum</i>	cheatgrass
<i>Dactylis glomerata</i>	orchard grass
<i>Elymus repens</i>	quackgrass
<i>Phleum pratense</i>	timothy
<i>Poa bulbosa</i>	bulbous bluegrass
<i>Poa</i> spp.	bluegrass
Non-native Invasive Forbs	
<i>Acroptilon repens</i>	Russian knapweed
<i>Cardaria draba</i>	whitetop
<i>Carduus nutans</i>	musk thistle
<i>Centaurea diffusa</i>	diffuse knapweed
<i>Centaurea maculosa</i>	spotted knapweed
<i>Cirsium vulgare</i>	bull thistle
<i>Isatis tinctoria</i>	dye's woad
<i>Kochia scoparia</i>	kochia
<i>Linaria dalmatica</i>	Dalmatian toadflax
<i>Linaria vulgaris</i>	yellow toadflax
<i>Potentilla recta</i>	sulfur cinquefoil
<i>Taraxacum officinale</i>	dandelion
<i>Tragopogon dubius</i>	salsify
<i>Medicago sativa</i>	alfalfa
<i>Melilotus</i> spp.	sweetclover

Appendix B Sample Frame Summary Tables and Maps

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Table B1. Percent of quadrats (n=52) for sample frame GRTE-02 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-02	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	0	65	22	8	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	96	2	2	0	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	17	15	35	12	17	4	0
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	96	4	0	0	0	0	0
<i>Achnatherum nelsonii</i> (Nelson's ricegrass)	52	48	0	0	0	0	0
<i>Carex</i> spp. (sedges)	41	55	2	0	0	2	0
<i>Danthonia unispicata</i> (onespike danthonia)	94	6	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	52	48	0	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	96	4	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	12	31	50	8	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	90	10	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	50	50	0	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	31	65	4	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	65	33	2	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	25	54	19	2	0	0	0
<i>Arenaria</i> spp. (sandwort)	77	23	0	0	0	0	0
<i>Aster</i> spp. (aster)	69	23	8	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	50	48	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	90	10	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	79	17	4	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	10	54	31	6	0	0	0
<i>Frasera speciosa</i> (green gentian)	98	2	0	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	48	52	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	17	56	23	4	0	0	0
<i>Phlox</i> spp. (phlox)	29	62	10	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	19	81	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	98	2	0	0	0	0	0
<i>Geum triflorum</i> (prairie smoke)	98	0	2	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	88	12	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	50	50	0	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	75	25	0	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

April 2014
NPS Inventory and Monitoring Division

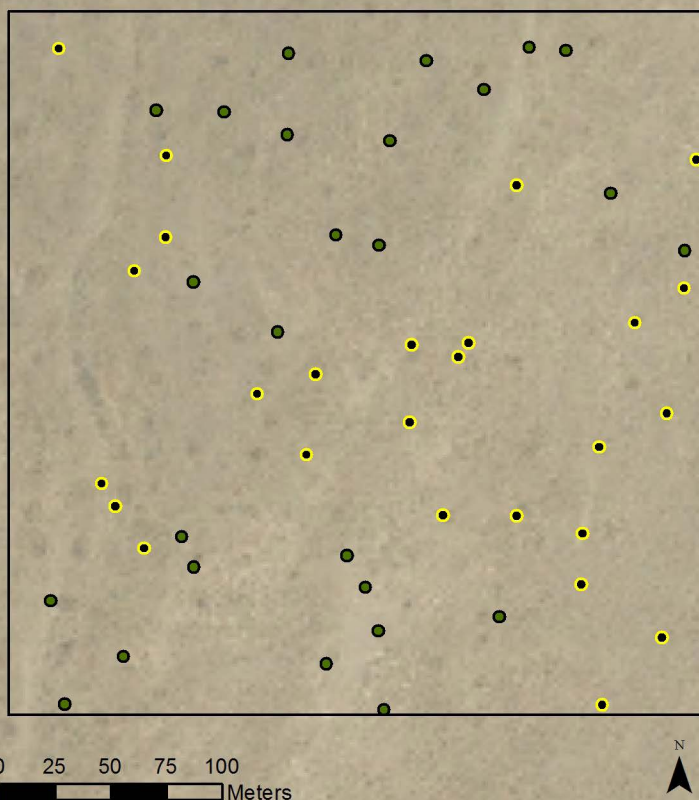
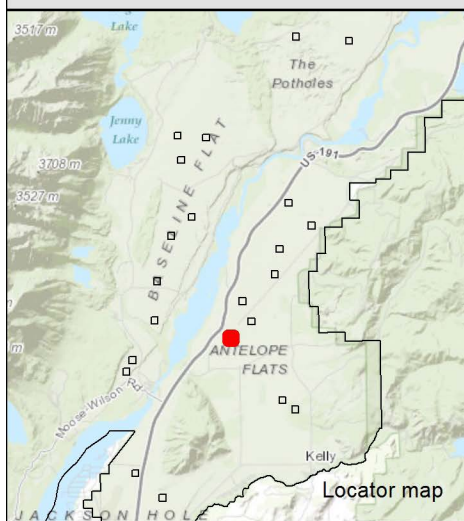


Figure B1. Map showing locations of 1 m² quadrats in sample frame GRTE-02 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*).

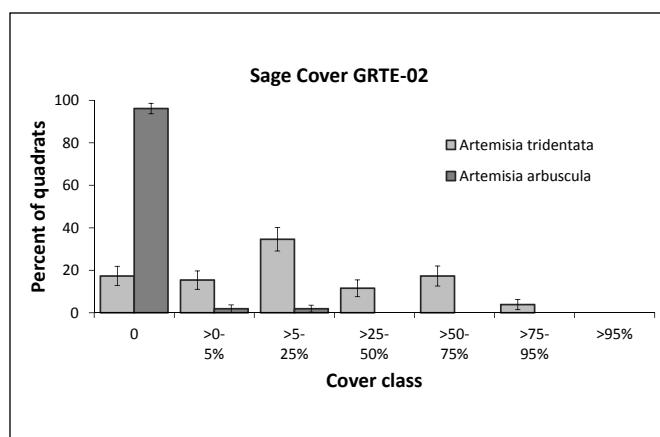


Figure B2. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

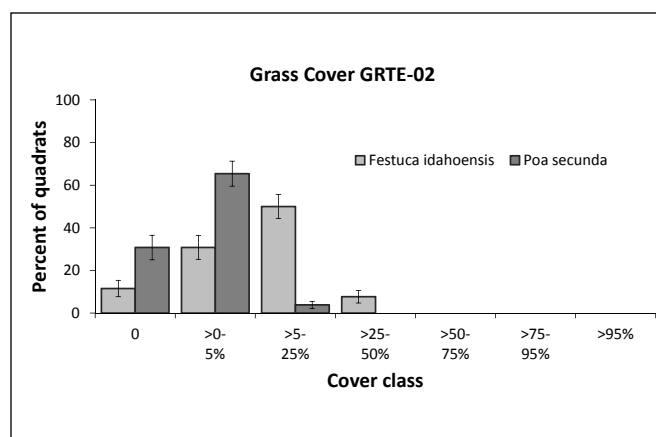


Figure B3. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and Sandberg's bluegrass (*Poa secunda*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B2. Percent of quadrats (n=52) for sample frame GRTE-04 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-04	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	31	65	2	2	0	0	0
Sagebrush							
<i>Artemisia tridentata</i> (big sagebrush)	8	21	36	25	10	0	0
Shrubs							
<i>Purshia tridentata</i> (antelope bitterbrush)	46	17	12	12	13	0	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's ricegrass)	88	8	4	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	98	2	0	0	0	0	0
<i>Carex</i> spp. (sedges)	46	40	14	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	98	2	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	59	31	10	0	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	67	8	17	8	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	51	43	6	0	0	0	0
<i>Melica</i> spp. (oniongrass)	98	2	0	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	75	17	8	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	57	24	20	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	77	21	2	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	92	8	0	0	0	0	0
<i>Aster</i> spp. (aster)	96	0	4	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	92	6	2	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	83	13	4	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	96	4	0	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	92	8	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	65	25	8	2	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	44	21	25	8	2	0	0
<i>Lomatium</i> spp. (lomatium)	98	2	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	37	42	17	4	0	0	0
<i>Phlox</i> spp. (phlox)	60	35	6	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	60	30	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	85	15	0	0	0	0	0
<i>Viola</i> spp. (violet)	98	2	0	0	0	0	0
Non-native Invasive Grasses							
<i>Bromus inermis</i> (smooth brome)	92	2	2	2	2	0	0
<i>Poa</i> spp. (bluegrass)	29	46	23	2	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	50	46	4	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	87	13	0	0	0	0	0

¹ Daubenmire Cover Class Categories

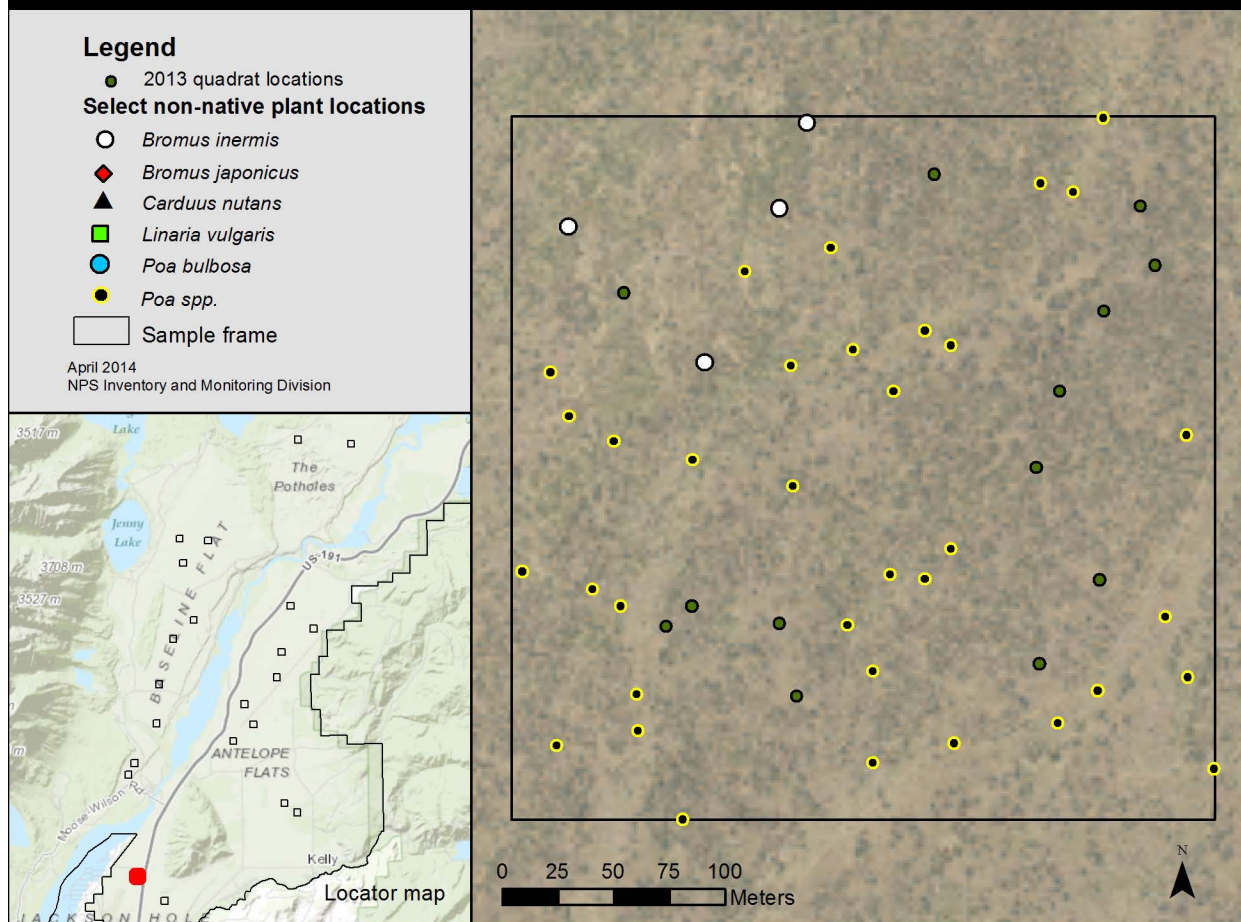


Figure B4. Map showing locations of 1 m² quadrats in sample frame GRTE-04 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy are four locations of smooth brome (*Bromus inermis*) (white circles; upper left). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

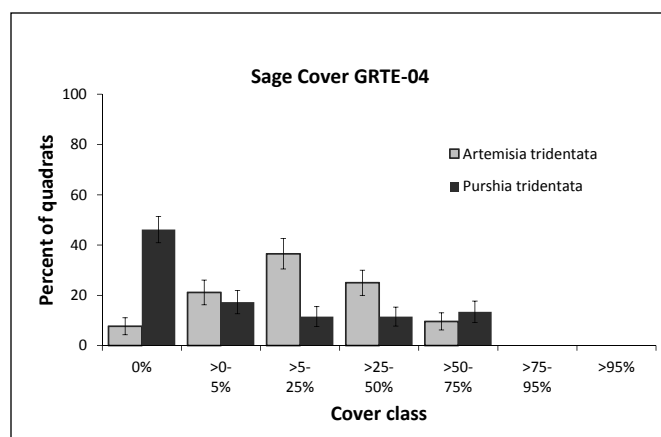


Figure B5. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and bitterbrush (*Purshia tridentata*).

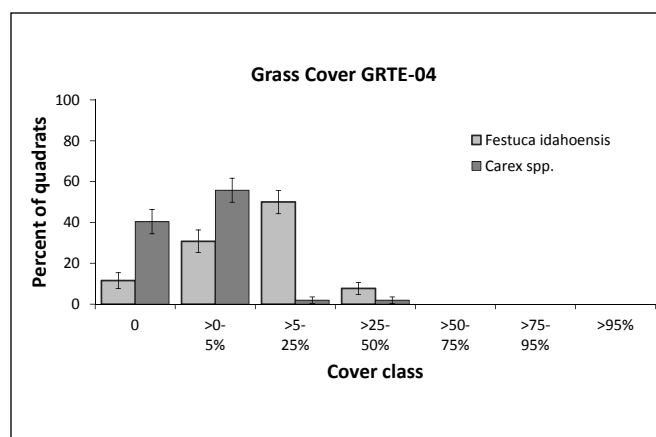


Figure B6. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and sedges (*Carex spp.*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B3. Percent of quadrats (n=53) for sample frame GRTE-05 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-05	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	81	19	0	0	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	98	2	0	0	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	23	23	19	23	8	6	0
Shrubs							
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	98	0	2	0	0	0	0
<i>Mahonia repens</i> (creeping barberry)	92	4	4	0	0	0	0
<i>Purshia tridentata</i> (antelope bitterbrush)	15	11	30	17	13	13	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	64	19	13	4	0	0	0
<i>Carex</i> spp. (sedges)	91	9	0	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	85	8	6	2	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	96	4	0	0	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	94	2	4	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	83	17	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	96	2	2	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	30	34	25	9	2	0	0
Native Persistent Forbs							
<i>Aster</i> spp. (aster)	98	2	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	21	32	43	2	2	0	0
<i>Castilleja</i> spp. (paintbrush)	98	2	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	66	30	4	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	62	15	21	2	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	60	17	21	2	0	0	0
<i>Helianthella</i> spp. (helianthella)	47	28	25	0	0	0	0
<i>Lithospermum ruderales</i> (western stoneseed)	74	11	15	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	64	36	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	66	30	4	0	0	0	0
<i>Perideridia montana</i> (yampah)	90	6	4	0	0	0	0
<i>Phlox</i> spp. (phlox)	77	15	8	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	43	57	0	0	0	0	0
<i>Viola</i> spp. (violet)	98	2	0	0	0	0	0
Non-native Invasive Grasses							
<i>Bromus inermis</i> (smooth brome)	96	0	0	2	2	0	0
<i>Poa</i> spp. (bluegrass)	32	38	28	2	0	0	0
Non-native Invasive Forbs							
<i>Carduus nutans</i> (musk thistle)	98	2	0	0	0	0	0
<i>Taraxacum officinale</i> (dandelion)	68	32	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	83	15	2	0	0	0	0

¹ Daubenmire Cover Class Categories

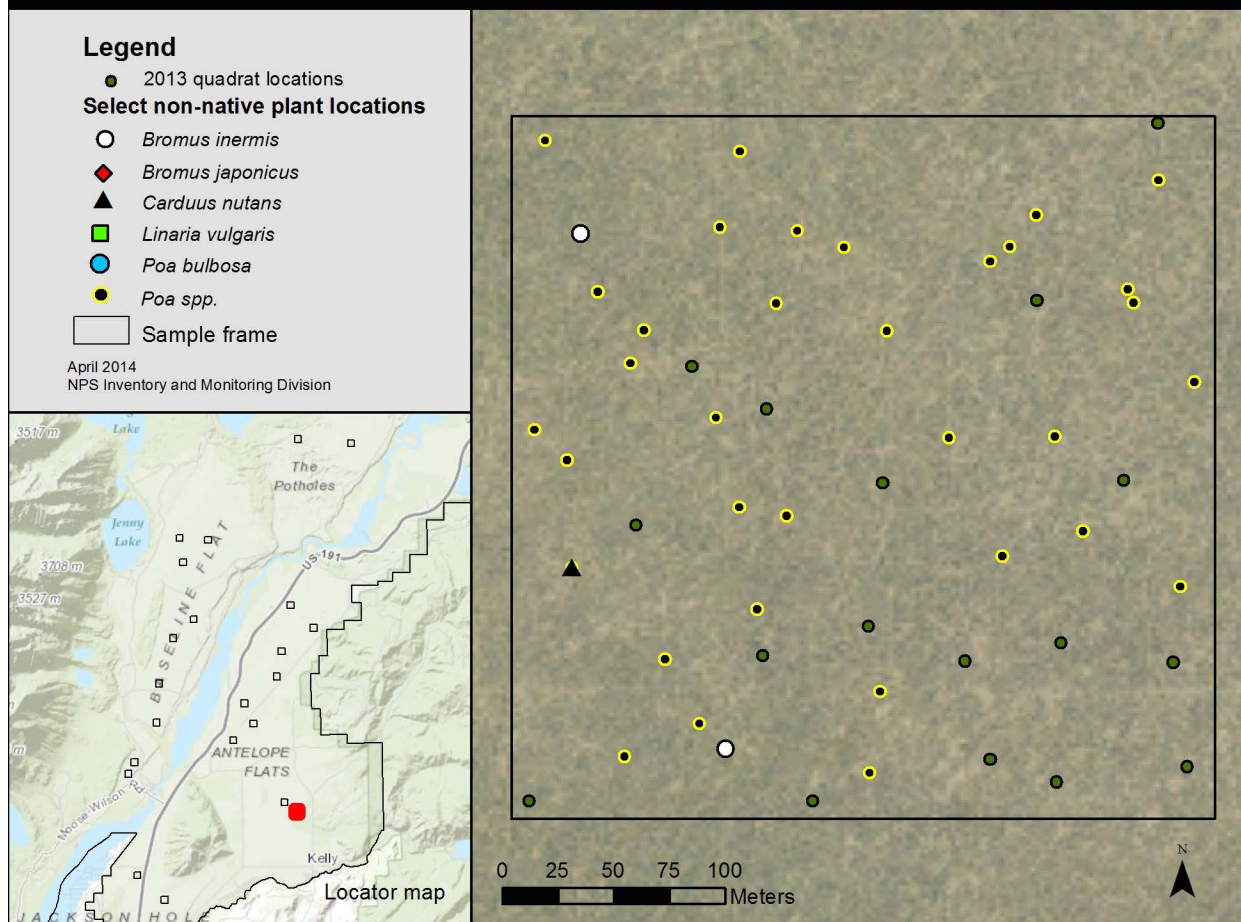


Figure B7. Map showing locations of 1 m² quadrats in sample frame GRTE-05 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy are two locations of smooth brome (*Bromus inermis*) (white circles; upper and lower left) and one location of musk thistle (*Carduus nutans*) (black triangle, lower left). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

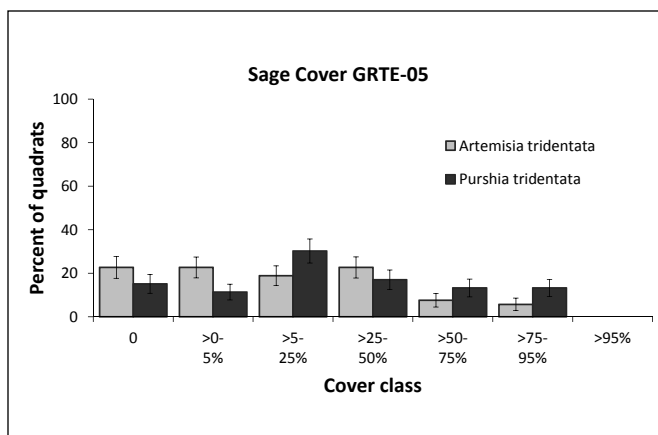


Figure B8. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and bitterbrush (*Purshia tridentata*).

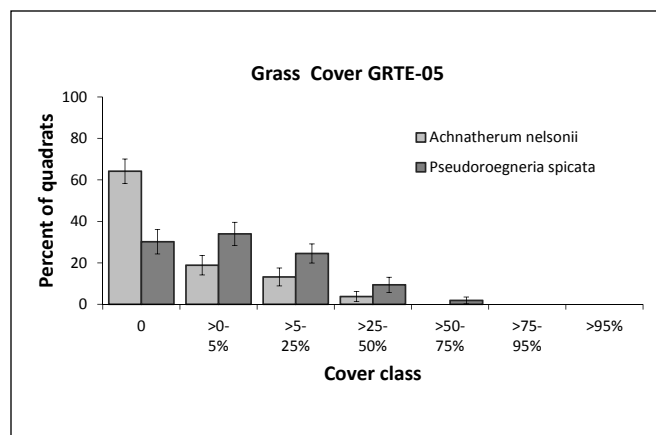


Figure B9. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and bluebunch wheatgrass (*Pseudoroegneria spicata*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B4. Percent of quadrats (n=52) for sample frame GRTE-06 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-06	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	2	71	25	2	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	71	17	4	8	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	21	21	27	23	4	4	0
Shrubs							
<i>Purshia tridentata</i> (antelope bitterbrush)	88	0	6	4	2	0	0
<i>Mahonia repens</i> (creeping barberry)	88	12	0	0	0	0	0
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	94	6	0	0	0	0	0
<i>Achnatherum nelsonii</i> (Nelson's ricegrass)	54	40	6	0	0	0	0
<i>Bromus marginatus</i> (mountain brome)	73	25	2	0	0	0	0
<i>Carex</i> spp. (sedges)	79	19	2	0	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	96	4	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	90	10	0	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	87	12	2	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	69	29	2	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	38	62	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	19	62	19	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	60	40	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	50	50	0	0	0	0	0
Native Persistent Forbs							
<i>Achillea millefolium</i> (yarrow)	96	4	0	0	0	0	0
<i>Antennaria</i> spp. (pussytoes)	98	2	0	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	90	10	0	0	0	0	0
<i>Aster</i> spp. (aster)	85	13	2	0	0	0	2
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	79	10	8	2	0	0	0
<i>Castilleja</i> spp. (paintbrush)	85	13	2	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	65	33	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	75	25	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	96	2	2	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	8	42	33	13	4	0	0
<i>Lomatium</i> spp. (lomatium)	87	13	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	52	37	10	2	0	0	0
<i>Perideridia montana</i> (yampah)	90	10	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	65	35	0	0	0	0	0
<i>Potentilla</i> spp. (cinquefoil)	98	2	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	23	77	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	87	13	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	58	42	0	0	0	0	0
<i>Viola</i> spp. (violet)	87	13	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa bulbosa</i> (bulbous bluegrass)	96	2	2	0	0	0	0
<i>Poa</i> spp. (bluegrass)	62	35	4	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	81	19	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	96	4	0	0	0	0	0

¹ Daubenmire Cover Class Categories

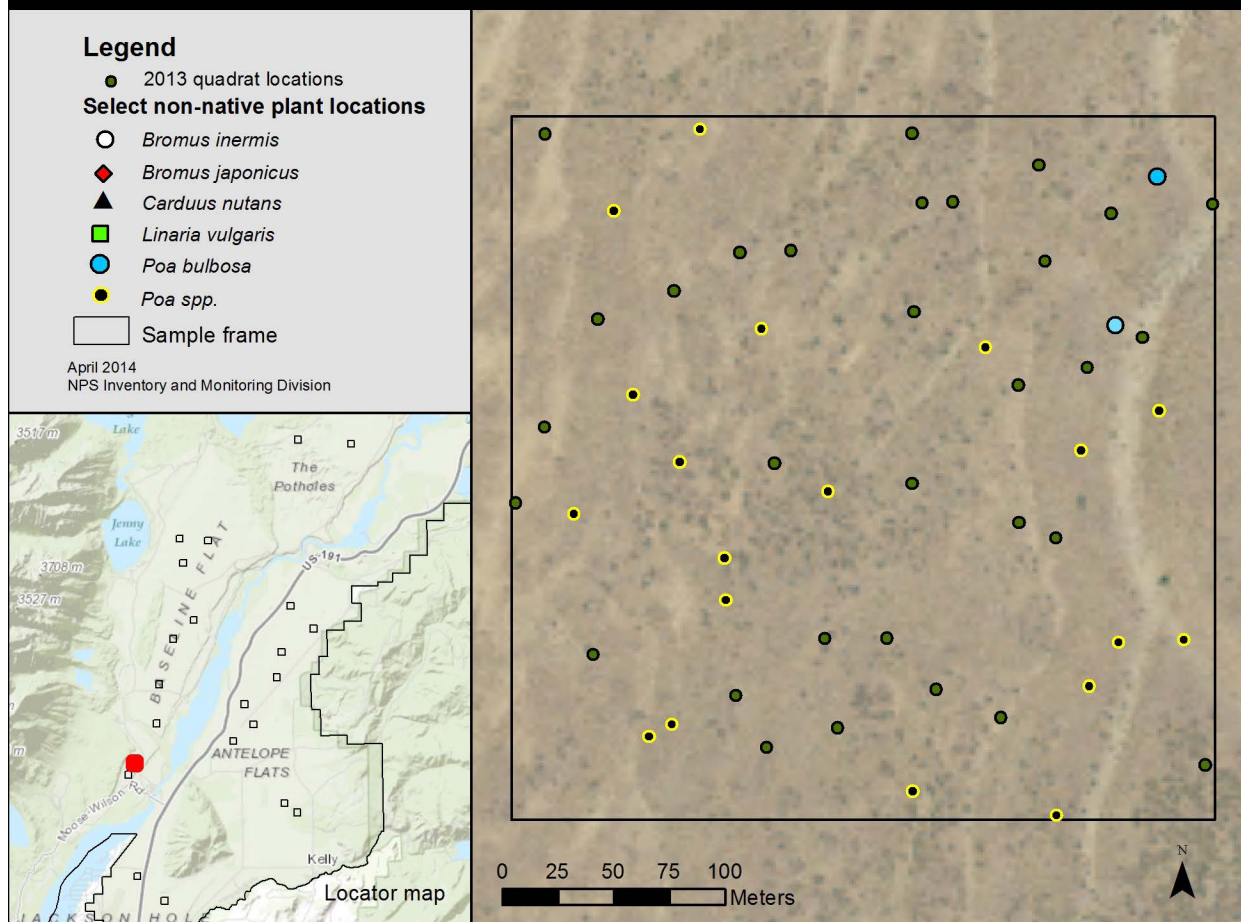


Figure B10. Map showing locations of 1 m² quadrats in sample frame GRTE-06 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy are two locations of bulbous bluegrass (*Poa bulbosa*) (blue circles; upper right). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

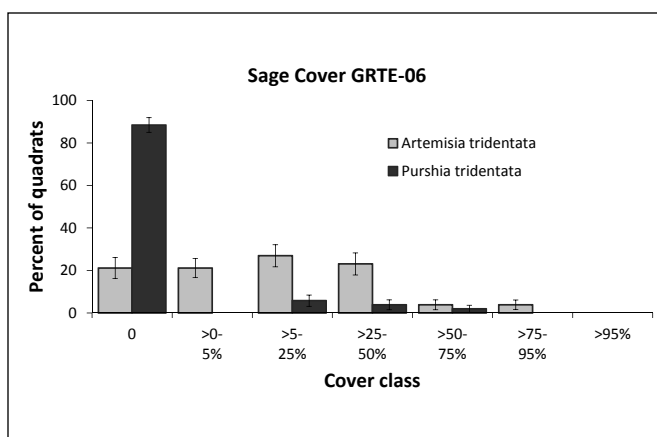


Figure B11. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and bitterbrush (*Purshia tridentata*).

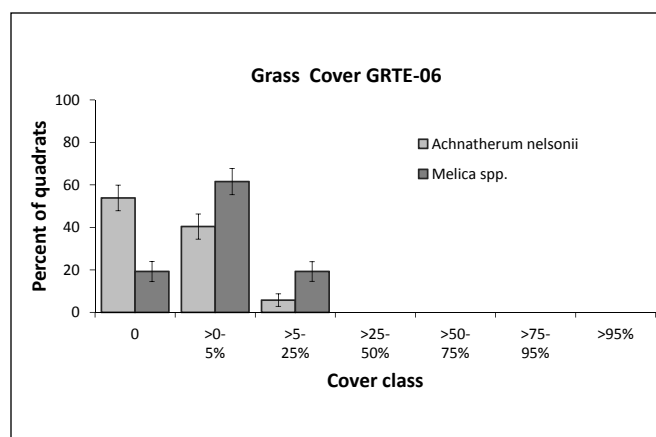


Figure B12. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and oniongrass (*Melica spp.*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B5. Percent of quadrats (n=49) for sample frame GRTE-09 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-09	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	29	51	18	2	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	98	2	0	0	0	0	0
<i>Artemisia cana</i> (silver sagebrush)	98	0	0	2	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	67	14	18	0	0	0	0
<i>Artemisia tripartita</i> (threetip sagebrush)	78	4	10	8	0	0	0
Shrubs							
<i>Chrysothamnus nauseosa</i> (grey rabbitbrush)	98	2	0	0	0	0	0
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	63	8	22	6	0	0	0
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	98	2	0	0	0	0	0
<i>Achnatherum nelsonii</i> (Nelson's ricegrass)	57	14	24	0	2	2	0
<i>Carex</i> spp. (sedges)	24	29	37	6	4	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	98	2	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	59	16	22	0	2	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	6	0	27	53	10	4	0
<i>Koeleria macrantha</i> (prairie junegrass)	65	33	2	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	39	41	16	4	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	63	31	6	0	0	0	0
Native Persistent Forbs							
<i>Achillea millefolium</i> (yarrow)	61	37	2	0	0	0	0
<i>Antennaria</i> spp. (pussytoes)	78	16	6	0	0	0	0
<i>Aster</i> spp. (aster)	96	4	0	0	0	0	0
<i>Astragalus</i> spp. (milkvetch)	76	20	4	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	98	2	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	94	6	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	80	16	4	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	37	33	27	2	2	0	0
<i>Geranium viscosissimum</i> (sticky geranium)	98	2	0	0	0	0	0
<i>Helianthella</i> spp. (helianthella)	94	6	0	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	94	4	2	0	0	0	0
<i>Lupinus</i> spp. (lupine)	41	33	22	4	0	0	0
<i>Penstemon</i> spp. (penstemon)	98	2	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	85	14	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	59	35	6	0	0	0	0
<i>Arabis</i> spp. (rockcress)	90	10	0	0	0	0	0
<i>Geum triflorum</i> (prairie smoke)	98	0	2	0	0	0	0
<i>Viola</i> spp. (violet)	98	2	0	0	0	0	0
Non-native Invasive Grasses							
<i>Bromus inermis</i> (smooth brome)	98	2	0	0	0	0	0
<i>Bromus japonicus</i> (Japanese brome)	98	0	2	0	0	0	0
<i>Poa</i> spp. (bluegrass)	43	22	22	10	2	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	55	45	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	71	29	0	0	0	0	0

¹ Daubenmire Cover Class Categories

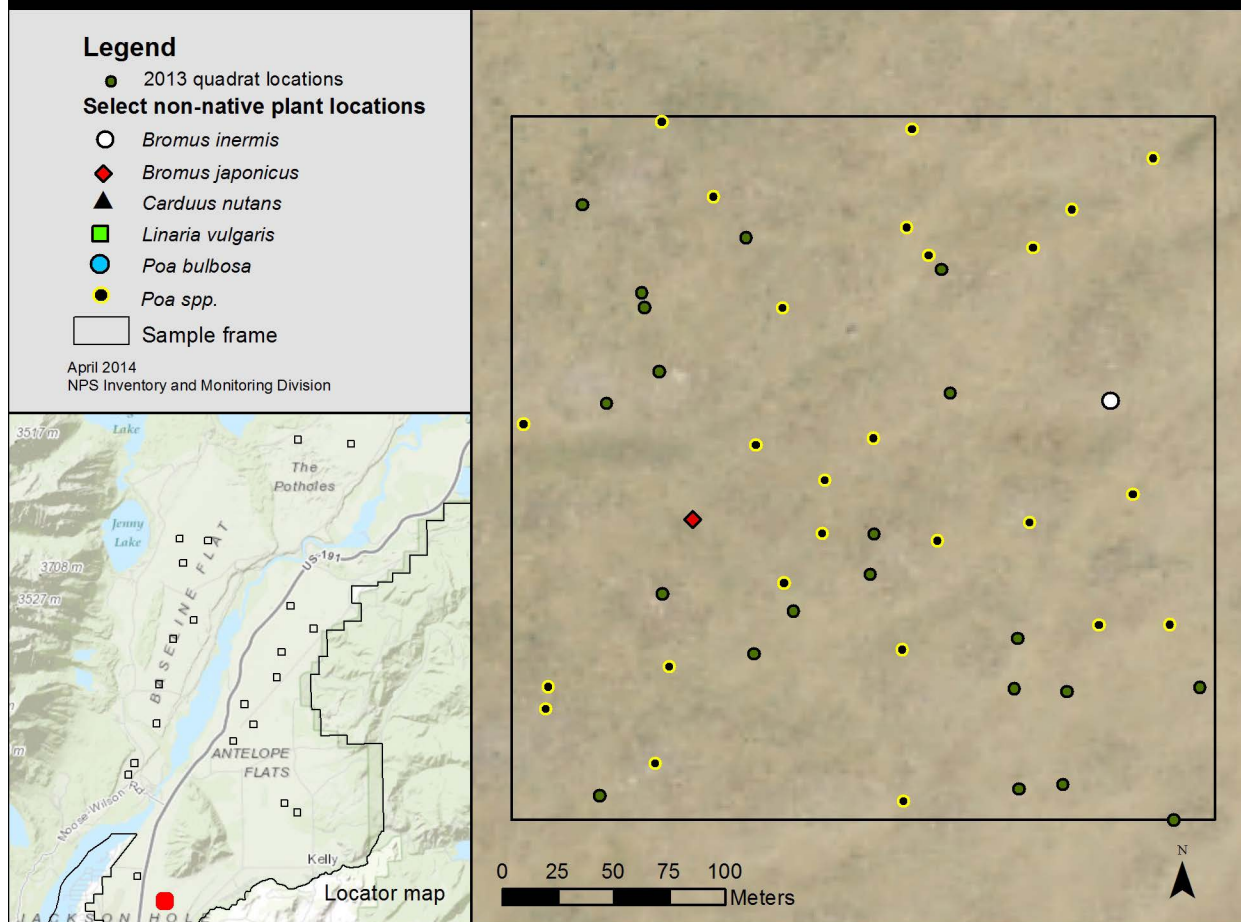


Figure B13. Map showing locations of 1 m² quadrats in sample frame GRTE-09 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy is one location of smooth brome (*Bromus inermis*) (white circle; right) and one location of Japanese brome (*Bromus japonicus*) (red diamond, left). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

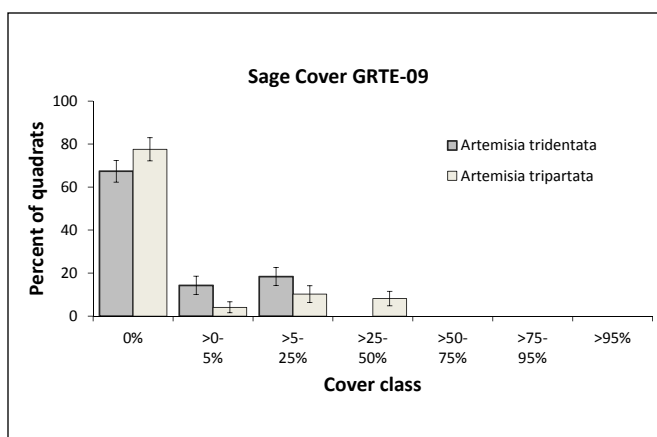


Figure B14. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and three-tip sagebrush (*A. tripartita*).

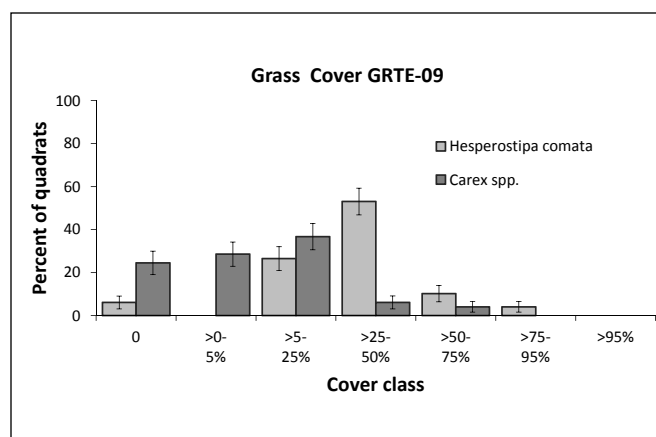


Figure B15. Percent of quadrats by cover class for two dominant grasses, needle-and-thread grass (*Hesperostipa comata*) and sedges (*Carex* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B6. Percent of quadrats (n=52) for sample frame GRTE-11 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-11	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	2	15	40	40	2	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	44	17	19	19	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	27	21	17	21	10	4	0
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	48	35	17	0	0	0	0
<i>Carex</i> spp. (sedges)	65	25	8	2	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	96	4	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	88	8	4	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	98	0	2	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	96	0	4	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	8	83	10	0	0	0	0
<i>Melica</i> spp. (oniongrass)	48	46	6	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	44	48	8	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	40	52	8	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	81	10	8	2	0	0	0
<i>Arenaria</i> spp. (sandwort)	90	10	0	0	0	0	0
<i>Aster</i> spp. (aster)	96	4	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	92	6	0	2	0	0	0
<i>Castilleja</i> spp. (paintbrush)	83	17	0	0	0	0	0
<i>Clematis hirsutissima</i> (clematis)	98	2	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	96	4	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	96	4	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	4	27	38	29	2	0	0
<i>Frasera speciosa</i> (green gentian)	98	0	2	0	0	0	0
<i>Lupinus</i> spp. (lupine)	65	27	8	0	0	0	0
<i>Phlox</i> spp. (phlox)	92	8	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	48	52	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	85	15	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	46	54	0	0	0	0	0
Non-native Invasive Grasses							
<i>Bromus inermis</i> (smooth brome)	98	2	0	0	0	0	0
<i>Poa</i> spp. (bluegrass)	67	31	2	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	96	4	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	98	2	0	0	0	0	0

¹ Daubenmire Cover Class Categories

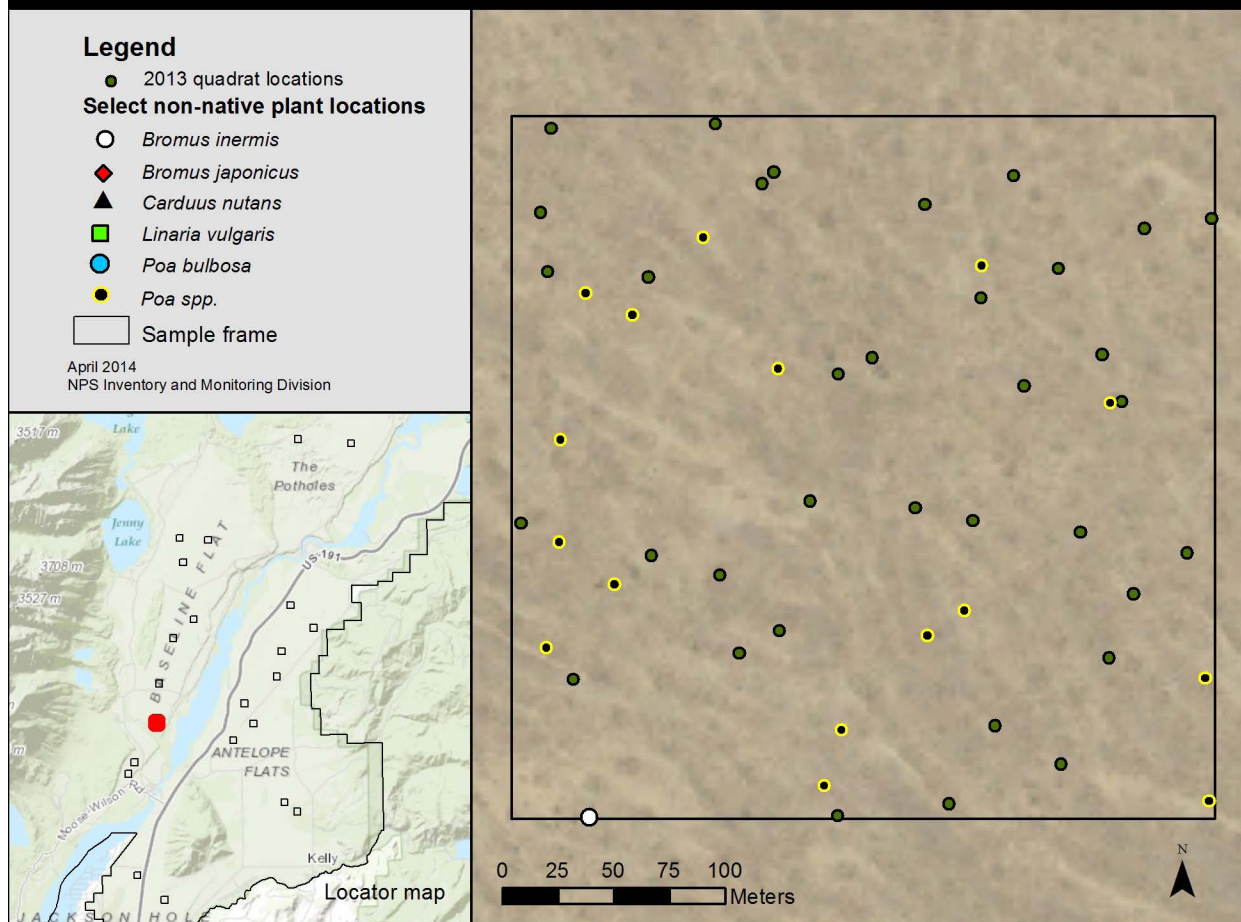


Figure B16. Map showing locations of 1 m² quadrats in sample frame GRTE-11 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy is one location of smooth brome (*Bromus inermis*) (white circle; lower left). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

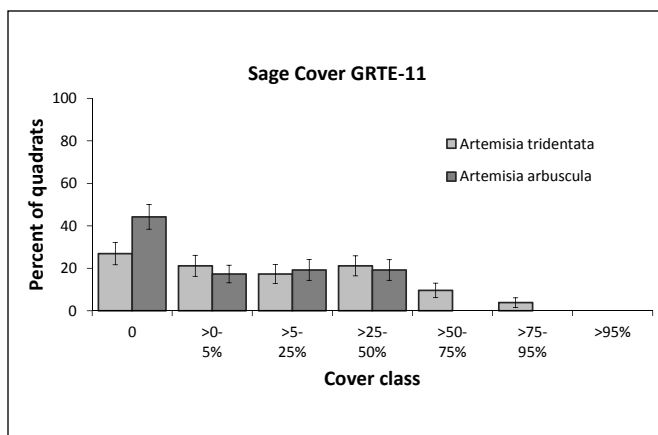


Figure B17. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

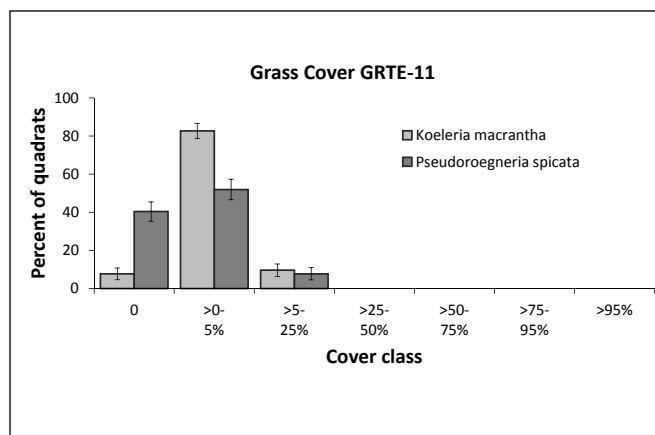


Figure B18. Percent of quadrats by cover class for two dominant grasses, bluebunch wheatgrass (*Pseudoroegneria spicata*) and prairie junegrass (*Koeleria macrantha*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B7. Percent of quadrats (n=52) for sample frame GRTE-12 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-12	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	10	77	13	0	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	92	8	2	0	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	2	21	33	33	8	4	2
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's ricegrass)	54	35	12	0	0	0	0
<i>Carex</i> spp. (sedges)	31	58	12	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	56	40	2	2	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	21	29	42	8	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	98	2	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	63	37	0	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	48	48	4	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	58	33	10	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	79	12	10	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	90	10	0	0	0	0	0
<i>Aster</i> spp. (aster)	94	4	2	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	67	31	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	79	21	0	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	98	2	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	96	2	2	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	4	50	35	12	0	0	0
<i>Lomatium</i> spp. (lomatium)	96	4	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	17	52	31	0	0	0	0
<i>Phlox</i> spp. (phlox)	65	35	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	52	48	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	92	8	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	90	10	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	52	44	4	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	40	60	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	92	8	0	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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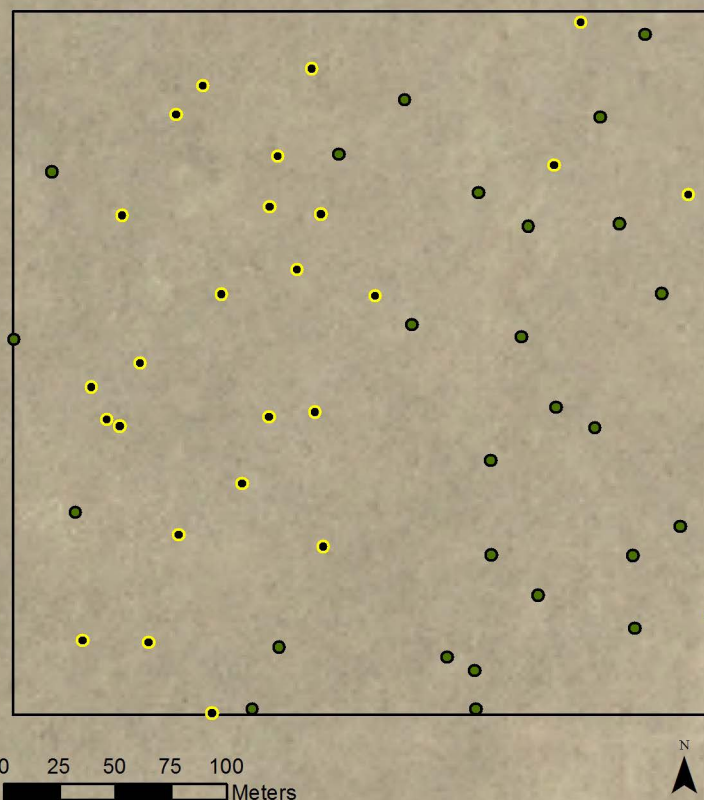
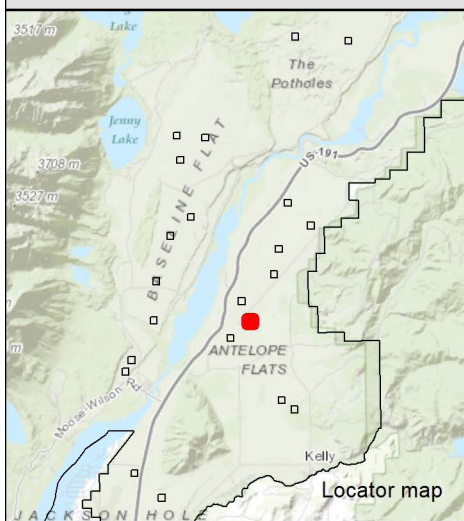


Figure B19. Map showing locations of 1 m² quadrats in sample frame GRTE-12 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*).

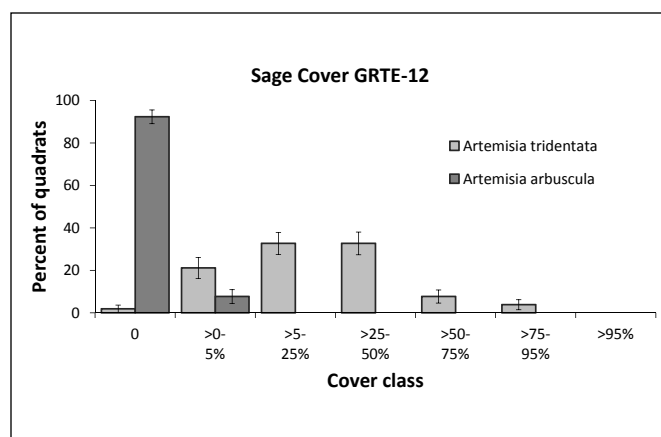


Figure B20. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

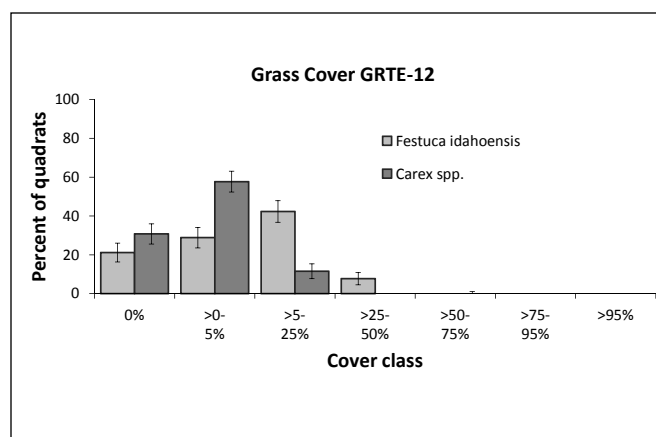


Figure B21. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and sedges (*Carex spp.*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B8. Percent of quadrats (n=52) for sample frame GRTE-13 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-13	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	13	60	19	8	0	0	0
Sagebrush							
<i>Artemisia tridentata</i> (big sagebrush)	2	19	31	19	23	4	2
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	96	4	0	0	0	0	0
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	75	25	0	0	0	0	0
<i>Carex</i> spp. (sedges)	37	42	19	2	0	0	0
<i>Elymus elymoides</i> (squirreltail)	92	8	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	62	25	12	2	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	60	40	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	35	44	19	2	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	71	25	4	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	8	17	60	15	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	90	4	4	0	2	0	0
<i>Aster</i> spp. (aster)	90	10	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	77	2	12	10	0	0	0
<i>Castilleja</i> spp. (paintbrush)	96	4	0	0	0	0	0
<i>Clematis hirsutissima</i> (clematis)	98	2	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	52	40	8	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	40	56	4	0	0	0	0
<i>Erigeron</i> spp. (daisy)	98	2	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	8	10	40	33	8	2	0
<i>Frasera speciosa</i> (green gentian)	94	0	6	0	0	0	0
<i>Lupinus</i> spp. (lupine)	15	25	40	17	2	0	0
<i>Perideridia montana</i> (yampah)	69	31	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	58	42	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	42	58	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	85	15	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	96	4	0	0	0	0	0
<i>Viola</i> spp. (violet)	90	10	0	0	0	0	2
Non-native Invasive Grasses							
<i>Bromus japonicus</i> (Japanese brome)	98	2	0	0	0	0	0
<i>Phleum pratense</i> (timothy)	98	2	0	0	0	0	0
<i>Poa</i> spp. (bluegrass)	40	37	21	2	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	63	35	2	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	94	6	0	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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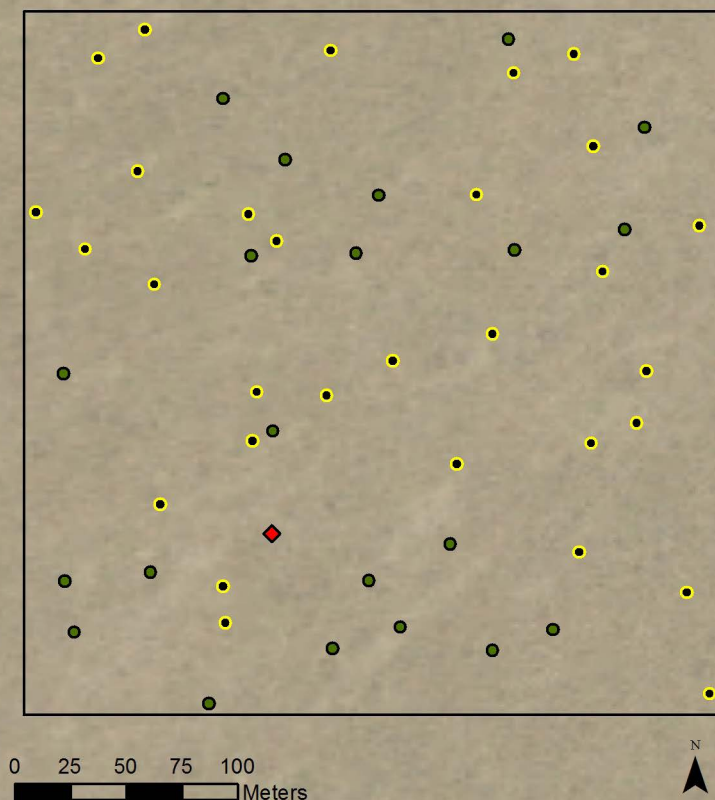
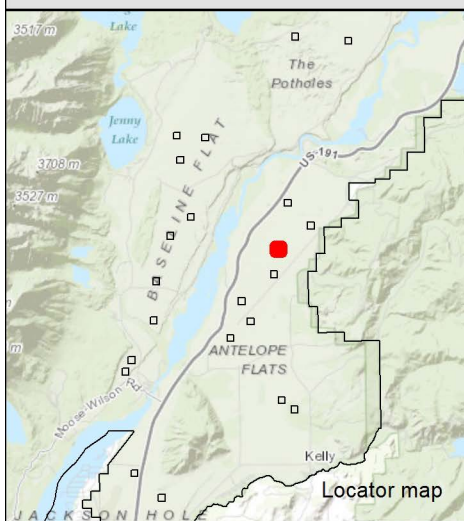


Figure B22. Map showing locations of 1 m² quadrats in sample frame GRTE-13 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy is one location of Japanese brome (*Bromus japonicus*) (red diamond, lower left). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

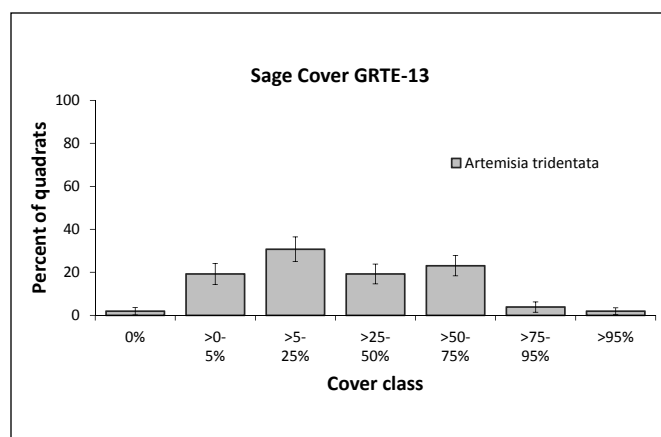


Figure B23. Percent of quadrats by cover class for the only dominant shrub, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*).

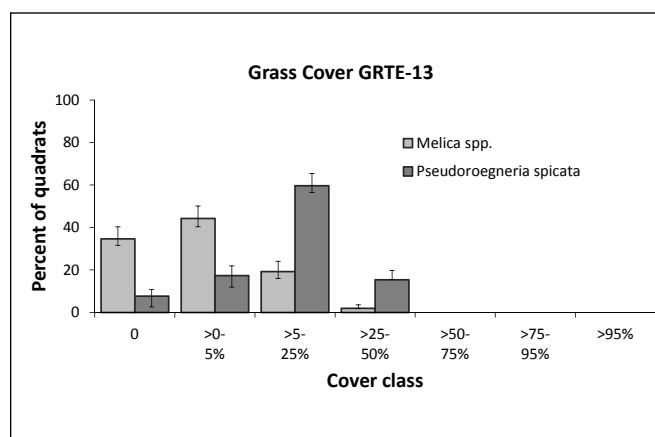


Figure B24. Percent of quadrats by cover class for two dominant grasses, bluebunch wheatgrass (*Pseudoroegneria spicata*) and oniongrass (*Melica* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B9. Percent of quadrats (n=51) for sample frame GRTE-14 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-14	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	2	61	24	14	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	86	6	6	2	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	27	29	37	6	0	0	0
Shrubs							
<i>Purshia tridentata</i> (antelope bitterbrush)	88	2	2	4	2	0	2
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	98	2	0	0	0	0	0
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	39	43	18	0	0	0	0
<i>Bromus marginatus</i> (mountain brome)	88	12	0	0	0	0	0
<i>Carex</i> spp. (sedges)	88	10	2	0	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	98	2	0	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	94	6	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	35	51	14	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	14	86	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	53	47	0	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	33	67	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	55	41	4	0	0	0	0
Native Persistent Forbs							
<i>Achillea millefolium</i> (yarrow)	98	2	0	0	0	0	0
<i>Antennaria</i> spp. (pussytoes)	86	14	0	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	84	16	0	0	0	0	0
<i>Aster</i> spp. (aster)	98	2	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	67	24	10	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	73	27	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	84	16	0	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	84	16	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	98	2	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	8	55	29	6	2	0	0
<i>Lomatium</i> spp. (lomatium)	80	20	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	49	45	6	0	0	0	0
<i>Phlox</i> spp. (phlox)	94	6	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	33	67	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	84	16	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	35	63	2	0	0	0	0
<i>Viola</i> spp. (violet)	98	2	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	69	31	0	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	80	20	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	94	6	0	0	0	0	0

¹ Daubenmire Cover Class Categories

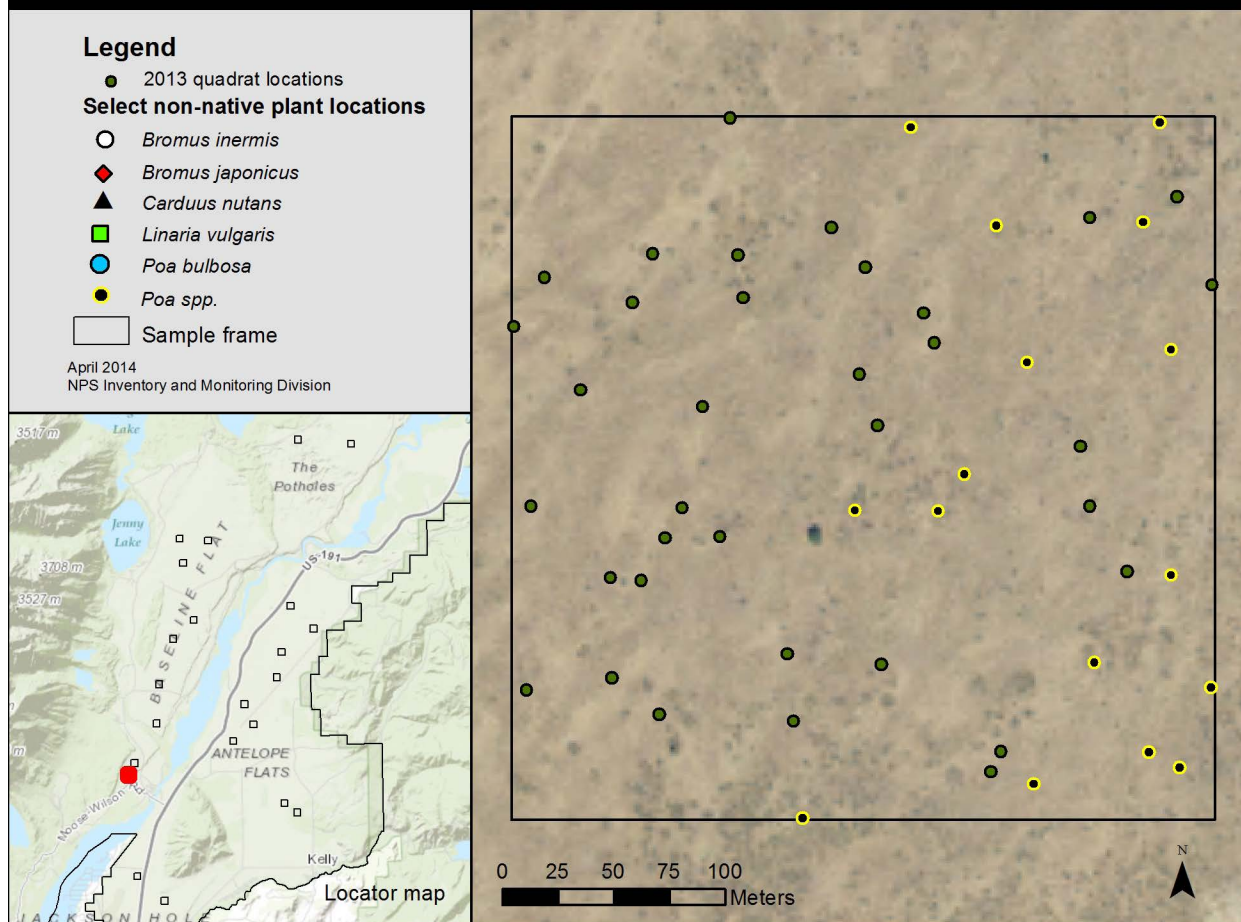


Figure B25. Map showing locations of 1 m² quadrats in sample frame GRTE-14 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

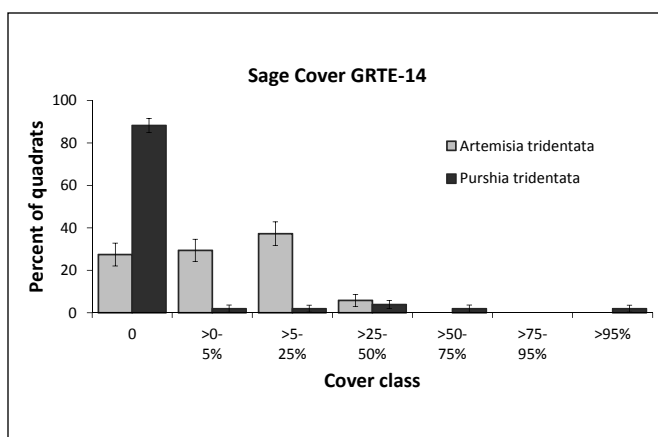


Figure B26. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and bitterbrush (*Purshia tridentata*).

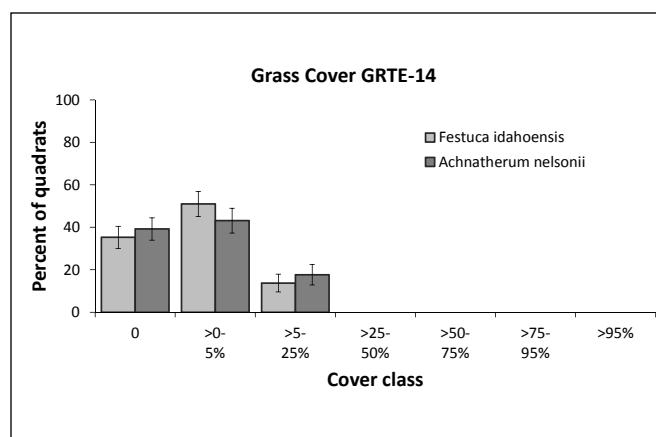


Figure B27. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and Idaho fescue (*Festuca idahoensis*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B10. Percent of quadrats (n=52) for sample frame GRTE-15 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-15	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	0	62	37	2	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	48	29	21	2	0	0	0
<i>Artemisia frigida</i> (fringed sagebrush)	98	2	0	0	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	31	25	23	21	0	0	0
Native Perennial Grasses							
<i>Achnatherum hymenoides</i> (Indian ricegrass)	98	2	0	0	0	0	0
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	27	71	2	0	0	0	0
<i>Bromus marginatus</i> (mountain brome)	98	2	0	0	0	0	0
<i>Carex</i> spp. (sedges)	54	44	2	0	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	92	8	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	96	4	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	96	4	0	0	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	94	6	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	10	90	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	29	69	2	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	65	35	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	48	52	0	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	94	4	0	2	0	0	0
<i>Arenaria</i> spp. (sandwort)	92	8	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	98	0	0	2	0	0	0
<i>Castilleja</i> spp. (paintbrush)	54	46	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	77	23	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	96	4	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	4	29	46	19	2	0	0
<i>Lomatium</i> spp. (lomatium)	98	2	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	46	46	8	0	0	0	0
<i>Potentilla</i> spp. (cinquefoil)	98	2	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	42	58	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	85	15	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	46	54	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa bulbosa</i> (bulbous bluegrass)	98	2	0	0	0	0	0
<i>Poa</i> spp. (bluegrass)	87	13	0	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	98	2	0	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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NPS Inventory and Monitoring Division

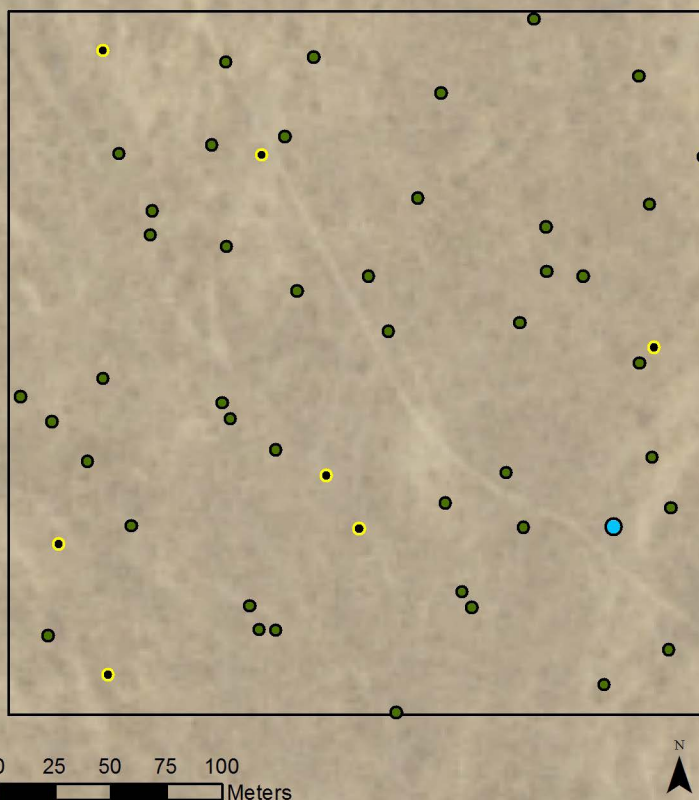
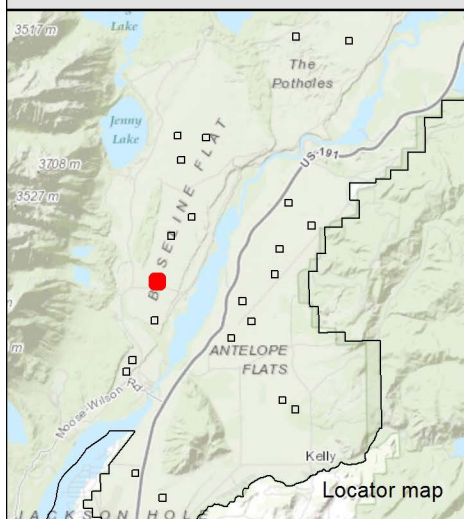


Figure B28. Map showing locations of 1 m² quadrats in sample frame GRTE-15 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy is one location of bulbous bluegrass (*Poa bulbosa*) (blue circle; lower right). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

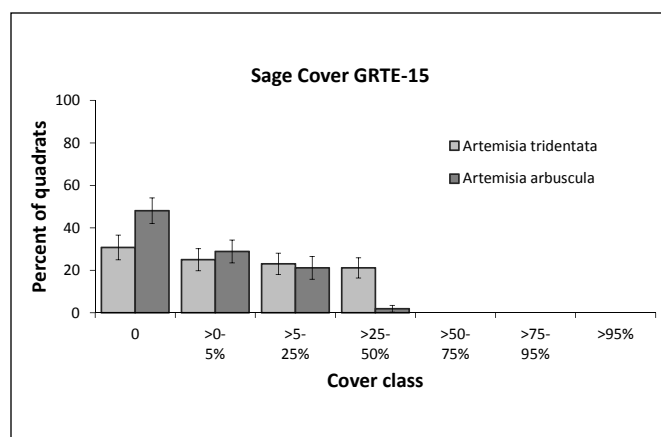


Figure B29. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

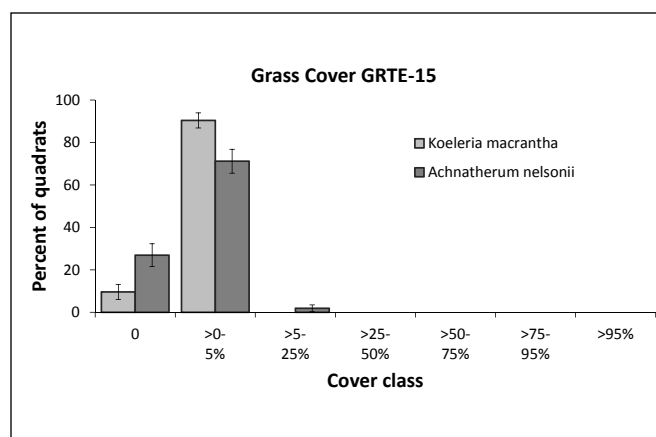


Figure B30. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and prairie junegrass (*Koeleria macrantha*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B11. Percent of quadrats (n=47) for sample frame GRTE-16 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-16	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	0	19	49	26	6	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	36	13	28	21	2	0	0
<i>Artemisia tridentata</i> (big sagebrush)	32	17	19	23	9	0	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	55	38	6	0	0	0	0
<i>Bromus marginatus</i> (mountain brome)	98	0	2	0	0	0	0
<i>Carex</i> spp. (sedges)	74	15	6	4	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	91	9	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	91	9	0	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	98	2	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	13	74	13	0	0	0	0
<i>Melica</i> spp. (oniongrass)	4	55	32	9	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	74	26	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	53	34	11	2	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	96	4	0	0	0	0	0
<i>Aster</i> spp. (aster)	94	6	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	74	26	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	87	13	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	96	4	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	23	30	38	4	2	0
<i>Lomatium</i> spp. (lomatium)	96	4	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	62	28	9	2	0	0	0
<i>Perideridia montana</i> (yampah)	68	32	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	21	77	2	0	0	0	0
<i>Arabis</i> spp. (rockcress)	94	6	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	60	40	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	70	26	4	0	0	0	0

¹ Daubenmire Cover Class Categories

Sample Frame GRTE- 16
Sagebrush Steppe Monitoring

National Park Service
U.S. Department of the Interior
Grand Teton National Park



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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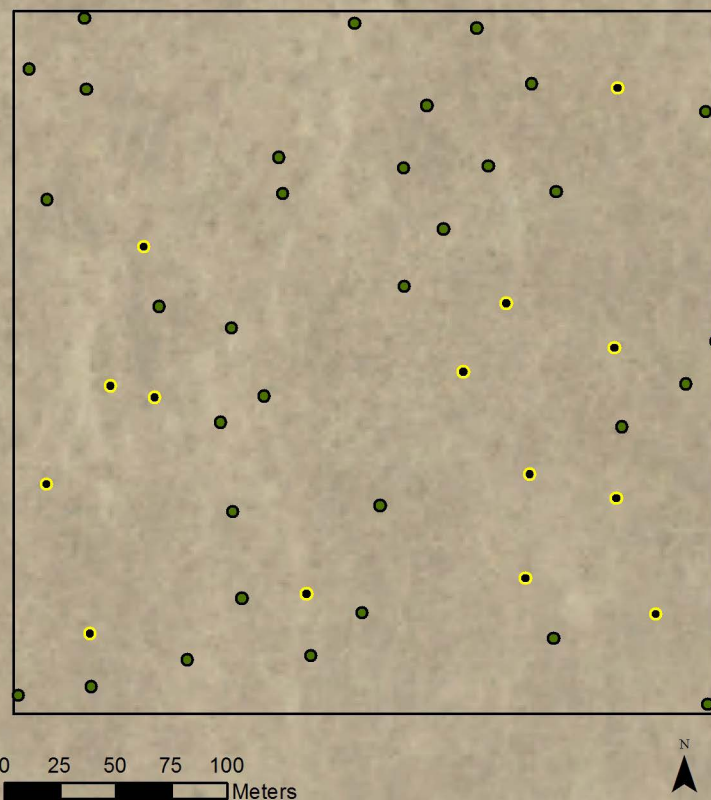
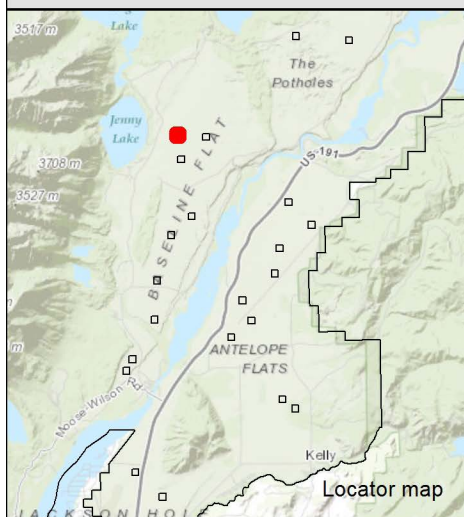


Figure B31. Map showing locations of 1 m² quadrats in sample frame GRTE-16 where soil and plant cover data were collected in July 2013 and where non-native plants were observed.

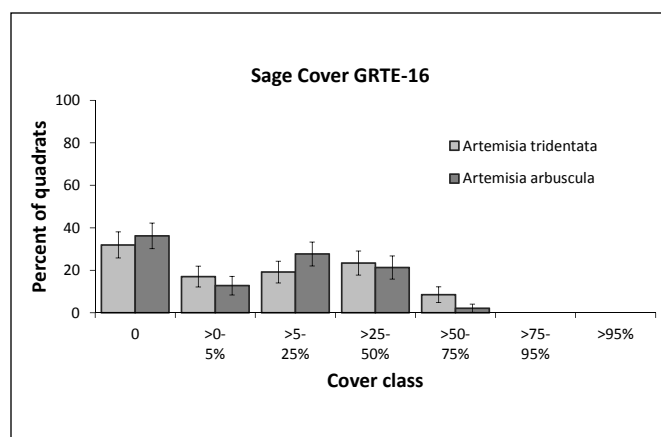


Figure B32. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

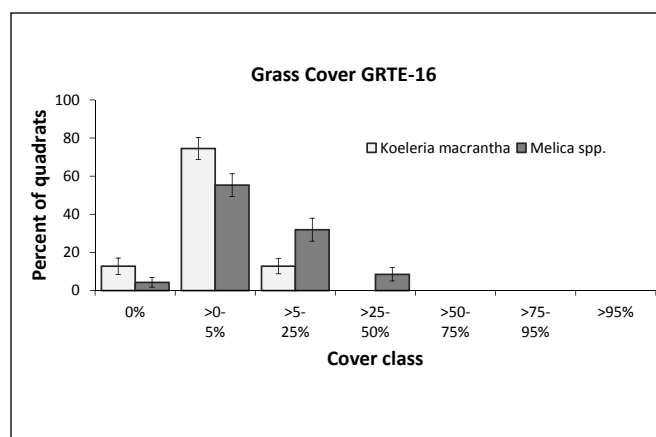


Figure B33. Percent of quadrats by cover class for two dominant grasses, prairie junegrass (*Koeleria macrantha*) and oniongrass (*Melica* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B12. Percent of quadrats (n=53) for sample frame GRTE-19 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-19	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	0	62	34	4	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	23	26	38	13	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	28	23	23	15	9	2	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	11	68	21	0	0	0	0
<i>Carex</i> spp. (sedges)	47	32	11	9	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	94	6	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	0	94	6	0	0	0	0
<i>Melica</i> spp. (oniongrass)	13	64	23	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	43	55	2	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	58	42	0	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	92	6	2	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	89	11	0	0	0	0	0
<i>Aster</i> spp. (aster)	89	11	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	98	2	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	26	55	19	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	89	11	0	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	98	2	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	96	4	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	28	49	17	4	0	0
<i>Lomatium</i> spp. (lomatium)	98	2	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	53	36	11	0	0	0	0
<i>Perideridia montana</i> (yampah)	85	15	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	11	87	0	0	0	0	2
<i>Arabis</i> spp. (rockcress)	91	9	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	36	60	4	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	91	8	0	2	0	0	0

¹ Daubenmire Cover Class Categories

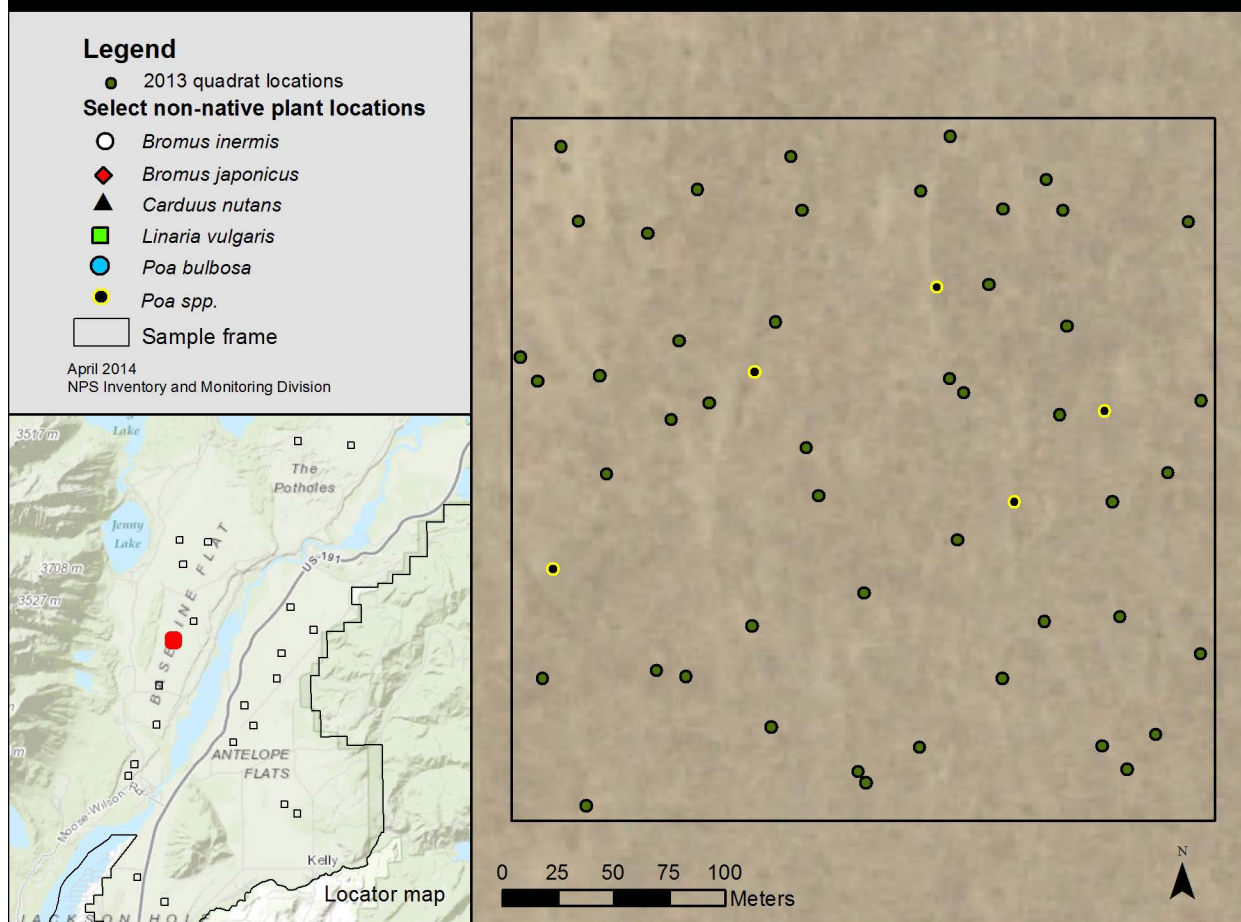


Figure B34. Map showing locations of 1 m² quadrats in sample frame GRTE-19 where soil and plant cover data were collected in July 2013 and where non-native plants were observed.

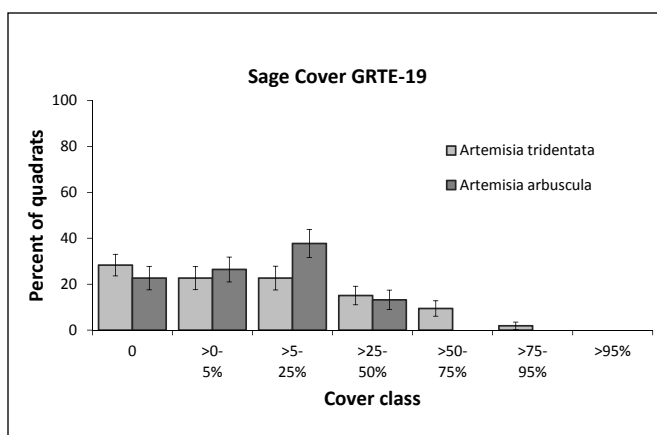


Figure B35. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

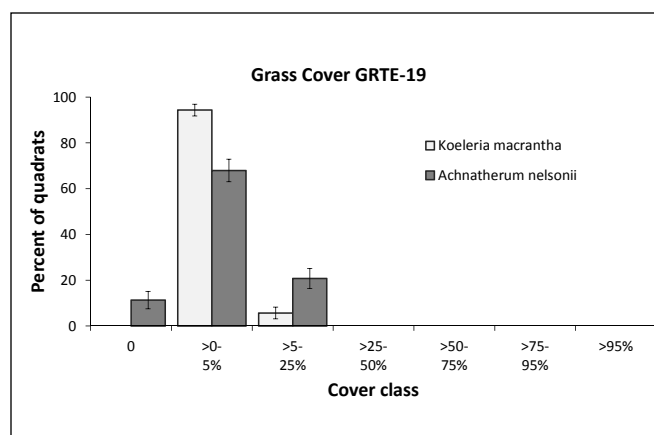


Figure B36. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and prairie junegrass (*Koeleria macrantha*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B13. Percent of quadrats (n=52) for sample frame GRTE-21 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-21	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	0	40	37	19	4	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	21	19	23	35	2	0	0
<i>Artemisia tridentata</i> (big sagebrush)	44	19	17	15	4	0	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	10	75	13	2	0	0	0
<i>Carex</i> spp. (sedges)	37	44	12	8	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	83	12	2	4	0	0	0
<i>Elymus elymoides</i> (squirreltail)	90	10	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	96	4	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	21	79	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	58	38	4	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	25	75	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	60	35	6	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	81	15	2	2	0	0	0
<i>Arenaria</i> spp. (sandwort)	81	19	0	0	0	0	0
<i>Aster</i> spp. (aster)	96	4	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	98	2	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	31	67	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	92	8	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	94	6	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	0	38	31	29	2	0	0
<i>Lomatium</i> spp. (lomatium)	98	2	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	83	17	0	0	0	0	0
<i>Perideridia montana</i> (yampah)	96	4	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	98	2	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	15	85	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	90	10	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	60	40	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	94	6	0	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	81	19	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	98	2	0	0	0	0	0

¹ Daubenmire Cover Class Categories

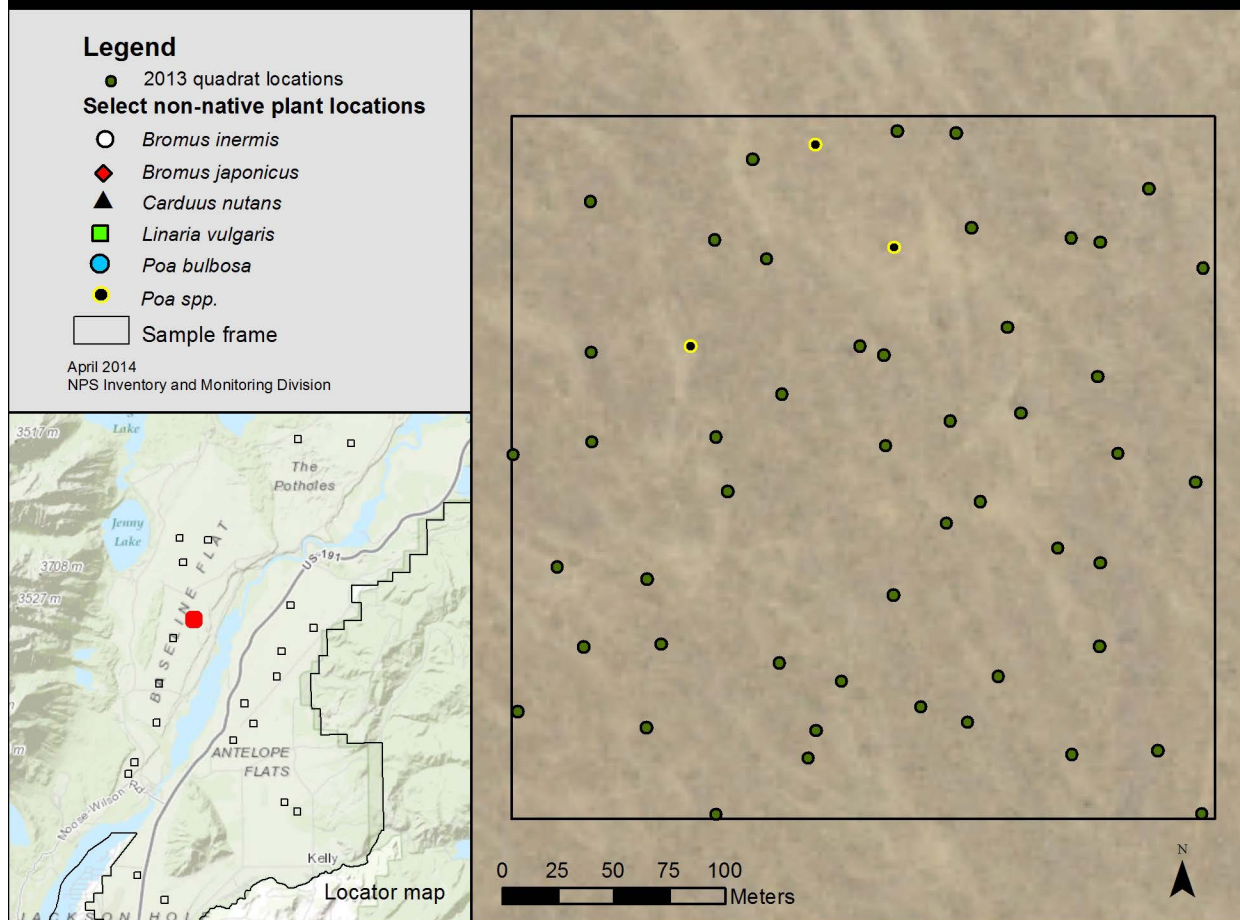


Figure B37. Map showing locations of 1 m² quadrats in sample frame GRTE-21 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

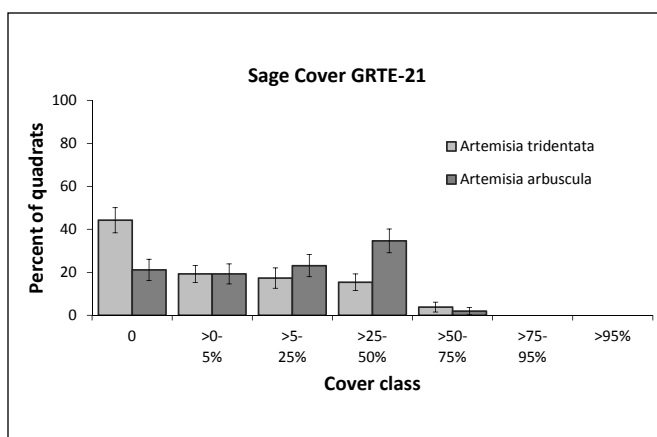


Figure B38. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

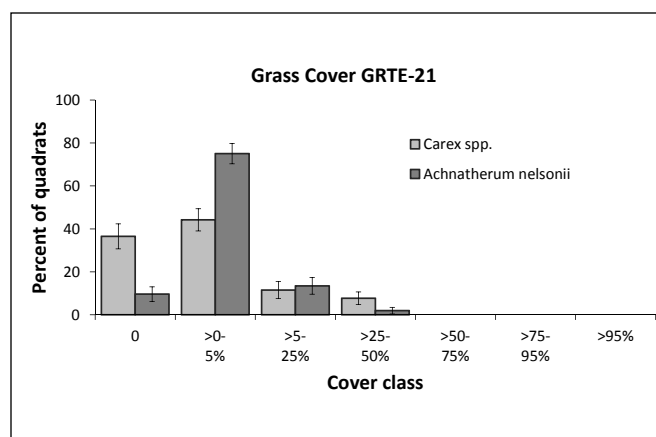


Figure B39. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and sedges (*Carex* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B14. Percent of quadrats (n=53) for sample frame GRTE-22 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-22	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	58	38	4	0	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	98	2	0	0	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	14	16	34	22	12	2	0
Shrubs							
<i>Mahonia repens</i> (creeping barberry)	64	17	19	0	0	0	0
<i>Purshia tridentata</i> (antelope bitterbrush)	21	11	19	19	23	8	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	77	13	9	0	0	0	0
<i>Carex</i> spp. (sedges)	81	17	2	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	94	6	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	83	17	0	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	85	13	2	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	23	47	28	2	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	98	2	0	0	0	0	0
<i>Aster</i> spp. (aster)	91	9	0	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	30	30	36	4	0	0	0
<i>Castilleja</i> spp. (paintbrush)	94	4	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	55	43	2	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	98	2	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	98	2	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	26	32	26	11	4	0	0
<i>Helianthella</i> spp. (helianthella)	43	38	17	2	0	0	0
<i>Lithospermum ruderales</i> (western stoneseed)	68	23	9	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	92	8	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	42	45	13	0	0	0	0
<i>Perideridia montana</i> (yampah)	92	6	2	0	0	0	0
<i>Phlox</i> spp. (phlox)	91	6	4	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	49	51	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	89	11	0	0	0	0	2
Non-native Invasive Grasses							
<i>Bromus inermis</i> (smooth brome)	98	0	2	0	0	0	0
<i>Phleum pratense</i> (timothy)	98	2	0	0	0	0	0
<i>Poa</i> spp. (bluegrass)	23	64	9	4	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	49	49	2	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	53	45	2	0	0	0	0

¹ Daubenmire Cover Class Categories

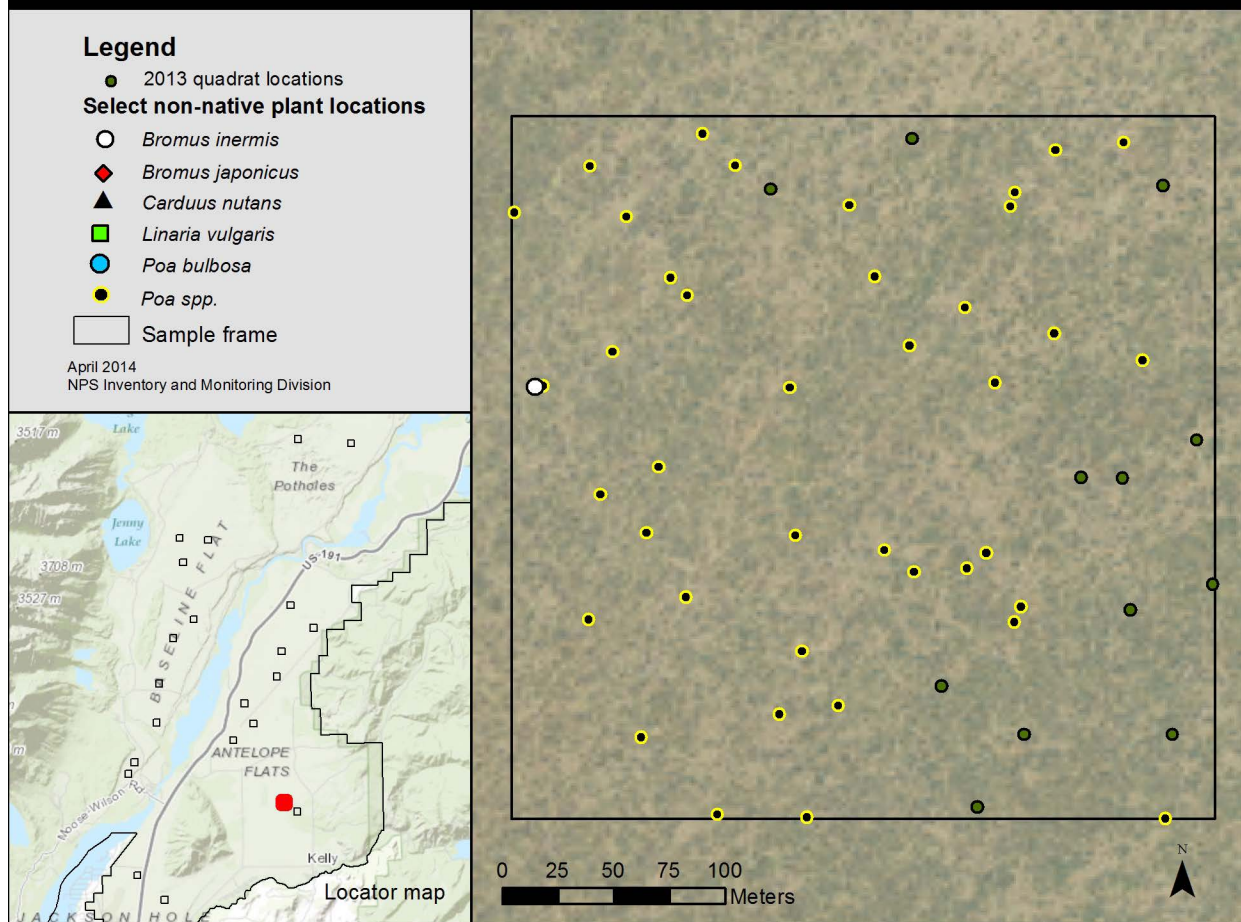


Figure B40. Map showing locations of 1 m² quadrats in sample frame GRTE-22 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy is one location of smooth brome (*Bromus inermis*) (white circle; left). Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

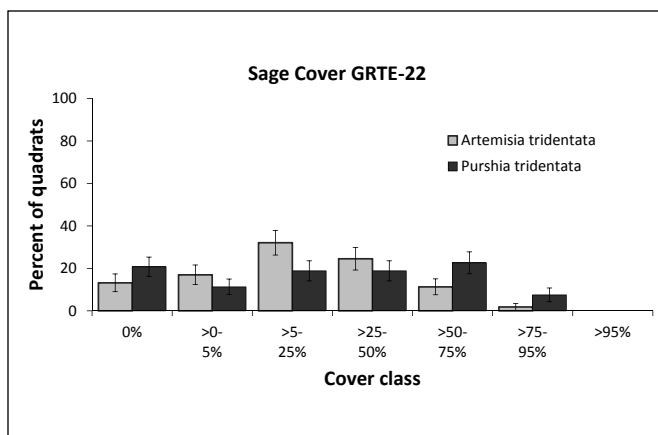


Figure B41. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and bitterbrush (*Purshia tridentata*).

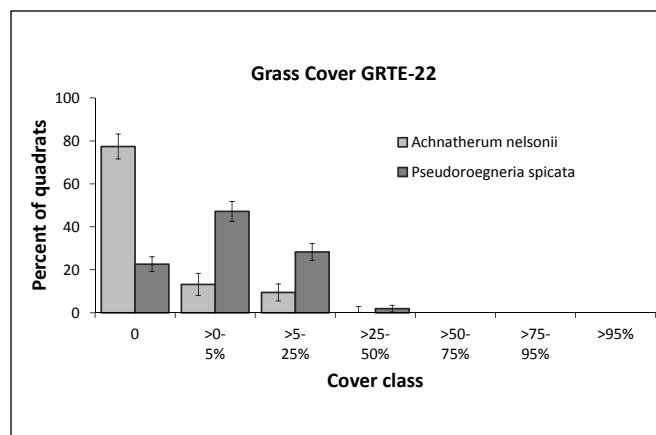


Figure B42. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and bluebunch wheatgrass (*Pseudoroegneria spicata*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B15. Percent of quadrats (n=50) for sample frame GRTE-23 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-23	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	2	32	44	22	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	30	10	34	26	0	0	0
<i>Artemisia cana</i> (silver sagebrush)	98	0	2	0	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	50	10	14	16	8	2	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	20	38	38	4	0	0	0
<i>Carex</i> spp. (sedges)	42	42	10	6	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	88	6	6	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	90	6	4	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	12	70	18	0	0	0	0
<i>Melica</i> spp. (oniongrass)	22	42	30	6	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	78	20	2	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	62	26	10	2	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	94	6	0	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	90	8	2	0	0	0	0
<i>Aster</i> spp. (aster)	98	2	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	76	22	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	92	8	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	88	12	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	4	20	56	16	2	2	0
<i>Frasera speciosa</i> (green gentian)	98	0	2	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	98	2	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	86	14	0	0	0	0	0
<i>Perideridia montana</i> (yampah)	62	38	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	98	2	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	20	78	2	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	58	42	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	94	2	4	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

April 2014
NPS Inventory and Monitoring Division

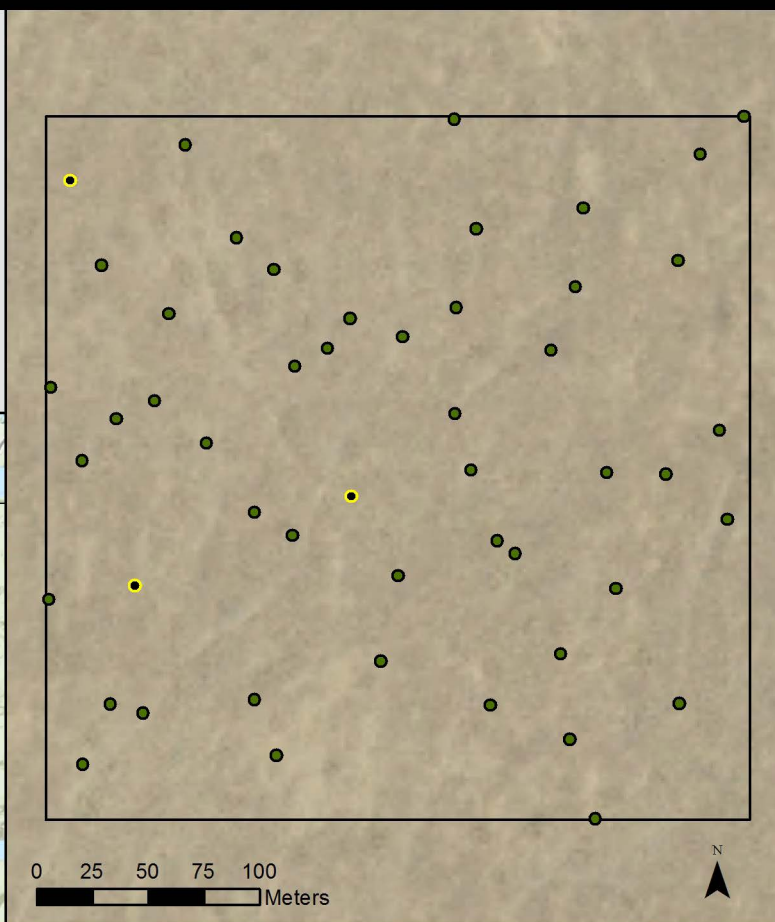
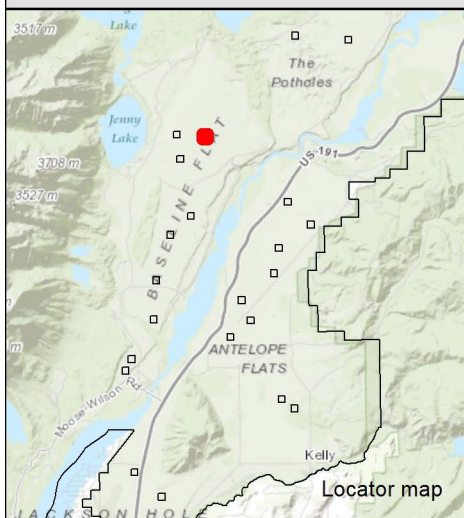


Figure B43. Map showing locations of 1 m² quadrats in sample frame GRTE-23 where soil and plant cover data were collected in July 2013 and where non-native plants were observed.

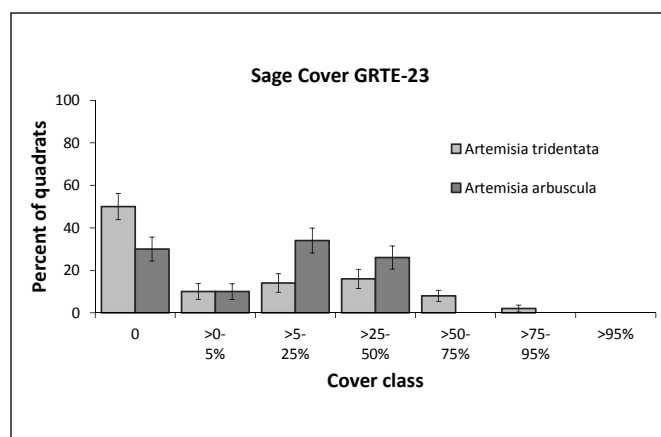


Figure B44. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

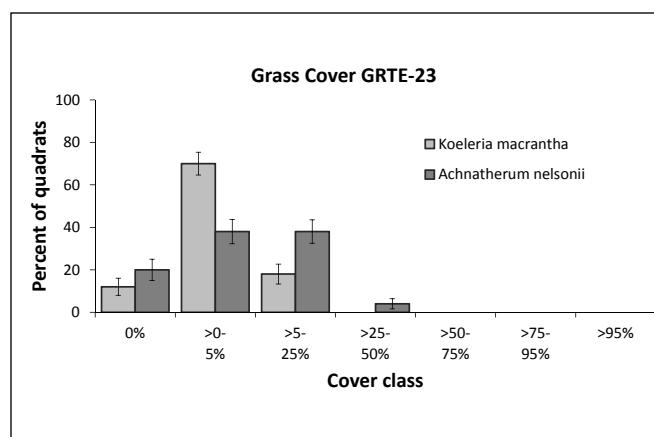


Figure B45. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and prairie junegrass (*Koeleria macrantha*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B16. Percent of quadrats (n=52) for sample frame GRTE-24 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-24	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	13	54	27	6	0	0	0
Sagebrush							
<i>Artemisia tridentata</i> (big sagebrush)	2	8	23	25	33	10	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	73	23	4	0	0	0	0
<i>Bromus marginatus</i> (mountain brome)	94	6	0	0	0	0	0
<i>Carex</i> spp. (sedges)	46	38	15	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	98	0	2	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	98	0	2	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	10	62	25	4	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	46	50	2	2	0	0	0
<i>Melica</i> spp. (oniongrass)	37	56	8	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	77	21	2	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	6	23	42	25	4	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	77	19	2	0	2	0	0
<i>Arenaria</i> spp. (sandwort)	96	4	0	0	0	0	0
<i>Aster</i> spp. (aster)	81	17	2	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	90	4	2	4	0	0	0
<i>Castilleja</i> spp. (paintbrush)	94	6	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	60	35	6	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	50	46	4	0	0	0	0
<i>Erigeron</i> spp. (daisy)	79	19	2	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	6	23	44	23	2	0
<i>Frasera speciosa</i> (green gentian)	98	0	2	0	0	0	0
<i>Lithospermum ruderales</i> (western stoneseed)	92	4	4	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	94	6	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	29	44	21	6	0	0	0
<i>Perideridia montana</i> (yampah)	54	44	2	0	0	0	0
<i>Phlox</i> spp. (phlox)	38	62	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	56	44	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	46	54	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	90	10	0	0	0	0	0
<i>Viola</i> spp. (violet)	65	33	2	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	67	17	10	4	2	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	90	10	0	0	0	0	0

¹ Daubenmire Cover Class Categories

Sample Frame GRTE-24
Sagebrush Steppe Monitoring

National Park Service
U.S. Department of the Interior
Grand Teton National Park



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

April 2014
NPS Inventory and Monitoring Division

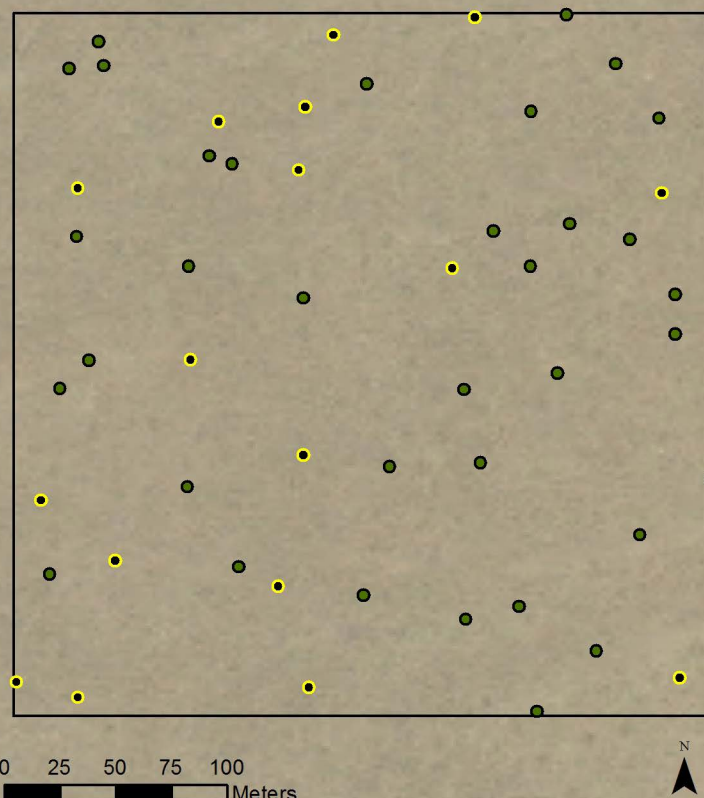
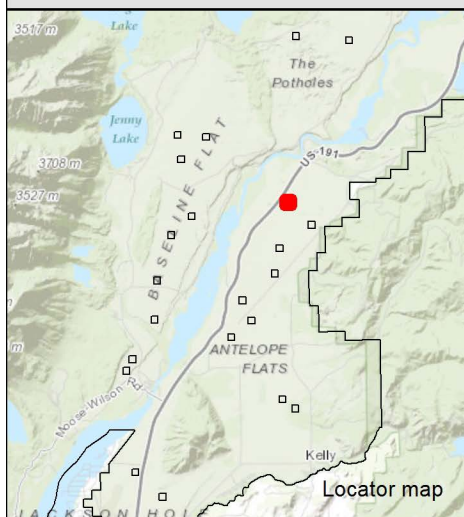


Figure B46. Map showing locations of 1 m² quadrats in sample frame GRTE-24 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*).

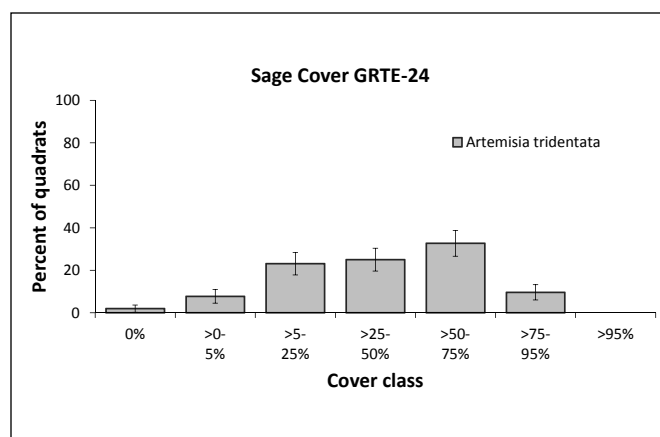


Figure B47. Percent of quadrats by cover class for the only dominant shrub, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*).

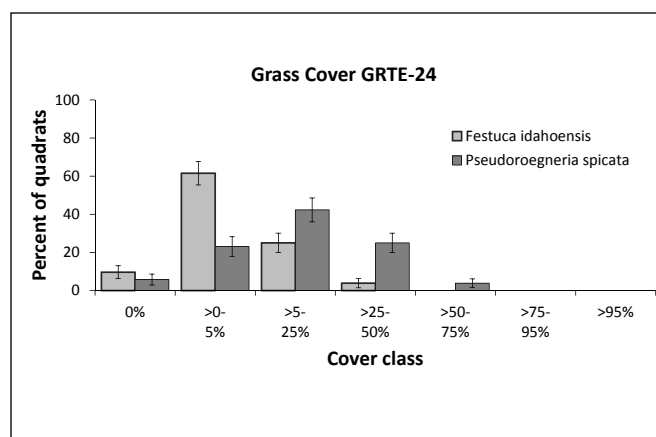


Figure B48. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoroegneria spicata*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B17. Percent of quadrats (n=51) for sample frame GRTE-25 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-25	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	7	58	18	2	0	0	0
Sagebrush							
<i>Artemisia tridentata</i> (big sagebrush)	12	14	24	20	12	12	4
<i>Artemisia tripartita</i> (threetip sagebrush)	98	0	0	2	0	0	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	63	31	6	0	0	0	0
<i>Bromus marginatus</i> (mountain brome)	98	2	0	0	0	0	0
<i>Carex</i> spp. (sedges)	33	47	14	6	0	0	0
<i>Elymus elymoides</i> (squirreltail)	98	2	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	67	27	6	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	71	29	0	0	0	0	0
<i>Melica</i> spp. (oniongrass)	59	41	0	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	86	14	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0	45	45	10	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	92	4	4	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	98	2	0	0	0	0	0
<i>Aster</i> spp. (aster)	69	31	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	84	16	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	67	31	2	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	45	45	10	0	0	0	0
<i>Erigeron</i> spp. (daisy)	98	2	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	24	29	35	10	0	0
<i>Helianthella</i> spp. (helianthella)	96	4	0	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	78	22	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	14	41	41	4	0	0	0
<i>Perideridia montana</i> (yampah)	73	27	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	80	20	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	31	69	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	86	14	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	98	2	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	73	20	8	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	63	37	0	0	0	0	0
<i>Tragopogon dubius</i> (salsify)	96	4	0	0	0	0	0

¹ Daubenmire Cover Class Categories

Sample Frame GRTE- 25
Sagebrush Steppe Monitoring

National Park Service
U.S. Department of the Interior
Grand Teton National Park



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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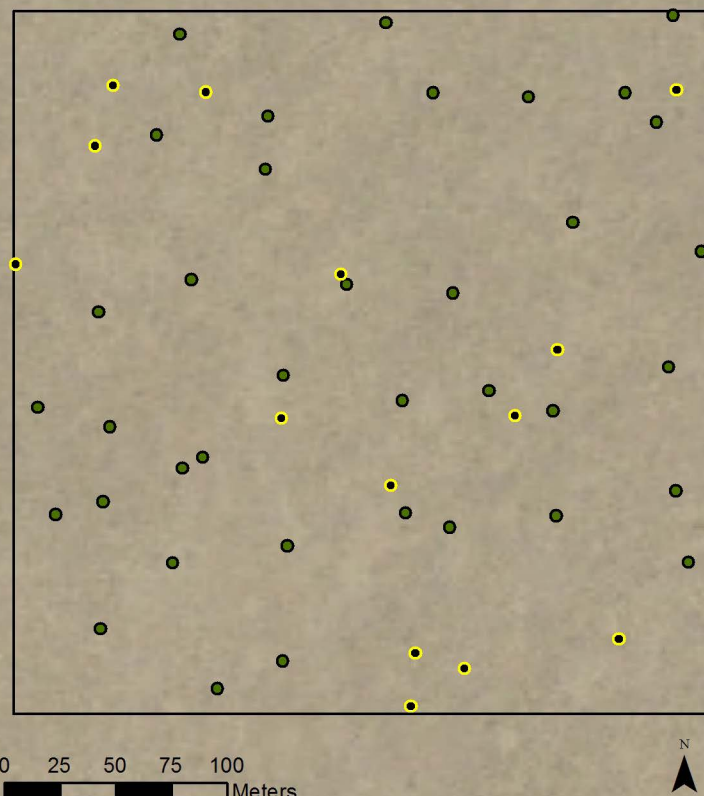
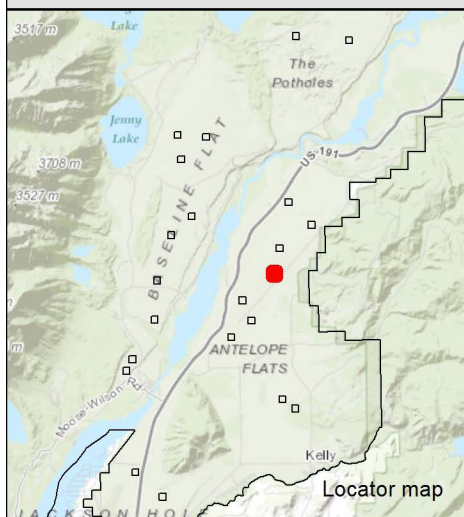


Figure B49. Map showing locations of 1 m² quadrats in sample frame GRTE-25 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*) and salsify (*Tragopogon dubius*).

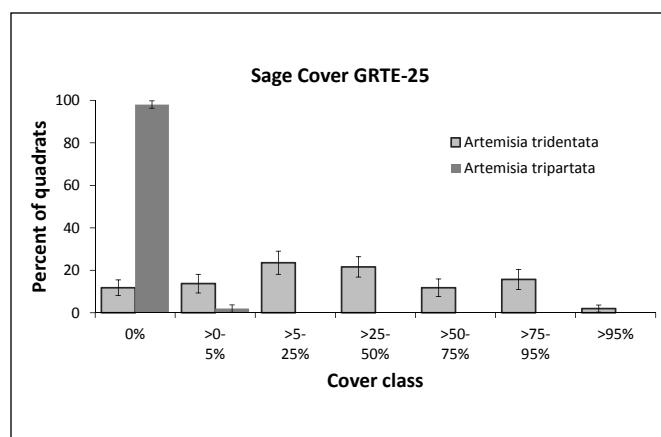


Figure B50. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and three-tip sagebrush (*A. tripartita*).

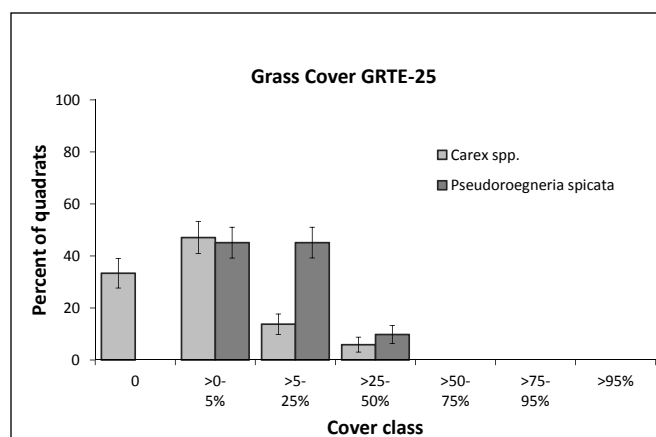


Figure B51. Percent of quadrats by cover class for two dominant grasses, bluebunch wheatgrass (*Pseudoroegneria spicata*) and sedges (*Carex spp.*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B18. Percent of quadrats (n=52) for sample frame GRTE-26 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-26	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	10	65	21	2	2	0	0
Sagebrush							
<i>Artemisia tridentata</i> (big sagebrush)	2	10	29	29	19	12	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	73	27	0	0	0	0	0
<i>Carex</i> spp. (sedges)	46	38	15	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	94	6	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	27	67	6	0	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	98	2	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	60	38	2	0	0	0	0
<i>Melica</i> spp. (oniongrass)	77	21	2	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	85	15	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	21	35	35	10	0	0	0
Native Persistent Forbs							
<i>Achillea millefolium</i> (yarrow)	98	2	0	0	0	0	0
<i>Antennaria</i> spp. (pussytoes)	33	48	19	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	96	0	4	0	0	0	0
<i>Aster</i> spp. (aster)	71	27	2	0	0	0	0
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)	92	0	8	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	75	23	0	2	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	63	35	2	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	44	56	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	73	17	10	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	0	8	37	42	12	2	0
<i>Helianthella</i> spp. (helianthella)	88	12	0	0	0	0	0
<i>Lomatium</i> spp. (lomatium)	35	47	18	0	0	0	0
<i>Lupinus</i> spp. (lupine)	35	48	17	0	0	0	0
<i>Perideridia montana</i> (yampah)	90	10	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	58	42	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	44	56	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	85	15	0	0	0	0	0
<i>Geum triflorum</i> (prairie smoke)	96	0	4	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	96	4	0	0	0	0	0
<i>Viola</i> spp. (violet)	88	12	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	85	15	0	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	87	13	0	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

April 2014
NPS Inventory and Monitoring Division

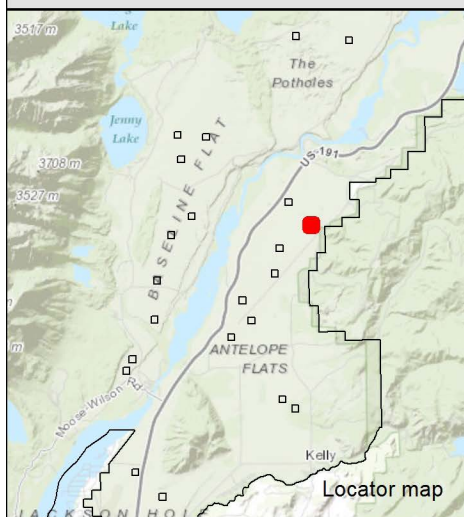


Figure B52. Map showing locations of 1 m² quadrats in sample frame GRTE-26 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*).

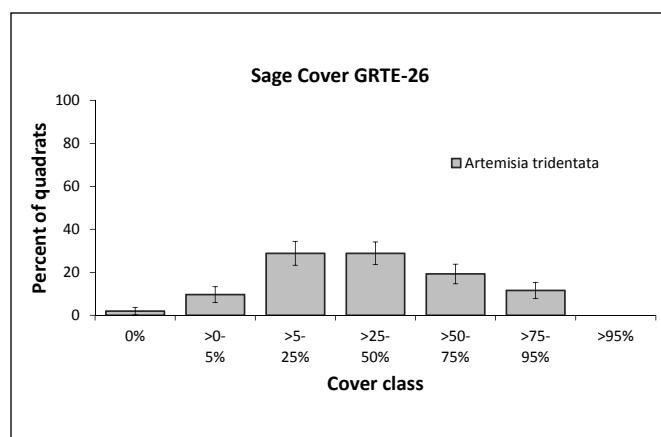


Figure B53. Percent of quadrats by cover class for the only dominant shrub, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*).

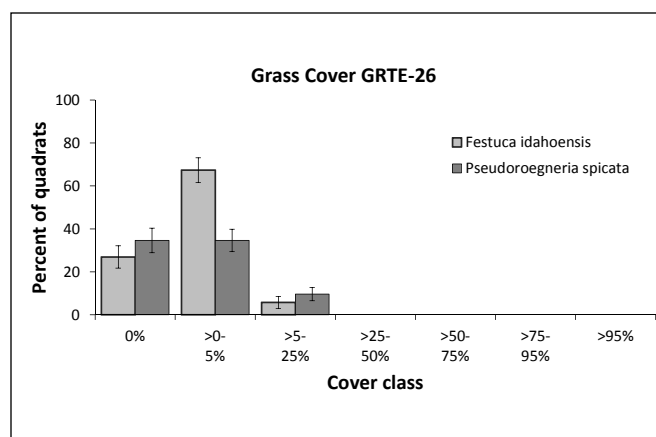


Figure B54. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoroegneria spicata*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B19. Percent of quadrats (n=52) for sample frame GRTE-27 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-27	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	8	75	12	6	0	0	0
Sagebrush							
<i>Artemisia tridentata</i> (big sagebrush)	15	17	27	29	8	4	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	42	35	15	6	2	0	0
<i>Carex</i> spp. (sedges)	13	42	35	10	0	0	0
<i>Elymus elymoides</i> (squirreltail)	92	4	4	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	19	29	50	2	0	0	0
<i>Hesperostipa comata</i> (needle-and-thread grass)	98	2	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	19	79	2	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	25	52	23	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	31	42	19	8	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	52	19	27	2	0	0	0
<i>Arenaria</i> spp. (sandwort)	87	13	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	44	52	4	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	67	31	2	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	79	21	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	75	21	4	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	21	63	13	0	0	0
<i>Lomatium</i> spp. (lomatium)	90	10	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	38	31	25	6	0	0	0
<i>Perideridia montana</i> (yampah)	81	19	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	48	46	6	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	13	85	2	0	0	0	0
<i>Arabis</i> spp. (rockcress)	88	12	0	0	0	0	2
<i>Sedum</i> spp. (stonecrop)	79	21	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	94	6	0	0	0	0	0
Non-native Invasive Forbs							
<i>Taraxacum officinale</i> (dandelion)	37	63	0	0	0	0	0

¹ Daubenmire Cover Class Categories

Sample Frame GRTE-27
Sagebrush Steppe Monitoring

National Park Service
U.S. Department of the Interior
Grand Teton National Park



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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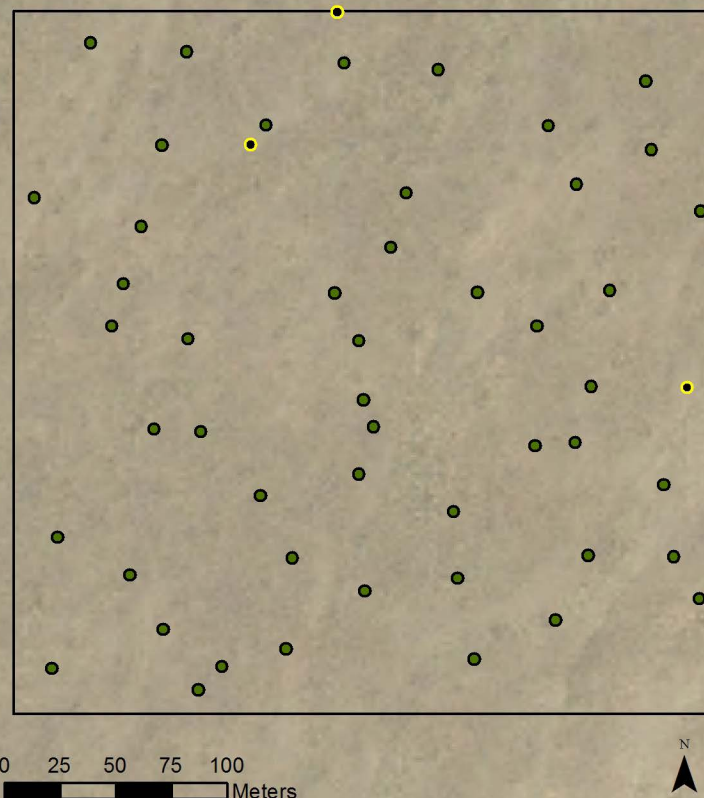
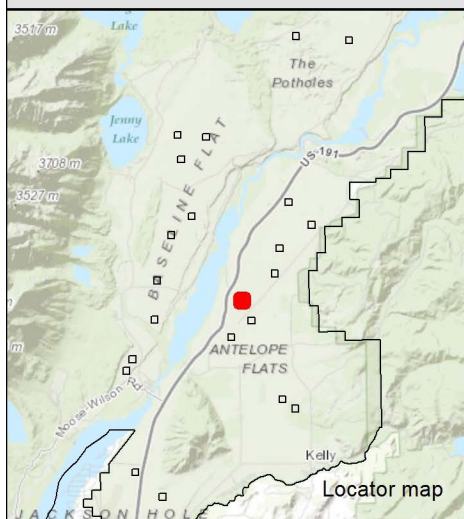


Figure B55. Map showing locations of 1 m² quadrats in sample frame GRTE-27 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Not shown are locations of dandelion (*Taraxacum officinale*).

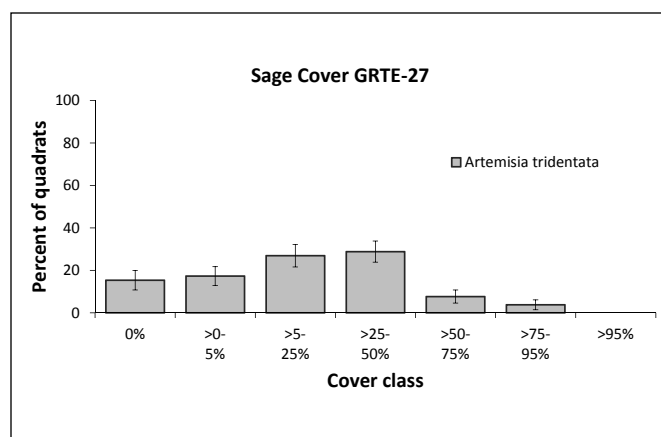


Figure B56. Percent of quadrats by cover class for the only dominant shrub, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*).

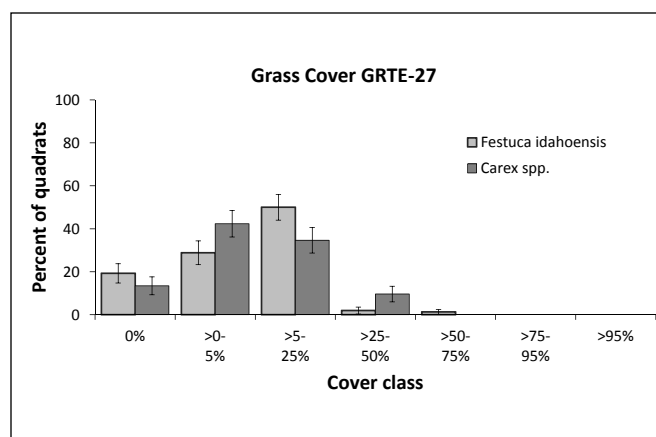


Figure B57. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and sedges (*Carex* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B20. Percent of quadrats (n=52) for sample frame GRTE-28 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-28	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	2	92	4	2	0	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	67	12	19	2	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	23	27	23	23	2	2	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	23	58	19	0	0	0	0
<i>Carex</i> spp. (sedges)	8	56	35	2	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	98	2	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	94	4	2	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	6	31	62	2	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	23	73	4	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	48	50	2	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	62	31	8	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	92	6	2	0	0	0	0
<i>Arenaria</i> spp. (sandwort)	63	35	2	0	0	0	0
<i>Aster</i> spp. (aster)	96	2	2	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	83	17	0	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	98	2	0	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	96	4	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	94	4	0	2	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	15	44	38	2	0	0	0
<i>Lupinus</i> spp. (lupine)	37	40	23	0	0	0	0
<i>Perideridia montana</i> (yampah)	96	4	0	0	0	0	0
<i>Phlox</i> spp. (phlox)	98	2	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	38	62	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	94	6	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	88	12	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	94	4	0	2	0	0	0
Non-native Invasive Forbs							
<i>Linaria vulgaris</i> (yellow toadflax)	98	2	0	0	0	0	0
<i>Taraxacum officinale</i> (dandelion)	98	2	0	0	0	0	0

¹ Daubenmire Cover Class Categories

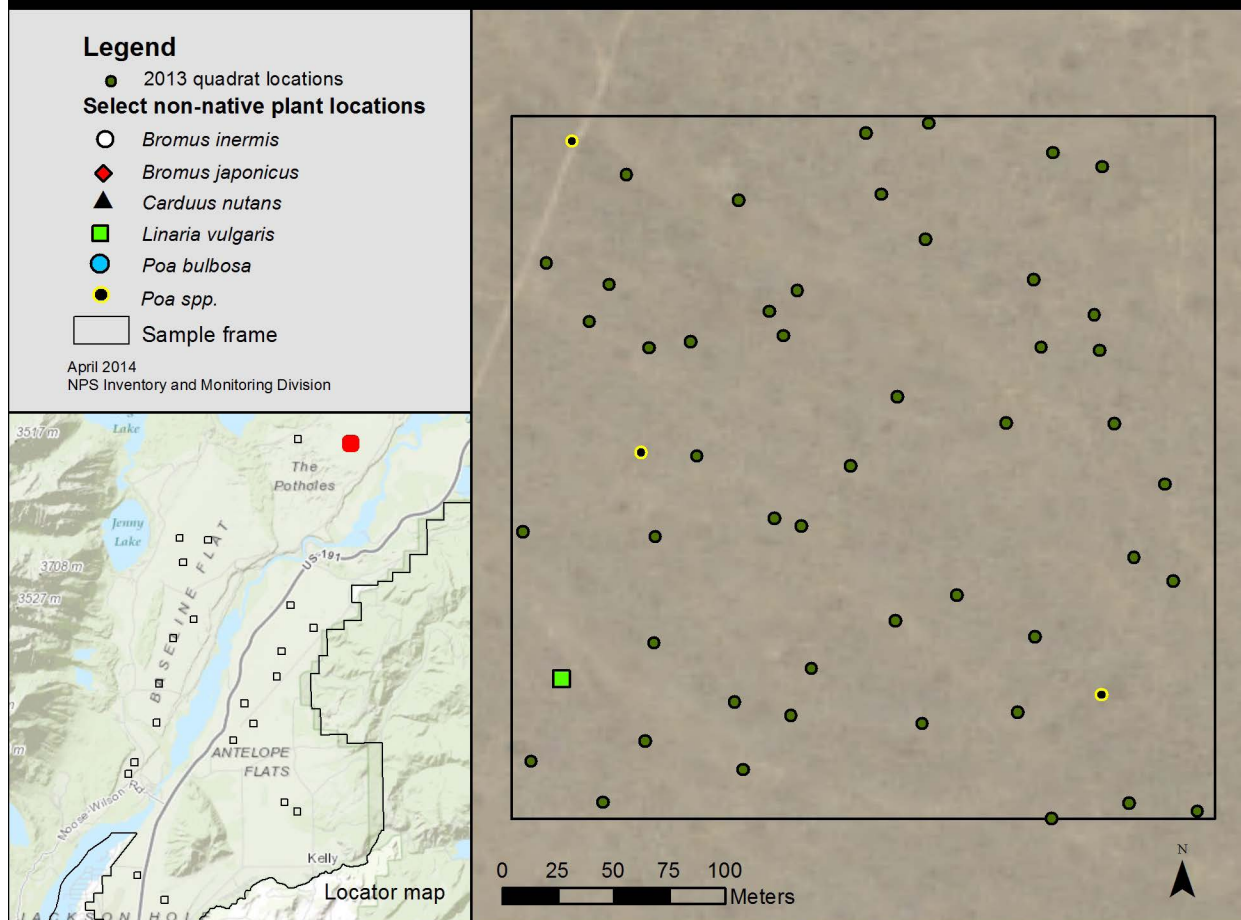


Figure B58. Map showing locations of 1 m² quadrats in sample frame GRTE-28 where soil and plant cover data were collected in July 2013 and where non-native plants were observed. Noteworthy is one location of yellow toadflax (*Linaria vulgaris*) (green square; lower left). Not shown are locations of dandelion (*Taraxacum officinale*).

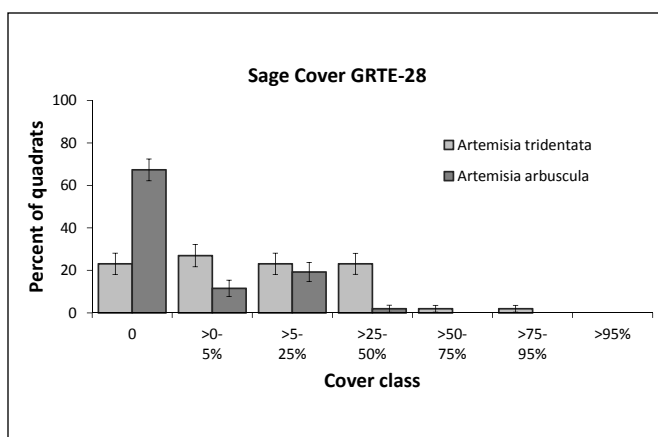


Figure B59. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

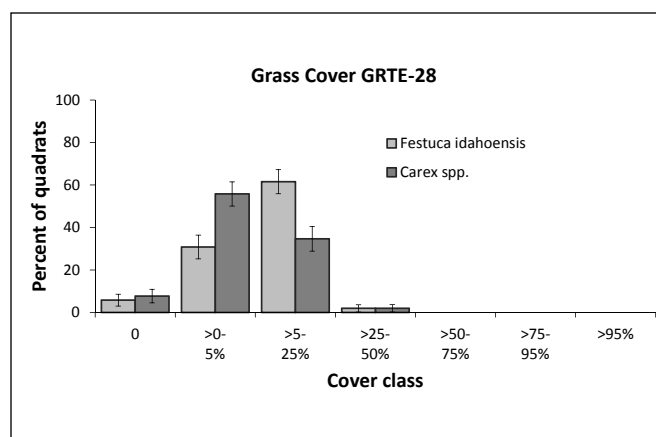


Figure B60. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and sedges (*Carex* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B21. Percent of quadrats (n=51) for sample frame GRTE-29 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-29	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	10	73	18	0	0	2	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	67	16	12	6	0	0	0
<i>Artemisia tridentata</i> (big sagebrush)	25	16	39	10	8	2	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	49	45	6	0	0	0	0
<i>Carex</i> spp. (sedges)	0	69	29	2	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	98	2	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	98	2	0	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	0	39	57	4	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	29	63	8	0	0	0	0
<i>Melica</i> spp. (oniongrass)	75	24	2	0	0	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	67	33	0	0	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	49	43	8	0	0	0	0
Native Persistent Forbs							
<i>Antennaria</i> spp. (pussytoes)	10	65	22	4	0	0	0
<i>Arenaria</i> spp. (sandwort)	6	92	2	0	0	0	0
<i>Aster</i> spp. (aster)	98	2	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	71	29	0	0	0	0	0
<i>Crepis</i> spp. (hawksbeard)	94	6	0	0	0	0	0
<i>Erigeron</i> spp. (daisy)	57	41	2	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	22	59	18	0	0	0
<i>Lomatium</i> spp. (lomatium)	94	6	0	0	0	0	0
<i>Lupinus</i> spp. (lupine)	20	45	35	0	0	0	0
<i>Perideridia montana</i> (yampah)	94	6	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	16	84	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	75	25	0	0	0	0	0
<i>Geum triflorum</i> (prairie smoke)	82	18	0	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	90	10	0	0	0	0	0

¹ Daubenmire Cover Class Categories

Sample Frame GRTE- 29
Sagebrush Steppe Monitoring

National Park Service
U.S. Department of the Interior
Grand Teton National Park



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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NPS Inventory and Monitoring Division

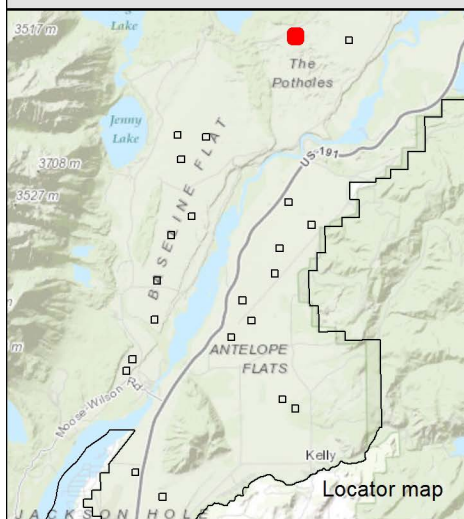


Figure B61. Map showing locations of 1 m² quadrats in sample frame GRTE-29 where soil and plant cover data were collected in July 2013 and where non-native plants were observed.

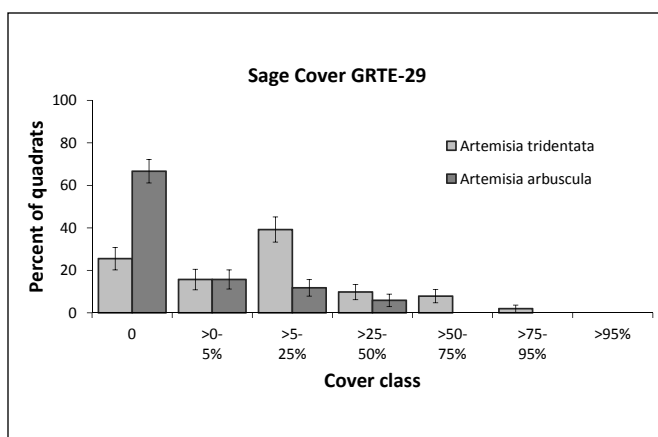


Figure B62. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

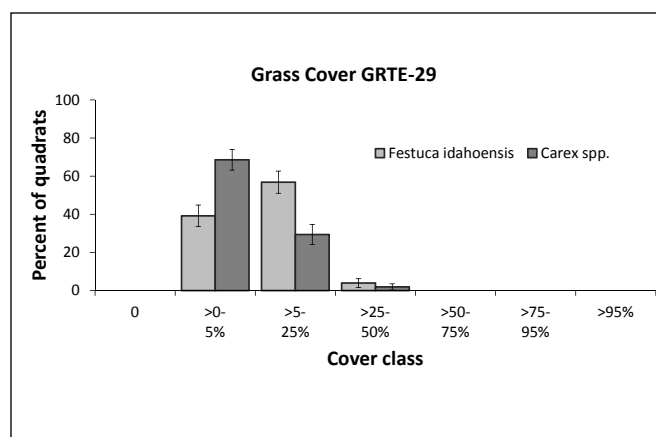


Figure B63. Percent of quadrats by cover class for two dominant grasses, Idaho fescue (*Festuca idahoensis*) and sedges (*Carex spp.*).

[Error bars show one standard error, calculated from the local variance estimator.]

Table B22. Percent of quadrats (n=51) for sample frame GRTE-30 within each cover class for ground cover attributes and plant species of interest organized by species guilds, Grand Teton National Park, 2013.

GRTE-30	0% ¹	>0-5%	>5-25%	>25-50%	>50-75%	>75-95%	>95-100%
Ground Cover							
Bare ground	0	12	53	33	2	0	0
Sagebrush							
<i>Artemisia arbuscula</i> (low sagebrush)	25	24	29	16	6	0	0
<i>Artemisia tridentata</i> (big sagebrush)	45	18	22	16	0	0	0
Native Perennial Grasses							
<i>Achnatherum nelsonii</i> (Nelson's needlegrass)	16	53	24	8	0	0	0
<i>Carex</i> spp. (sedges)	73	20	8	0	0	0	0
<i>Danthonia unispicata</i> (onespike danthonia)	94	6	0	0	0	0	0
<i>Elymus elymoides</i> (squirreltail)	90	10	0	0	0	0	0
<i>Elymus trachycaulus</i> (slender wheatgrass)	96	0	4	0	0	0	0
<i>Festuca idahoensis</i> (Idaho fescue)	98	2	0	0	0	0	0
<i>Koeleria macrantha</i> (prairie junegrass)	4	69	27	0	0	0	0
<i>Melica</i> spp. (oniongrass)	10	49	33	6	2	0	0
<i>Poa secunda</i> (Sandberg bluegrass)	65	29	4	2	0	0	0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	63	24	10	4	0	0	0
Native Persistent Forbs							
<i>Arenaria</i> spp. (sandwort)	96	4	0	0	0	0	0
<i>Aster</i> spp. (aster)	98	2	0	0	0	0	0
<i>Castilleja</i> spp. (paintbrush)	49	49	2	0	0	0	0
<i>Comandra umbellata</i> (bastard toadflax)	96	4	0	0	0	0	0
<i>Eriogonum</i> spp. (buckwheat)	2	20	57	20	2	0	0
<i>Lupinus</i> spp. (lupine)	59	37	4	0	0	0	0
<i>Perideridia montana</i> (yampah)	96	4	0	0	0	0	0
Other Native Forbs							
<i>Agoseris</i> spp. (agoseris)	16	84	0	0	0	0	0
<i>Arabis</i> spp. (rockcress)	96	4	0	0	0	0	0
<i>Sedum</i> spp. (stonecrop)	45	53	2	0	0	0	0
Non-native Invasive Grasses							
<i>Poa</i> spp. (bluegrass)	92	8	0	0	0	0	0

¹ Daubenmire Cover Class Categories



Legend

- 2013 quadrat locations
- Select non-native plant locations**
- *Bromus inermis*
- ◆ *Bromus japonicus*
- ▲ *Carduus nutans*
- *Linaria vulgaris*
- *Poa bulbosa*
- *Poa spp.*
- Sample frame

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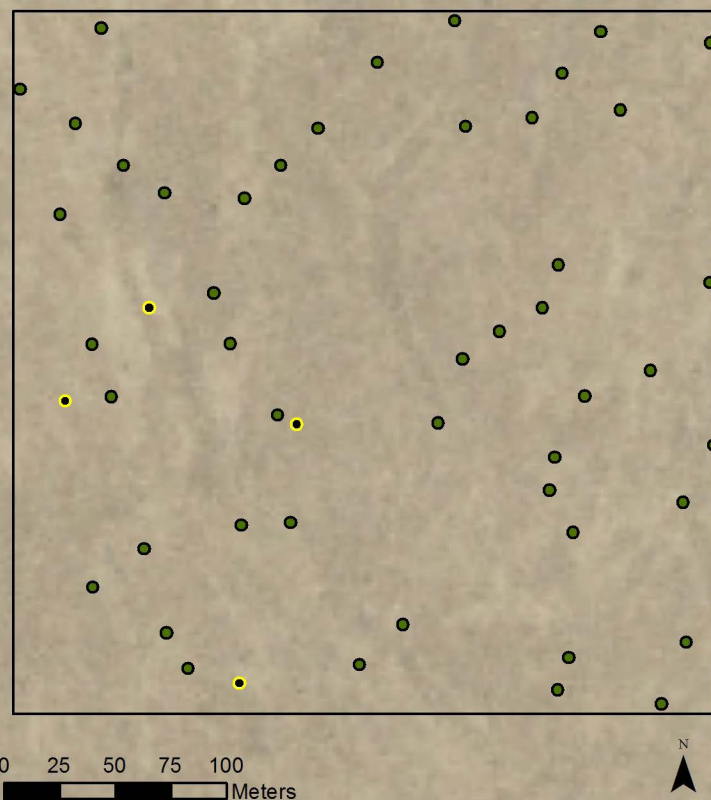
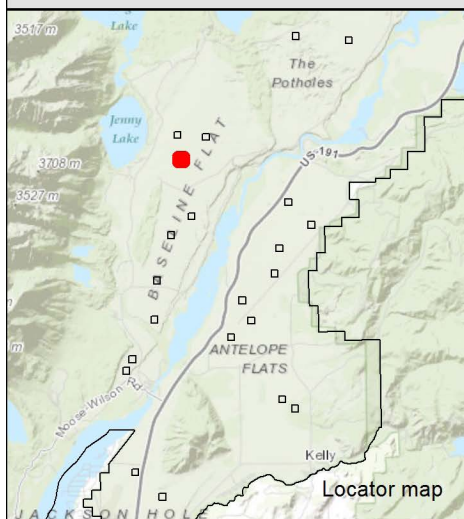


Figure B64. Map showing locations of 1 m² quadrats in sample frame GRTE-30 where soil and plant cover data were collected in July 2013 and where non-native plants were observed.

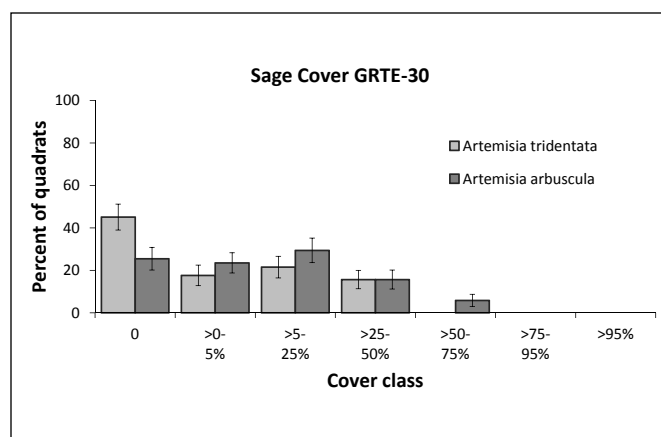


Figure B65. Percent of quadrats by cover class for two dominant shrubs, mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) and low sagebrush (*A. arbuscula*).

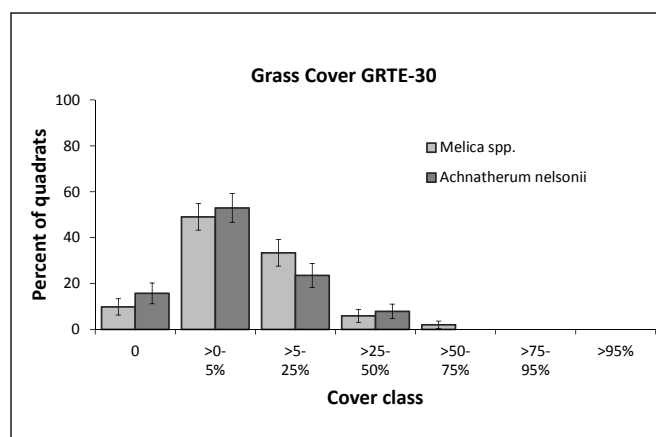


Figure B66. Percent of quadrats by cover class for two dominant grasses, Nelson's needlegrass (*Achnatherum nelsonii*) and oniongrass (*Melica* spp.).

[Error bars show one standard error, calculated from the local variance estimator.]

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 136/125610, August 2014

National Park Service
U.S. Department of the Interior



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