Appendix 4. Testing the Influence of Post-Management Treatments on Vegetation Composition Variables on Federal Lands Managed under an Adaptive-Management Framework by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13

A. Mean Brome Cover (percent)

Table 4.1. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1percent), testing the influence of post-management treatments on mean cover (percent) of smooth brome (*Bromus inermis*) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[*, evidence for moderate effect ($0.05<p\leq0.10$); **, evidence for strong effect ($p \leq 0.05$)]

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	118.7	1.61	0.0669*
Contrasts:	Mixed: burned linear	1	99.1	0.31	0.5772
	Mixed: burned quadratic	1	81.9	0.06	0.8044
	Mixed: BG0 vs BG1-3	1	93.5	1.92	0.1690
	Mixed: grazed linear	1	133.6	6.28	0.0134**
	Mixed: grazed quadratic	1	117.1	2.32	0.1301
	Tall: burned linear	1	98.7	0.31	0.5808
	Tall: grazed linear	1	123.5	7.37	0.0076**
	Tall: grazed quadratic	1	114.6	1.19	0.2781
	B1: mixed versus tall	1	152.3	0.04	0.8403
	B2: mixed versus tall	1	157.9	0.00	0.9500
	G0: mixed versus tall	1	167.9	0.03	0.8683
	G: mixed versus tall	1	165.1	0.20	0.6572
	G1: mixed versus tall	1	151.4	1.27	0.2609
	G2: mixed versus tall	1	167.3	2.95	0.0875*
	Mixed: burned versus rest	1	100.8	0.18	0.6765
	Mixed: grazed versus rest	1	98.5	0.63	0.4290
	Mixed: burned-grazed versus rest	1	103.5	0.13	0.7153
	Mixed: burned versus grazed	1	136.5	1.88	0.1722
	Tall: burned versus rest	1	164.6	2.11	0.1487
	Tall: grazed versus rest	1	161.3	0.44	0.5069
	Tall: burned versus grazed	1	163.3	1.98	0.1613

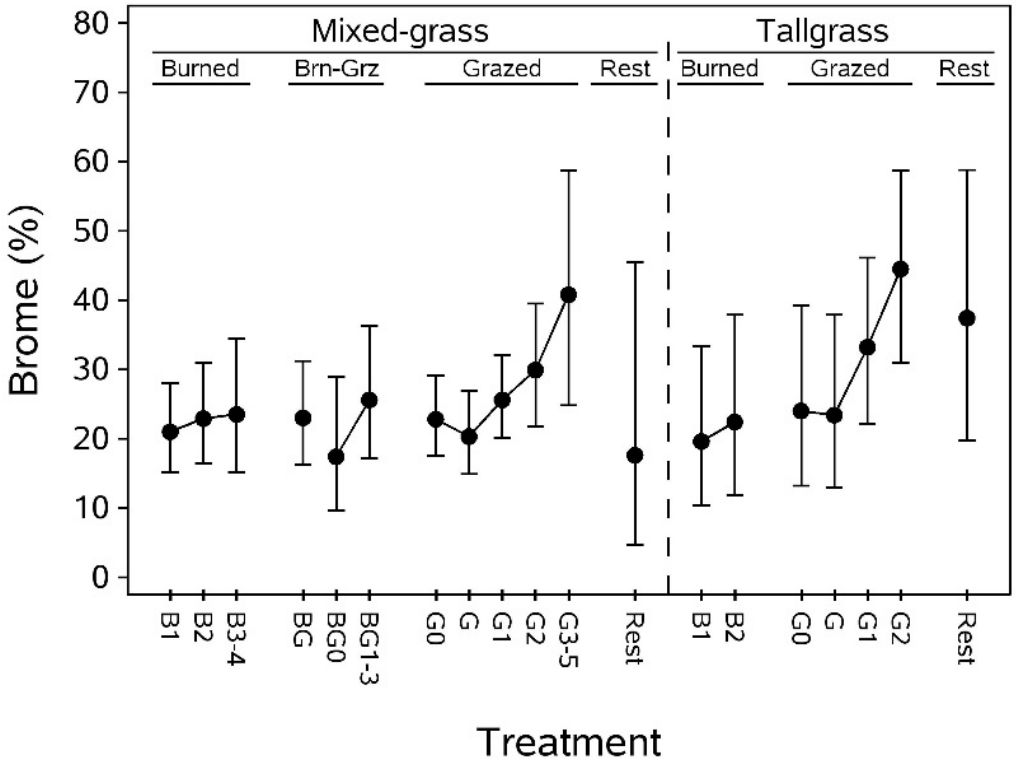
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.2. Least squares mean (standard error) cover (percent) of smooth brome (*Bromus inermis*) and back-transformed least squares mean (95-percent confidence intervals) cover (percent) of smooth brome (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−1.269	0.190	21.0	15.2	28.0
	B2	−1.157	0.205	22.9	16.4	31.0
	B3-4	−1.124	0.267	23.5	15.2	34.4
	BG	−1.153	0.209	23.0	16.3	31.2
	BG0	−1.491	0.327	17.4	9.6	28.9
	BG1-3	−1.013	0.251	25.6	17.2	36.3
	G0	−1.164	0.164	22.8	17.5	29.1
	G	−1.308	0.182	20.3	14.9	26.9
	G1	−1.013	0.157	25.6	20.1	32.1
	G2	−0.803	0.213	29.9	21.8	39.5
	G3-5	−0.332	0.371	40.8	24.8	58.7
	Rest	−1.479	0.682	17.6	4.7	45.5
Tall	B1	−1.351	0.359	19.6	10.4	33.4
	B2	−1.184	0.374	22.4	11.8	37.9
	G0	−1.099	0.358	24.0	13.2	39.2
	G	−1.133	0.348	23.4	13.0	37.9
	G1	−0.655	0.276	33.2	22.2	46.1
	G2	−0.180	0.293	44.5	31.0	58.7
	Rest	−0.472	0.444	37.4	19.7	58.8

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent]

Figure 4.1. Back-transformed least squares mean cover (percent) of smooth brome (*Bromus inermis*) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.1 and 4.2.

B. Standard Deviation of Brome Cover (percent)

Table 4.3. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on standard deviation of mean cover (percent) of smooth brome (*Bromus inermis*) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	125.6	1.20	0.2676
Contrasts:	Mixed: burned linear	1	108.2	1.76	0.1874
	Mixed: burned quadratic	1	79.3	0.16	0.6945
	Mixed: BG0 vs BG1-3	1	98.2	2.29	0.1335
	Mixed: grazed linear	1	153.5	0.01	0.9271
	Mixed: grazed quadratic	1	131.1	0.55	0.4600
	Tall: burned linear	1	104.9	0.02	0.8888
	Tall: grazed linear	1	131.8	0.21	0.6450
	Tall: grazed quadratic	1	114.5	0.25	0.6193
	B1: mixed versus tall	1	157.2	1.02	0.3153
	B2: mixed versus tall	1	160.4	1.65	0.2006
	G0: mixed versus tall	1	164.3	0.00	0.9496
	G: mixed versus tall	1	168.0	0.15	0.6949
	G1: mixed versus tall	1	160.0	0.00	0.9808
	G2: mixed versus tall	1	167.8	1.57	0.2121
	Mixed: burned versus rest	1	110.7	0.17	0.6791
	Mixed: grazed versus rest	1	108.8	0.00	0.9555
	Mixed: burned-grazed versus rest	1	117.2	0.25	0.6149
	Mixed: burned versus grazed	1	160.2	1.83	0.1777
	Tall: burned versus rest	1	154.6	5.94	0.0159
	Tall: grazed versus rest	1	167.9	3.70	0.0561
	Tall: burned versus grazed	1	150.4	1.47	0.2277

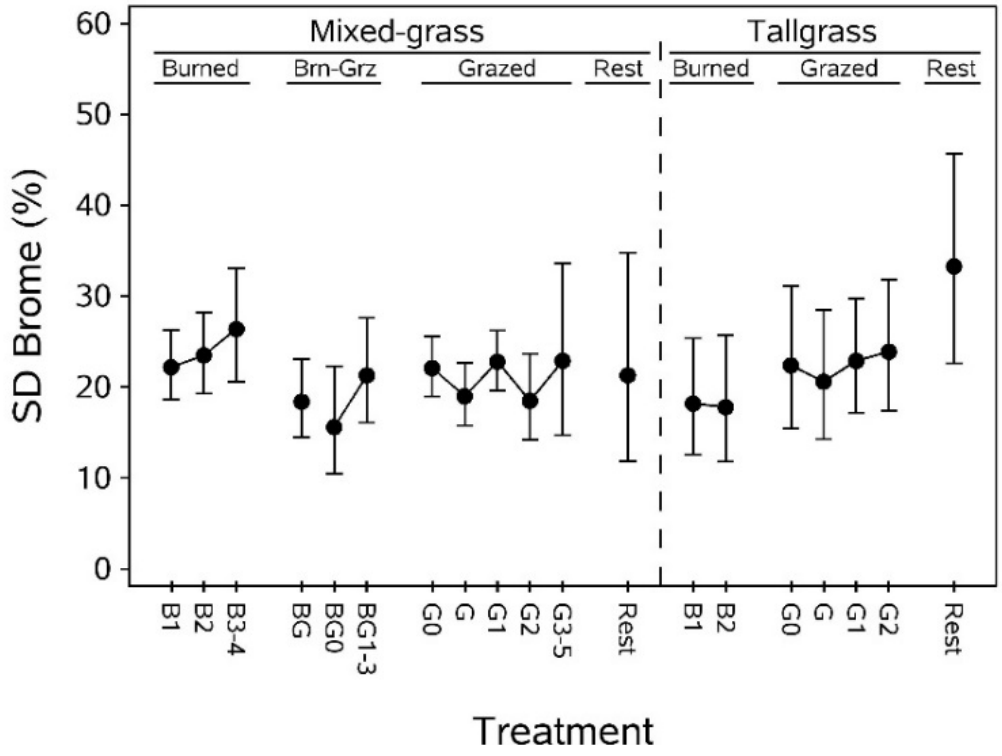
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.4. Least squares mean (standard error) standard deviation of smooth brome (*Bromus inermis*) cover (percent) and back-transformed least squares mean (95-percent confidence intervals) standard deviation of brome cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−1.196	0.109	22.2	18.6	26.3
	B2	−1.128	0.123	23.5	19.3	28.2
	B3-4	−0.974	0.161	26.4	20.6	33.1
	BG	−1.422	0.140	18.4	14.5	23.1
	BG0	−1.616	0.217	15.6	10.5	22.3
	BG1-3	−1.247	0.170	21.3	16.1	27.6
	G0	−1.202	0.095	22.1	19.0	25.6
	G	−1.386	0.110	19.0	15.8	22.7
	G1	−1.166	0.093	22.8	19.6	26.2
	G2	−1.416	0.154	18.5	14.2	23.7
	G3-5	−1.159	0.267	22.9	14.7	33.6
	Rest	−1.246	0.338	21.3	11.9	34.8
Tall	B1	−1.434	0.210	18.2	12.6	25.4
	B2	−1.464	0.231	17.8	11.8	25.7
	G0	−1.187	0.224	22.4	15.4	31.1
	G	−1.291	0.215	20.6	14.3	28.5
	G1	−1.161	0.176	22.9	17.2	29.7
	G2	−1.103	0.197	23.9	17.4	31.8
	Rest	−0.652	0.266	33.3	22.6	45.7

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent; SD, standard deviation]

Figure 4.2. Back-transformed least squares mean standard deviation of smooth brome (Bromus inermis) cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.3 and 4.4.

C. Mean Kentucky Bluegrass Cover (percent)

Table 4.5. Generalized linear mixed model, assuming a beta distribution with a logit link, *y* = (*y*+1 percent), testing the influence of post-management treatments on mean Kentucky bluegrass (*Poa pratensis*) cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	130.5	0.56	0.9235
Contrasts:	Mixed: burned linear	1	115.9	0.66	0.4184
	Mixed: burned quadratic	1	79.0	0.22	0.6380
	Mixed: BG0 vs BG1-3	1	100.8	2.10	0.1507
	Mixed: grazed linear	1	162.0	0.13	0.7240
	Mixed: grazed quadratic	1	139.1	0.07	0.7972
	Tall: burned linear	1	108.9	0.07	0.7984
	Tall: grazed linear	1	140.9	1.20	0.2750
	Tall: grazed quadratic	1	112.6	1.37	0.2446
	B1: mixed versus tall	1	160.0	0.72	0.3958
	B2: mixed versus tall	1	162.3	1.08	0.3008
	G0: mixed versus tall	1	162.6	0.01	0.9281
	G: mixed versus tall	1	167.4	0.05	0.8240
	G1: mixed versus tall	1	163.3	0.01	0.9321
	G2: mixed versus tall	1	167.9	1.14	0.2865
	Mixed: burned versus rest	1	118.1	0.49	0.4874
	Mixed: grazed versus rest	1	116.7	0.42	0.5159
	Mixed: burned-grazed versus rest	1	123.6	0.27	0.6014
	Mixed: burned versus grazed	1	167.3	0.02	0.8825
	Tall: burned versus rest	1	154.2	0.00	0.9851
	Tall: grazed versus rest	1	167.6	0.27	0.6062
	Tall: burned versus grazed	1	143.8	0.68	0.4122

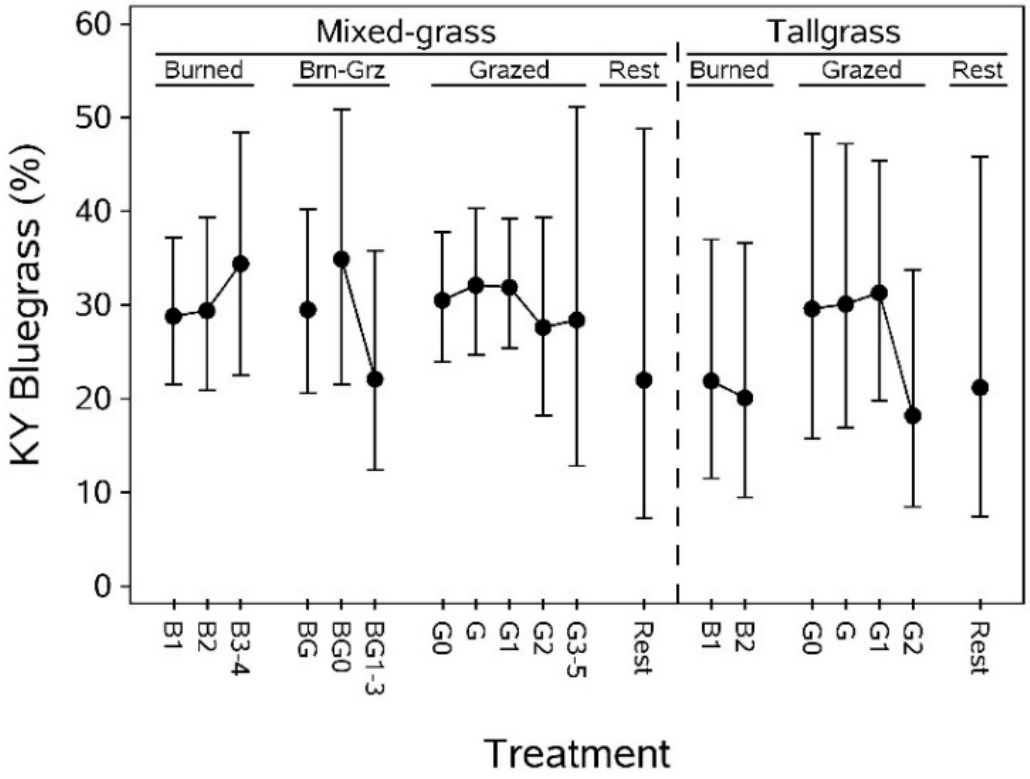
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.6. Least squares mean (standard error) Kentucky bluegrass (*Poa pratensis*) cover (percent) and back-transformed least squares mean (95-percent confidence intervals) Kentucky bluegrass (*Poa pratensis*) cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−0.859	0.194	28.8	21.5	37.2
	B2	−0.830	0.225	29.4	20.9	39.4
	B3-4	−0.603	0.295	34.4	22.5	48.4
	BG	−0.823	0.239	29.5	20.6	40.2
	BG0	−0.580	0.336	34.9	21.5	50.9
	BG1-3	−1.203	0.337	22.1	12.4	35.8
	G0	−0.779	0.165	30.5	23.9	37.8
	G	−0.705	0.181	32.1	24.7	40.3
	G1	−0.712	0.161	31.9	25.4	39.2
	G2	−0.914	0.267	27.6	18.2	39.4
	G3-5	−0.874	0.489	28.4	12.8	51.1
	Rest	−1.209	0.613	22.0	7.2	48.8
Tall	B1	−1.216	0.371	21.9	11.5	37.0
	B2	−1.321	0.417	20.1	9.5	36.6
	G0	−0.818	0.404	29.6	15.7	48.3
	G	−0.796	0.369	30.1	16.9	47.2
	G1	−0.741	0.305	31.3	19.8	45.4
	G2	−1.439	0.413	18.2	8.5	33.7
	Rest	−1.256	0.576	21.2	7.4	45.8

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent; KY, Kentucky]

Figure 4.3. Back-transformed least squares mean Kentucky bluegrass (*Poa pratensis*) cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.5 and 4.6.

D. Standard Deviation of Kentucky Bluegrass Cover (percent)

Table 4.7. Generalized linear mixed model, assuming a beta distribution with a logit link, $y = (y+1$ percent), testing the influence of post-management treatments on standard deviation of Kentucky bluegrass (*Poa pratensis*) cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	133.9	0.83	0.6610
Contrasts:	Mixed: burned linear	1	121.7	0.23	0.6347
	Mixed: burned quadratic	1	80.4	0.85	0.3592
	Mixed: BG0 vs BG1-3	1	105.4	1.20	0.2750
	Mixed: grazed linear	1	165.1	0.06	0.8129
	Mixed: grazed quadratic	1	142.0	0.01	0.9367
	Tall: burned linear	1	111.9	0.19	0.6603
	Tall: grazed linear	1	141.9	0.34	0.5626
	Tall: grazed quadratic	1	117.2	0.57	0.4516
	B1: mixed versus tall	1	161.3	3.70	0.0560
	B2: mixed versus tall	1	163.2	3.33	0.0699
	G0: mixed versus tall	1	162.4	0.19	0.6606
	G: mixed versus tall	1	166.8	0.12	0.7342
	G1: mixed versus tall	1	164.6	0.91	0.3423
	G2: mixed versus tall	1	167.5	0.20	0.6583
	Mixed: burned versus rest	1	124.0	0.00	0.9810
	Mixed: grazed versus rest	1	122.7	0.23	0.6288
	Mixed: burned-grazed versus rest	1	130.6	0.04	0.8493
	Mixed: burned versus grazed	1	167.9	1.64	0.2015
	Tall: burned versus rest	1	152.3	0.87	0.3538
	Tall: grazed versus rest	1	167.2	0.11	0.7357
	Tall: burned versus grazed	1	142.6	1.01	0.3157

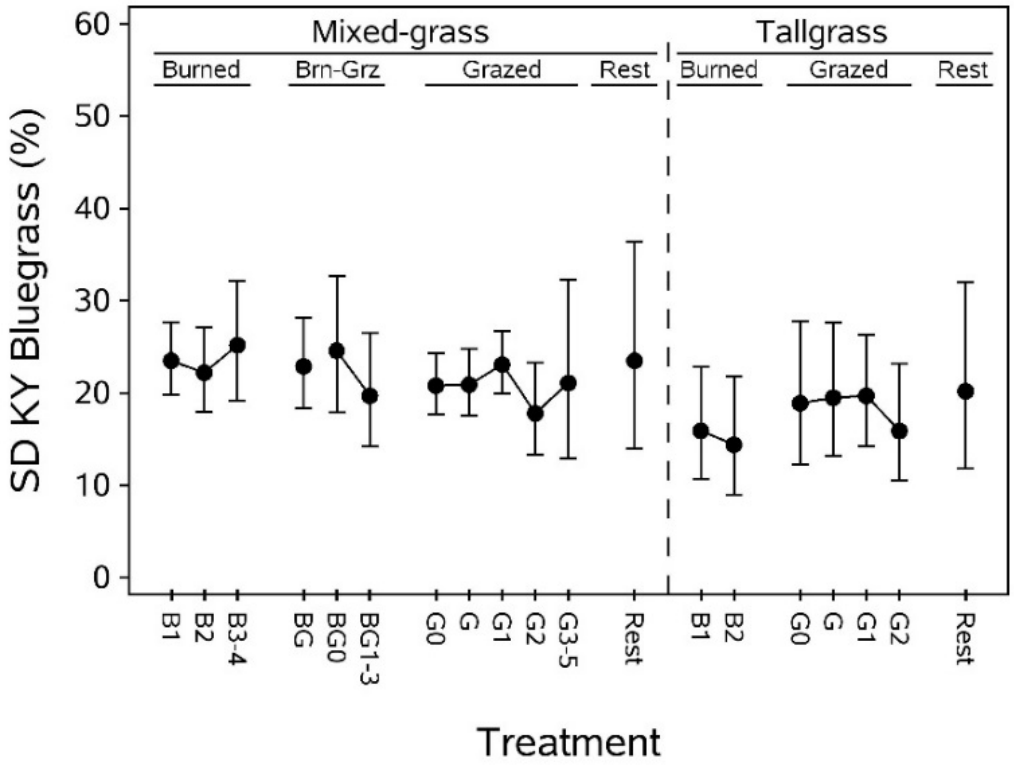
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.8. Least squares mean (standard error) standard deviation of Kentucky bluegrass (*Poa pratensis*) cover (percent) and back-transformed least squares mean (95-percent confidence intervals) standard deviation of Kentucky bluegrass (*Poa pratensis*) cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−1.124	0.109	23.5	19.8	27.7
	B2	−1.196	0.131	22.2	18.0	27.1
	B3-4	−1.035	0.172	25.2	19.2	32.2
	BG	−1.158	0.140	22.9	18.3	28.2
	BG0	−1.067	0.199	24.6	17.9	32.7
	BG1-3	−1.344	0.190	19.7	14.2	26.5
	G0	−1.277	0.098	20.8	17.7	24.3
	G	−1.270	0.110	20.9	17.5	24.8
	G1	−1.145	0.094	23.1	19.9	26.7
	G2	−1.464	0.166	17.8	13.3	23.3
	G3-5	−1.259	0.287	21.1	12.9	32.3
	Rest	−1.126	0.311	23.5	14.0	36.4
Tall	B1	−1.595	0.219	15.9	10.7	22.8
	B2	−1.707	0.248	14.4	9.0	21.8
	G0	−1.396	0.250	18.9	12.2	27.8
	G	−1.355	0.226	19.5	13.2	27.6
	G1	−1.344	0.186	19.7	14.3	26.3
	G2	−1.590	0.229	15.9	10.5	23.2
	Rest	−1.311	0.308	20.2	11.8	32.0

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent, KY, Kentucky; SD, standard deviation]

Figure 4.4. Back-transformed least squares mean standard deviation of Kentucky bluegrass (Poa pratensis) cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.7 and 4.8.

E. Mean Native Forb Cover (percent)

Table 4.9. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on mean native forb cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[*, evidence for moderate effect ($0.05<p\leq0.10$); **, evidence for strong effect ($p\leq0.05$)]

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	153.6	1.98	0.0140**
Contrasts:	Mixed: burned linear	1	160.4	1.25	0.2645
	Mixed: burned quadratic	1	99.5	0.99	0.3211
	Mixed: BG0 vs BG1-3	1	148.1	0.42	0.5163
	Mixed: grazed linear	1	163.2	1.41	0.2368
	Mixed: grazed quadratic	1	155.0	1.38	0.2420
	Tall: burned linear	1	121.3	0.02	0.8801
	Tall: grazed linear	1	160.0	0.18	0.6685
	Tall: grazed quadratic	1	138.8	0.14	0.7058
	B1: mixed versus tall	1	167.7	1.63	0.2031
	B2: mixed versus tall	1	168.0	1.39	0.2407
	G0: mixed versus tall	1	167.0	0.00	0.9496
	G: mixed versus tall	1	167.0	0.08	0.7798
	G1: mixed versus tall	1	168.0	0.01	0.9208
	G2: mixed versus tall	1	167.4	0.36	0.5476
	Mixed: burned versus rest	1	158.4	0.74	0.3896
	Mixed: grazed versus rest	1	160.0	0.42	0.5178
	Mixed: burned-grazed versus rest	1	159.8	1.59	0.2086
	Mixed: burned versus grazed	1	138.7	0.26	0.6115
	Tall: burned versus rest	1	157.1	3.35	0.0690*
	Tall: grazed versus rest	1	163.7	10.98	0.0011**
	Tall: burned versus grazed	1	139.5	3.41	0.0668*

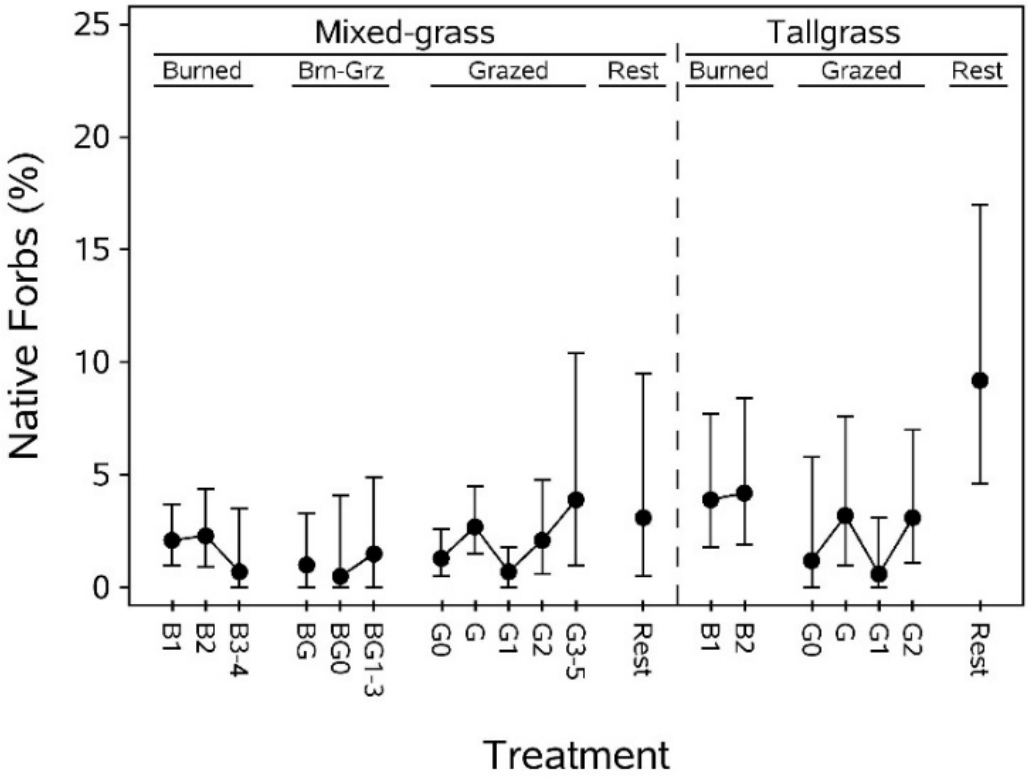
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.10. Least squares mean (standard error) native forb cover (percent) and back-transformed least squares mean (95-percent confidence intervals) native forb cover (percent) by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−3.443	0.227	2.1	1.0	3.7
	B2	−3.390	0.274	2.3	0.9	4.4
	B3-4	−4.068	0.515	0.7	0.0	3.5
	BG	−3.870	0.390	1.0	0.0	3.3
	BG0	−4.178	0.642	0.5	0.0	4.1
	BG1-3	−3.673	0.459	1.5	0.0	4.9
	G0	−3.742	0.228	1.3	0.5	2.6
	G	−3.262	0.213	2.7	1.5	4.5
	G1	−4.075	0.263	0.7	0.0	1.8
	G2	−3.440	0.336	2.1	0.6	4.8
	G3-5	−2.973	0.471	3.9	1.0	10.4
	Rest	−3.152	0.512	3.1	0.5	9.5
Tall	B1	−2.956	0.306	3.9	1.8	7.7
	B2	−2.893	0.322	4.2	1.9	8.4
	G0	−3.782	0.594	1.2	0.0	5.8
	G	−3.137	0.392	3.2	1.0	7.6
	G1	−4.131	0.497	0.6	0.0	3.1
	G2	−3.144	0.360	3.1	1.1	7.0
	Rest	−2.176	0.335	9.2	4.6	17.0

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent]

Figure 4.5. Back-transformed least squares mean native forb cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.9 and 4.10.

F. Standard Deviation of Native Forb Cover (percent)

Table 4.11. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on standard deviation of native forb cover (percent) on two grass types on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[*, evidence for moderate effect ($0.05<p\leq0.10$); **, evidence for strong effect ($p\leq0.05$)]

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	150.8	2.07	0.0094**
Contrasts:	Mixed: burned linear	1	155.9	2.10	0.1497
	Mixed: burned quadratic	1	96.0	3.20	0.0767*
	Mixed: BG0 vs BG1-3	1	141.2	0.87	0.3519
	Mixed: grazed linear	1	164.9	0.87	0.3518
	Mixed: grazed quadratic	1	151.8	0.96	0.3293
	Tall: burned linear	1	119.5	0.02	0.8890
	Tall: grazed linear	1	156.5	0.80	0.3717
	Tall: grazed quadratic	1	137.2	0.20	0.6514
	B1: mixed versus tall	1	167.2	0.09	0.7596
	B2: mixed versus tall	1	167.7	0.00	0.9692
	G0: mixed versus tall	1	166.1	0.01	0.9142
	G: mixed versus tall	1	166.4	0.12	0.7292
	G1: mixed versus tall	1	167.9	0.00	0.9480
	G2: mixed versus tall	1	166.6	2.02	0.1576
	Mixed: burned versus rest	1	153.3	2.18	0.1416
	Mixed: grazed versus rest	1	153.5	4.24	0.0411**
	Mixed: burned-grazed versus rest	1	156.7	5.38	0.0216**
	Mixed: burned versus grazed	1	144.7	0.92	0.3381
	Tall: burned versus rest	1	156.5	1.31	0.2536
	Tall: grazed versus rest	1	165.0	5.02	0.0264**
	Tall: burned versus grazed	1	142.0	2.04	0.1555

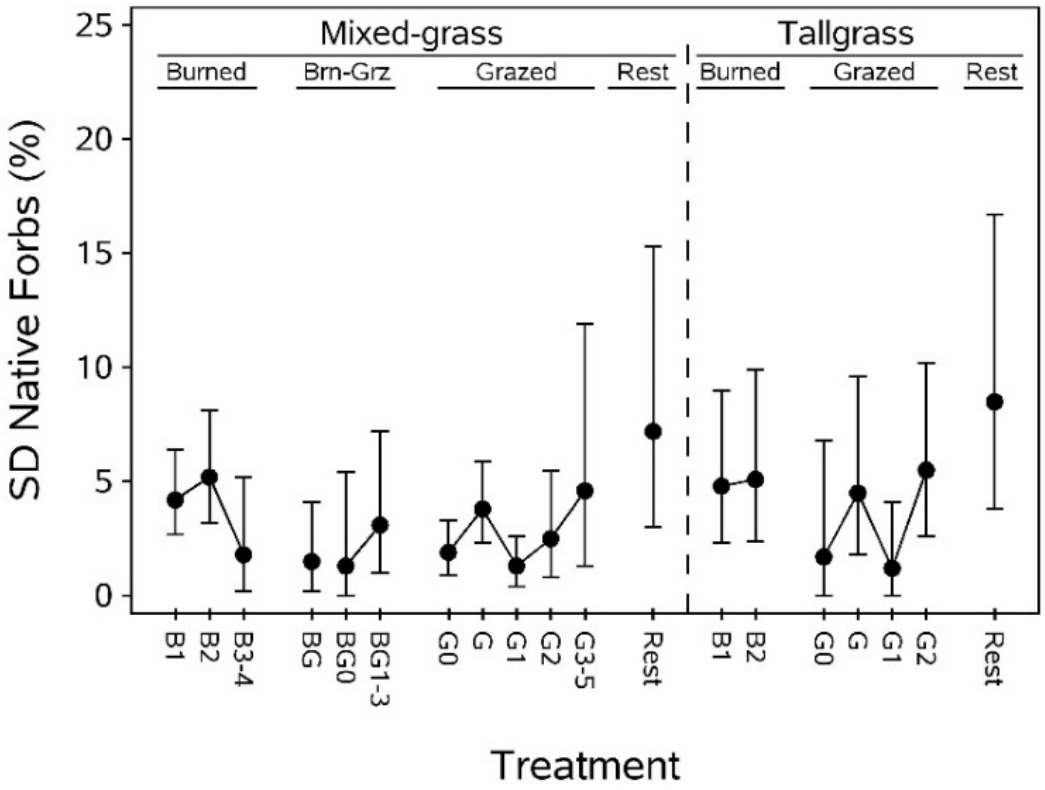
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.12. Least squares mean (standard error) standard deviation of native forb cover (percent) and back-transformed least squares mean (95-percent confidence intervals) standard deviation of native forb cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−2.894	0.187	4.2	2.7	6.4
	B2	−2.714	0.212	5.2	3.2	8.1
	B3-4	−3.557	0.426	1.8	0.2	5.2
	BG	−3.652	0.369	1.5	0.2	4.1
	BG0	−3.769	0.555	1.3	0.0	5.4
	BG1-3	−3.156	0.379	3.1	1.0	7.2
	G0	−3.520	0.217	1.9	0.9	3.3
	G	−2.983	0.197	3.8	2.3	5.9
	G1	−3.760	0.239	1.3	0.4	2.6
	G2	−3.320	0.335	2.5	0.8	5.5
	G3-5	−2.823	0.466	4.6	1.3	11.9
	Rest	−2.411	0.395	7.2	3.0	15.3
Tall	B1	−2.785	0.302	4.8	2.3	9.0
	B2	−2.729	0.318	5.1	2.4	9.9
	G0	−3.586	0.571	1.7	0.0	6.8
	G	−2.840	0.362	4.5	1.8	9.6
	G1	−3.794	0.448	1.2	0.0	4.1
	G2	−2.673	0.309	5.5	2.6	10.2
	Rest	−2.256	0.368	8.5	3.8	16.7

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent; SD, standard deviation]

Figure 4.6. Back-transformed least squares mean standard deviation of native forb cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.11 and 4.12.

G. Mean Native Grass Cover (percent)

Table 4.13. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on mean native grass cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	131.3	1.39	0.1471
Contrasts:	Mixed: burned linear	1	117.6	5.02	0.0269
	Mixed: burned quadratic	1	87.7	0.53	0.4671
	Mixed: BG0 vs BG1-3	1	104.0	0.35	0.5540
	Mixed: grazed linear	1	157.2	0.57	0.4501
	Mixed: grazed quadratic	1	139.1	0.23	0.6355
	Tall: burned linear	1	111.1	1.78	0.1847
	Tall: grazed linear	1	139.5	0.56	0.4560
	Tall: grazed quadratic	1	119.4	0.25	0.6194
	B1: mixed versus tall	1	159.5	0.00	0.9993
	B2: mixed versus tall	1	163.3	2.62	0.1077
	G0: mixed versus tall	1	164.7	0.14	0.7082
	G: mixed versus tall	1	168.0	0.02	0.9004
	G1: mixed versus tall	1	161.7	0.41	0.5242
	G2: mixed versus tall	1	167.9	0.02	0.8919
	Mixed: burned versus rest	1	118.9	0.03	0.8534
	Mixed: grazed versus rest	1	116.8	0.46	0.5003
	Mixed: burned-grazed versus rest	1	122.9	0.05	0.8269
	Mixed: burned versus grazed	1	162.7	1.60	0.2078
	Tall: burned versus rest	1	159.9	2.55	0.1123
	Tall: grazed versus rest	1	168.0	0.22	0.6398
	Tall: burned versus grazed	1	152.3	4.55	0.0345

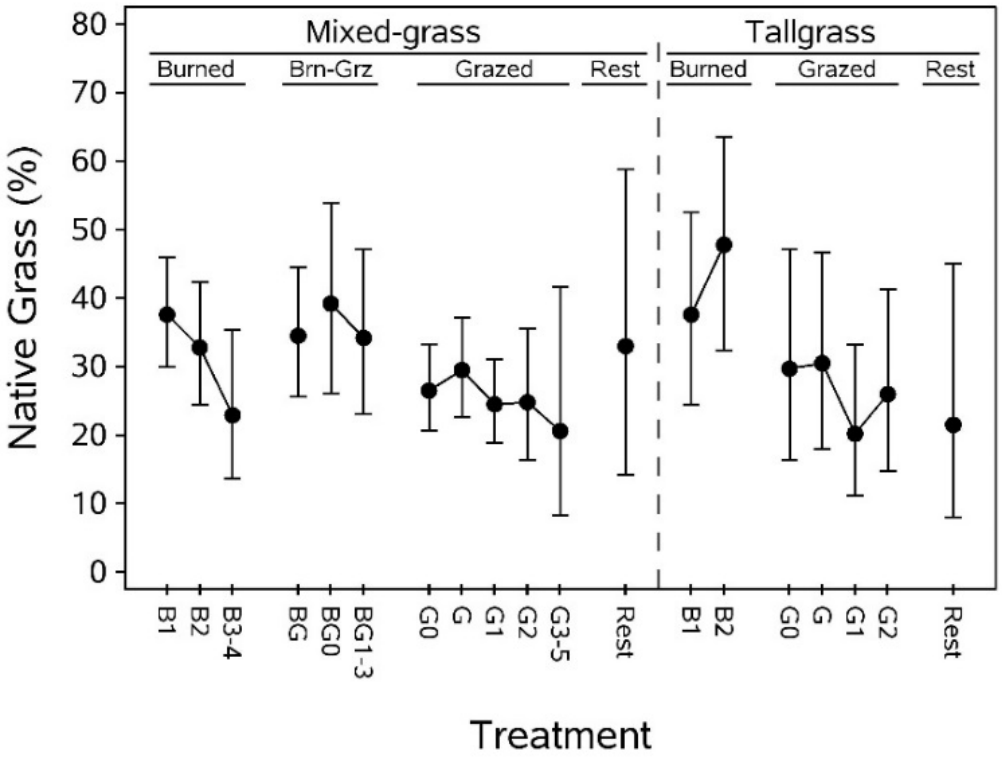
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.14. Least squares mean (standard error) native grass cover (percent) and back-transformed least squares mean (95-percent confidence intervals) native grass cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−0.465	0.173	37.6	29.9	45.9
	B2	−0.674	0.206	32.8	24.4	42.3
	B3-4	−1.160	0.308	22.9	13.6	35.4
	BG	−0.599	0.213	34.5	25.6	44.5
	BG0	−0.397	0.303	39.2	26.1	53.9
	BG1-3	−0.612	0.273	34.2	23.1	47.1
	G0	−0.969	0.164	26.5	20.6	33.3
	G	−0.824	0.175	29.5	22.7	37.2
	G1	−1.075	0.167	24.5	18.8	31.1
	G2	−1.054	0.256	24.8	16.4	35.5
	G3-5	−1.291	0.508	20.6	8.2	41.7
	Rest	−0.661	0.540	33.0	14.2	58.8
Tall	B1	−0.465	0.309	37.6	24.5	52.5
	B2	−0.047	0.329	47.8	32.4	63.5
	G0	−0.815	0.378	29.7	16.4	47.1
	G	−0.775	0.348	30.5	17.9	46.7
	G1	−1.314	0.335	20.2	11.2	33.2
	G2	−0.995	0.350	26.0	14.7	41.3
	Rest	−1.239	0.551	21.5	8.0	45.0

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent]

Figure 4.7. Back-transformed least squares mean native grass cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.13 and 4.14.

H. Standard Deviation of Native Grass Cover (percent)

Table 4.15. Generalized linear mixed model, assuming a beta distribution with a logit link, $y = (y+1$ percent), testing the influence of post-management treatments on standard deviation of native grass cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	126.0	1.11	0.3477
Contrasts:	Mixed: burned linear	1	108.8	0.95	0.3317
	Mixed: burned quadratic	1	84.5	1.09	0.3002
	Mixed: BG0 vs BG1-3	1	99.0	0.78	0.3791
	Mixed: grazed linear	1	148.6	0.04	0.8443
	Mixed: grazed quadratic	1	130.6	0.30	0.5824
	Tall: burned linear	1	110.1	4.37	0.0389
	Tall: grazed linear	1	133.5	0.15	0.6997
	Tall: grazed quadratic	1	115.3	0.06	0.8142
	B1: mixed versus tall	1	156.6	0.54	0.4642
	B2: mixed versus tall	1	159.9	2.19	0.1409
	G0: mixed versus tall	1	166.1	0.28	0.5958
	G: mixed versus tall	1	167.7	0.31	0.5773
	G1: mixed versus tall	1	158.3	0.01	0.9320
	G2: mixed versus tall	1	168.0	0.01	0.9162
	Mixed: burned versus rest	1	111.1	0.02	0.8792
	Mixed: grazed versus rest	1	108.9	0.50	0.4825
	Mixed: burned-grazed versus rest	1	115.0	0.00	0.9459
	Mixed: burned versus grazed	1	153.9	2.47	0.1183
	Tall: burned versus rest	1	160.4	0.50	0.4815
	Tall: grazed versus rest	1	167.0	0.09	0.7664
	Tall: burned versus grazed	1	156.3	0.53	0.4680

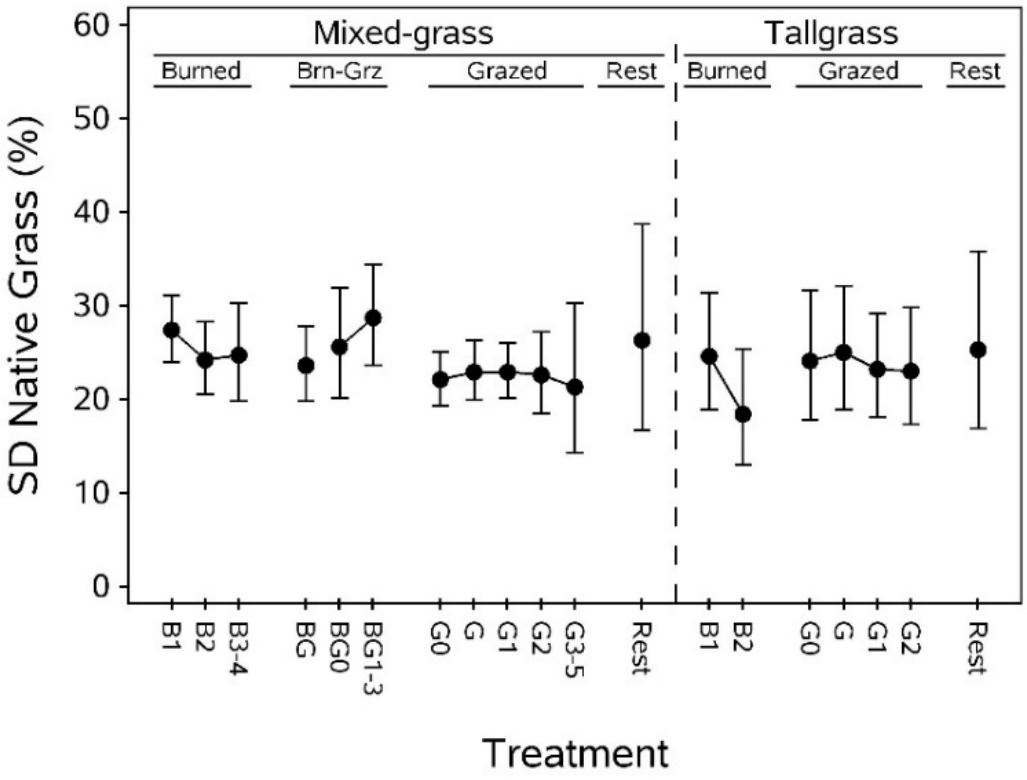
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.16. Least squares mean (standard error) standard deviation of native grass cover (percent) and back-transformed least squares mean (95-percent confidence intervals) standard deviation of native grass cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−0.925	0.090	27.4	24.0	31.1
	B2	−1.086	0.105	24.2	20.5	28.3
	B3-4	−1.062	0.140	24.7	19.8	30.3
	BG	−1.119	0.110	23.6	19.8	27.8
	BG0	−1.017	0.155	25.6	20.1	31.9
	BG1-3	−0.861	0.131	28.7	23.6	34.4
	G0	−1.205	0.084	22.1	19.3	25.1
	G	−1.156	0.090	22.9	19.9	26.3
	G1	−1.156	0.082	22.9	20.1	26.0
	G2	−1.176	0.123	22.6	18.5	27.2
	G3-5	−1.248	0.235	21.3	14.3	30.3
	Rest	−0.979	0.286	26.3	16.7	38.7
Tall	B1	−1.064	0.167	24.6	18.9	31.4
	B2	−1.422	0.202	18.4	13.0	25.4
	G0	−1.095	0.189	24.1	17.8	31.6
	G	−1.046	0.176	25.0	18.9	32.1
	G1	−1.141	0.154	23.2	18.1	29.2
	G2	−1.154	0.175	23.0	17.3	29.8
	Rest	−1.033	0.251	25.3	16.9	35.8

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent, SD, standard deviation]

Figure 4.8. Back-transformed least squares mean standard deviation of native grass cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.15 and 4.16.

I. Mean Nonnative Forb Cover (percent)

Table 4.17. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on mean nonnative forb cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	156.8	0.77	0.7342
Contrasts:	Mixed: burned linear	1	165.5	0.25	0.6197
	Mixed: burned quadratic	1	105.8	0.04	0.8516
	Mixed: BG0 vs BG1-3	1	160.3	1.01	0.3175
	Mixed: grazed linear	1	161.6	0.65	0.4219
	Mixed: grazed quadratic	1	161.1	0.06	0.8034
	Tall: burned linear	1	133.2	2.85	0.0935
	Tall: grazed linear	1	165.7	0.55	0.4580
	Tall: grazed quadratic	1	137.4	0.32	0.5703
	B1: mixed versus tall	1	168.0	2.85	0.0930
	B2: mixed versus tall	1	168.0	0.27	0.6073
	G0: mixed versus tall	1	167.9	0.02	0.9022
	G: mixed versus tall	1	167.8	1.83	0.1779
	G1: mixed versus tall	1	168.0	0.31	0.5805
	G2: mixed versus tall	1	167.9	0.19	0.6601
	Mixed: burned versus rest	1	165.0	0.17	0.6811
	Mixed: grazed versus rest	1	166.2	0.10	0.7518
	Mixed: burned-grazed versus rest	1	163.8	0.92	0.3393
	Mixed: burned versus grazed	1	130.8	0.05	0.8300
	Tall: burned versus rest	1	166.0	0.26	0.6110
	Tall: grazed versus rest	1	167.9	0.36	0.5513
	Tall: burned versus grazed	1	137.4	0.02	0.8992

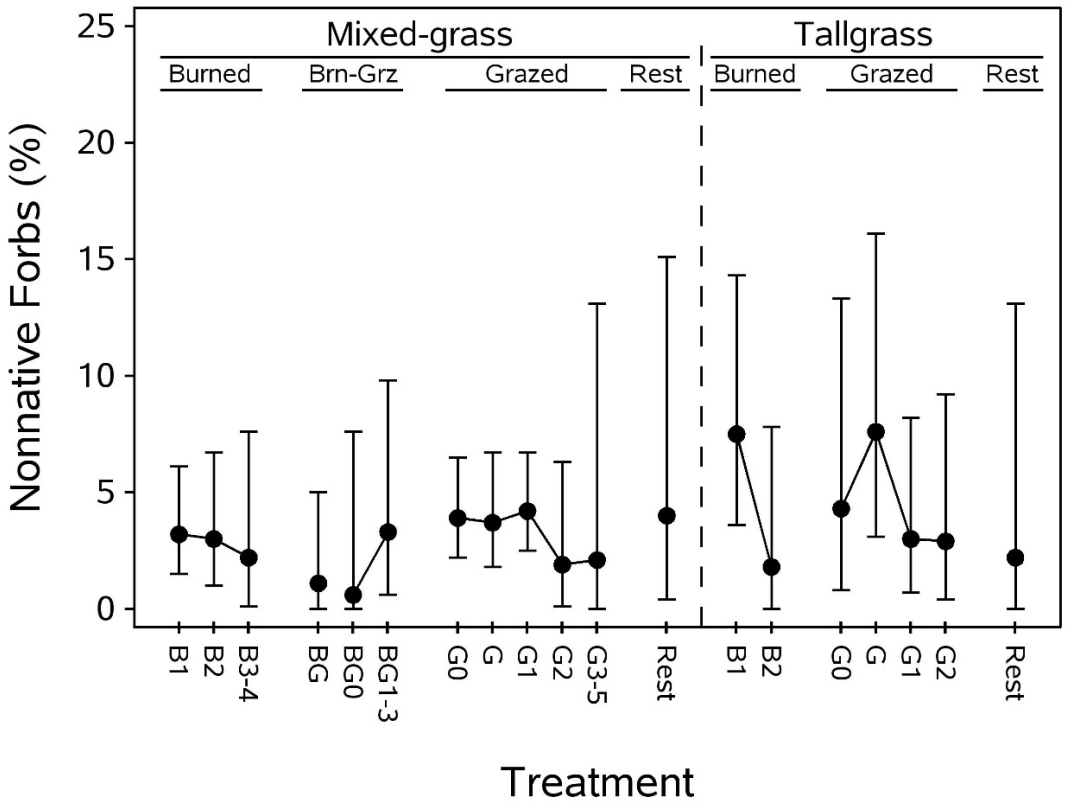
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.18. Least squares mean (standard error) nonnative forb cover (percent) and back-transformed least squares mean (95-percent confidence intervals) nonnative forb cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−3.118	0.278	3.2	1.5	6.1
	B2	−3.183	0.356	3.0	1.0	6.7
	B3-4	−3.420	0.542	2.2	0.1	7.6
	BG	−3.842	0.556	1.1	0.0	5.0
	BG0	−4.129	0.900	0.6	0.0	7.6
	BG1-3	−3.098	0.506	3.3	0.6	9.8
	G0	−2.962	0.227	3.9	2.2	6.5
	G	−3.017	0.273	3.7	1.8	6.7
	G1	−2.904	0.217	4.2	2.5	6.7
	G2	−3.527	0.503	1.9	0.1	6.3
	G3-5	−3.446	0.836	2.1	0.0	13.1
	Rest	−2.951	0.662	4.0	0.4	15.1
Tall	B1	−2.377	0.339	7.5	3.6	14.3
	B2	−3.551	0.620	1.8	0.0	7.8
	G0	−2.887	0.561	4.3	0.8	13.3
	G	−2.361	0.400	7.6	3.1	16.1
	G1	−3.182	0.452	3.0	0.7	8.2
	G2	−3.205	0.528	2.9	0.4	9.2
	Rest	−3.423	0.825	2.2	0.0	13.1

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent]

Figure 4.9. Back-transformed least squares mean nonnative forb cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.17 and 4.18.

J. Standard Deviation of Nonnative Forb Cover (percent)

Table 4.19. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on standard deviation of nonnative forb cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	p-value
Overall	Grass type × Treatment	18	155.2	0.89	0.5921
Contrasts:	Mixed: burned linear	1	162.0	0.58	0.4485
	Mixed: burned quadratic	1	101.3	0.41	0.5239
	Mixed: BG0 vs BG1-3	1	152.7	0.73	0.3943
	Mixed: grazed linear	1	162.9	0.32	0.5736
	Mixed: grazed quadratic	1	158.9	0.07	0.7897
	Tall: burned linear	1	131.3	3.24	0.0741
	Tall: grazed linear	1	164.8	2.81	0.0954
	Tall: grazed quadratic	1	133.2	0.39	0.5355
	B1: mixed versus tall	1	167.8	2.38	0.1249
	B2: mixed versus tall	1	167.8	0.63	0.4301
	G0: mixed versus tall	1	167.4	0.51	0.4743
	G: mixed versus tall	1	167.3	2.25	0.1358
	G1: mixed versus tall	1	168.0	0.14	0.7114
	G2: mixed versus tall	1	167.7	0.01	0.9317
	Mixed: burned versus rest	1	161.4	0.23	0.6322
	Mixed: grazed versus rest	1	162.6	0.35	0.5542
	Mixed: burned-grazed versus rest	1	161.5	1.56	0.2137
	Mixed: burned versus grazed	1	136.9	0.05	0.8183
	Tall: burned versus rest	1	164.3	0.36	0.5471
	Tall: grazed versus rest	1	167.5	0.30	0.5870
	Tall: burned versus grazed	1	135.6	0.03	0.8734

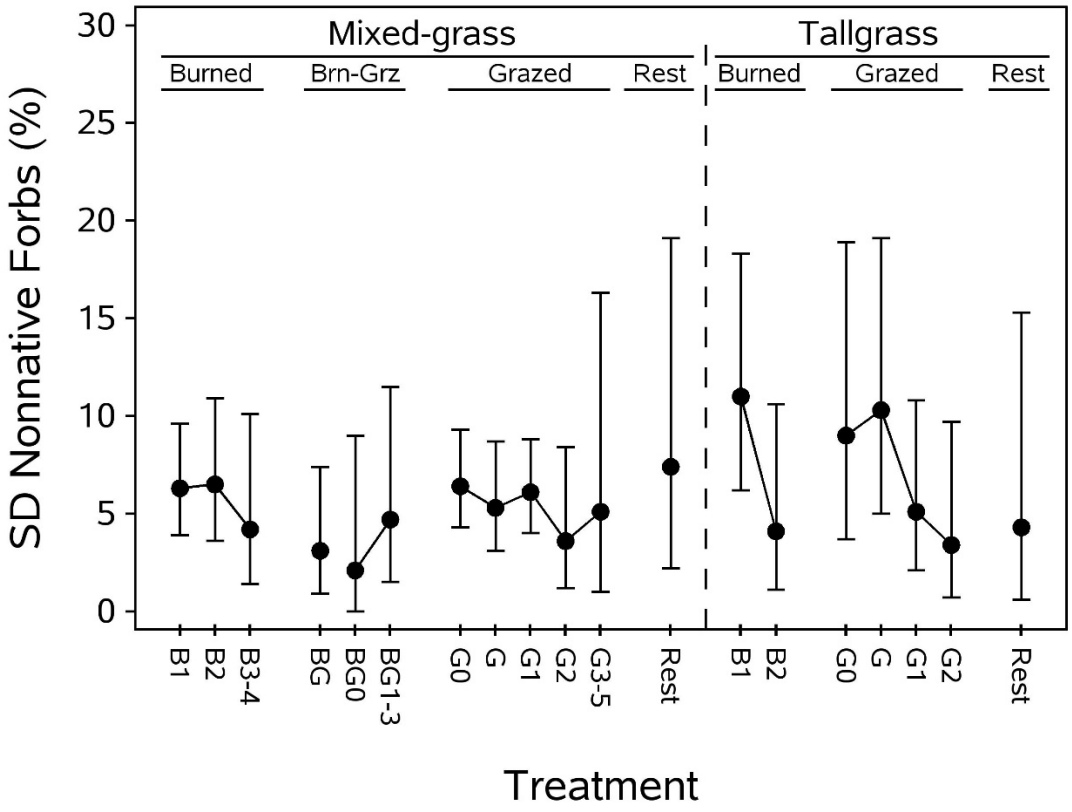
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.20. Least squares mean (standard error) standard deviation of nonnative forb cover (percent) and back-transformed least squares mean (95-percent confidence intervals) standard deviation of nonnative forb cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−2.547	0.213	6.3	3.9	9.6
	B2	−2.512	0.260	6.5	3.6	10.9
	B3-4	−2.902	0.420	4.2	1.4	10.1
	BG	−3.156	0.394	3.1	0.9	7.4
	BG0	−3.450	0.640	2.1	0.0	9.0
	BG1-3	−2.798	0.433	4.7	1.5	11.5
	G0	−2.523	0.185	6.4	4.3	9.3
	G	−2.692	0.232	5.3	3.1	8.7
	G1	−2.578	0.186	6.1	4.0	8.8
	G2	−3.030	0.393	3.6	1.2	8.4
	G3-5	−2.735	0.596	5.1	1.0	16.3
	Rest	−2.391	0.515	7.4	2.2	19.1
Tall	B1	−1.995	0.288	11.0	6.2	18.3
	B2	−2.930	0.460	4.1	1.1	10.6
	G0	−2.199	0.412	9.0	3.7	18.9
	G	−2.063	0.349	10.3	5.0	19.1
	G1	−2.730	0.364	5.1	2.1	10.8
	G2	−3.084	0.493	3.4	0.7	9.7
	Rest	−2.883	0.637	4.3	0.6	15.3

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent; SD, standard deviation]

Figure 4.10. Back-transformed least squares mean standard deviation of nonnative forb cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.19 and 4.20.

K. Mean Nonnative Grass Cover (percent)

Table 4.21. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on mean nonnative grass cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	130.0	1.35	0.1682
Contrasts:	Mixed: burned linear	1	115.5	1.28	0.2606
	Mixed: burned quadratic	1	83.1	0.40	0.5297
	Mixed: BG0 vs BG1-3	1	102.6	0.02	0.8768
	Mixed: grazed linear	1	159.6	0.71	0.3999
	Mixed: grazed quadratic	1	139.0	0.11	0.7371
	Tall: burned linear	1	109.5	0.02	0.8751
	Tall: grazed linear	1	138.6	1.23	0.2686
	Tall: grazed quadratic	1	116.4	0.04	0.8365
	B1: mixed versus tall	1	159.3	0.66	0.4183
	B2: mixed versus tall	1	162.4	0.97	0.3271
	G0: mixed versus tall	1	162.5	0.06	0.8133
	G: mixed versus tall	1	166.7	0.00	0.9835
	G1: mixed versus tall	1	161.7	1.63	0.2030
	G2: mixed versus tall	1	166.6	0.47	0.4940
	Mixed: burned versus rest	1	118.6	0.21	0.6495
	Mixed: grazed versus rest	1	116.9	1.08	0.3017
	Mixed: burned-grazed versus rest	1	123.9	0.09	0.7641
	Mixed: burned versus grazed	1	164.2	2.25	0.1356
	Tall: burned versus rest	1	156.6	2.35	0.1274
	Tall: grazed versus rest	1	167.0	0.00	0.9596
	Tall: burned versus grazed	1	148.6	7.23	0.0080

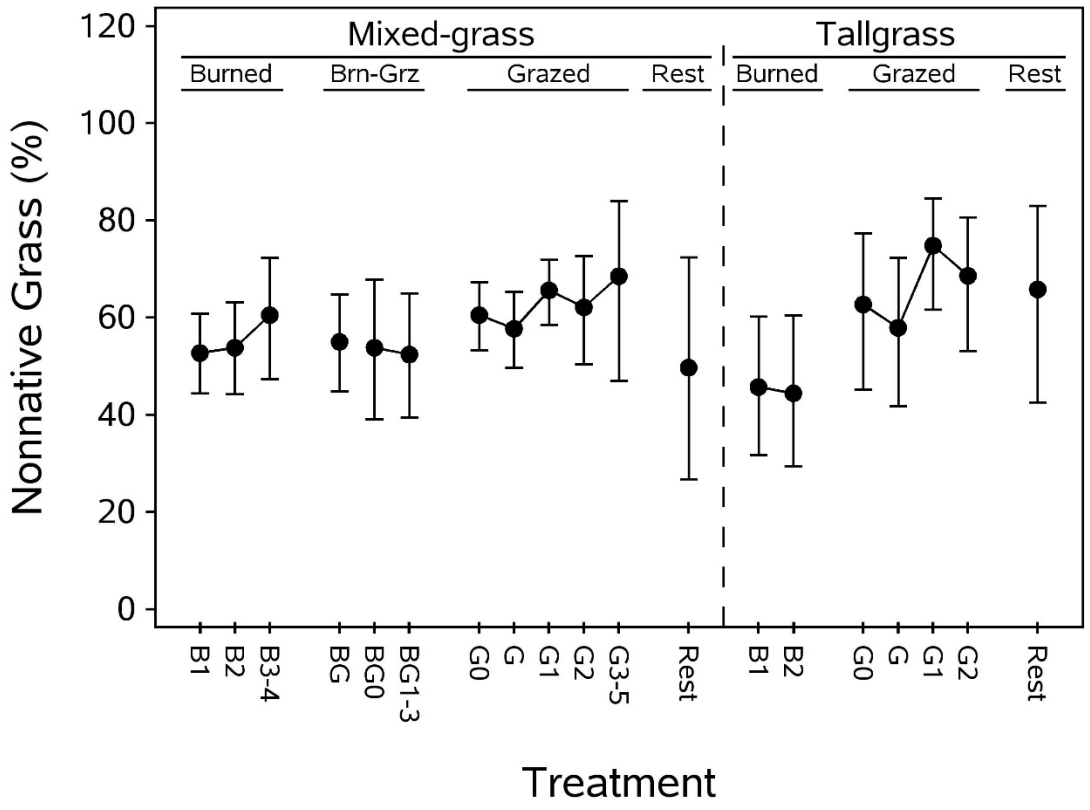
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.22. Least squares mean (standard error) nonnative grass cover (percent) and back-transformed least squares mean (95-percent confidence intervals) nonnative grass cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	0.148	0.170	52.7	44.4	60.8
	B2	0.194	0.198	53.8	44.2	63.1
	B3-4	0.470	0.274	60.5	47.3	72.3
	BG	0.240	0.209	55.0	44.8	64.7
	BG0	0.194	0.305	53.8	39.1	67.8
	BG1-3	0.138	0.268	52.4	39.4	65.0
	G0	0.469	0.151	60.5	53.3	67.2
	G	0.352	0.165	57.7	49.7	65.3
	G1	0.688	0.154	65.6	58.5	71.9
	G2	0.539	0.249	62.1	50.3	72.6
	G3-5	0.825	0.462	68.5	47.0	84.0
	Rest	0.029	0.504	49.7	26.7	72.4
Tall	B1	−0.133	0.301	45.7	31.7	60.2
	B2	−0.183	0.329	44.4	29.4	60.4
	G0	0.563	0.367	62.7	45.1	77.3
	G	0.360	0.331	57.9	41.8	72.3
	G1	1.143	0.320	74.8	61.6	84.5
	G2	0.827	0.339	68.6	53.1	80.6
	Rest	0.697	0.488	65.8	42.5	83.0

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent]

Figure 4.11. Back-transformed least squares mean nonnative grass cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.21 and 4.22.

L. Standard Deviation of Nonnative Grass Cover (percent)

Table 4.23. Generalized linear mixed model, assuming a beta distribution with a logit link, y = (y+1 percent), testing the influence of post-management treatments on standard deviation of nonnative grass cover (percent) on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	137.3	1.42	0.1329
Contrasts:	Mixed: burned linear	1	126.3	0.00	0.9485
	Mixed: burned quadratic	1	86.5	0.85	0.3603
	Mixed: BG0 vs BG1-3	1	111.4	0.05	0.8202
	Mixed: grazed linear	1	165.3	0.07	0.7911
	Mixed: grazed quadratic	1	146.3	2.07	0.1523
	Tall: burned linear	1	120.8	11.67	0.0009
	Tall: grazed linear	1	144.2	0.18	0.6711
	Tall: grazed quadratic	1	122.8	0.62	0.4321
	B1: mixed versus tall	1	162.5	0.46	0.5006
	B2: mixed versus tall	1	163.8	9.73	0.0021
	G0: mixed versus tall	1	163.3	0.61	0.4377
	G: mixed versus tall	1	167.0	2.26	0.1345
	G1: mixed versus tall	1	165.1	0.00	0.9626
	G2: mixed versus tall	1	167.5	0.00	0.9794
	Mixed: burned versus rest	1	128.2	0.18	0.6693
	Mixed: grazed versus rest	1	127.1	0.08	0.7759
	Mixed: burned-grazed versus rest	1	134.0	0.02	0.8925
	Mixed: burned versus grazed	1	168.0	3.40	0.0670
	Tall: burned versus rest	1	154.0	3.86	0.0513
	Tall: grazed versus rest	1	167.3	0.42	0.5196
	Tall: burned versus grazed	1	145.9	4.92	0.0281

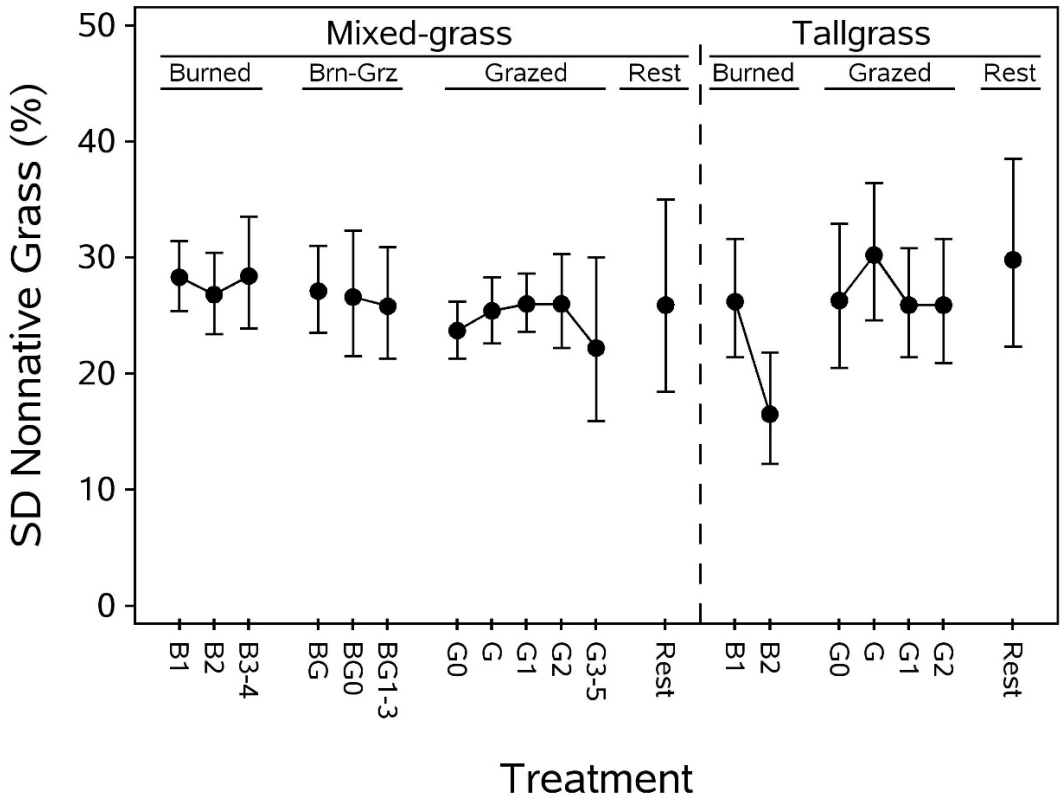
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.24. Least squares mean (standard error) standard deviation of nonnative grass cover (percent) and back-transformed least squares mean (95-percent confidence intervals) standard deviation of nonnative grass cover (percent), by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	−0.882	0.074	28.3	25.4	31.4
	B2	−0.956	0.089	26.8	23.4	30.4
	B3-4	−0.874	0.119	28.4	23.9	33.5
	BG	−0.940	0.095	27.1	23.5	31.0
	BG0	−0.965	0.139	26.6	21.5	32.3
	BG1-3	−1.004	0.124	25.8	21.3	30.9
	G0	−1.117	0.067	23.7	21.3	26.2
	G	−1.028	0.074	25.4	22.6	28.3
	G1	−0.995	0.065	26.0	23.6	28.6
	G2	−0.993	0.105	26.0	22.2	30.3
	G3-5	−1.195	0.202	22.2	15.9	30.0
	Rest	−1.001	0.217	25.9	18.4	35.0
Tall	B1	−0.984	0.132	26.2	21.4	31.6
	B2	−1.550	0.168	16.5	12.2	21.8
	G0	−0.981	0.160	26.3	20.5	32.9
	G	−0.789	0.141	30.2	24.6	36.4
	G1	−1.001	0.122	25.9	21.4	30.8
	G2	−0.998	0.139	25.9	20.9	31.6
	Rest	−0.810	0.196	29.8	22.3	38.5

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed; %, percent; SD, standard deviation]

Figure 4.12. Back-transformed least squares mean standard deviation of nonnative grass cover (percent) on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.23 and 4.24.

M. Defoliation Index

Table 4.25. Generalized linear mixed model, assuming a gamma distribution with a log link, $y = (y+1)$, testing the influence of post-management treatments on the Defoliation Index on two grass types (mixed-grass, tallgrass) on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[<, less than; *, evidence for moderate effect ($0.05<p\leq0.10$); **, evidence for strong effect ($p\leq0.05$)]

Effect	Sources of variation[1]	Numerator degrees of freedom	Denominator degrees of freedom[2]	*F*-statistic	*p*-value
Overall	Grass type × Treatment	18	118.6	10.28	<0.0001**
Contrasts:	Mixed: burned linear	1	99.7	11.88	0.0008**
	Mixed: burned quadratic	1	80.9	0.03	0.8708
	Mixed: BG0 vs BG1-3	1	91.9	0.09	0.7692
	Mixed: grazed linear	1	136.1	17.02	<0.0001**
	Mixed: grazed quadratic	1	120.2	8.22	0.0049**
	Tall: burned linear	1	99.6	14.80	0.0002**
	Tall: grazed linear	1	126.8	17.49	<0.0001**
	Tall: grazed quadratic	1	110.6	0.68	0.4122
	B1: mixed versus tall	1	150.5	4.84	0.0294**
	B2: mixed versus tall	1	156.1	13.76	0.0003**
	G0: mixed versus tall	1	166.8	6.17	0.0140**
	G: mixed versus tall	1	160.3	18.29	<0.0001**
	G1: mixed versus tall	1	150.0	18.07	<0.0001**
	G2: mixed versus tall	1	166.0	29.70	<0.0001**
	Mixed: burned versus rest#	1	96.2	31.25	<0.0001**
	Mixed: grazed versus rest#	1	95.5	36.26	<0.0001**
	Mixed: burned-grazed versus rest#	1	97.3	40.72	<0.0001**
	Mixed: burned versus grazed	1	139.9	5.05	0.0262**
	Tall: burned versus rest	1	163.8	11.22	0.0010**
	Tall: grazed versus rest	1	161.8	18.07	<0.0001**
	Tall: burned versus grazed	1	159.8	0.21	0.6459

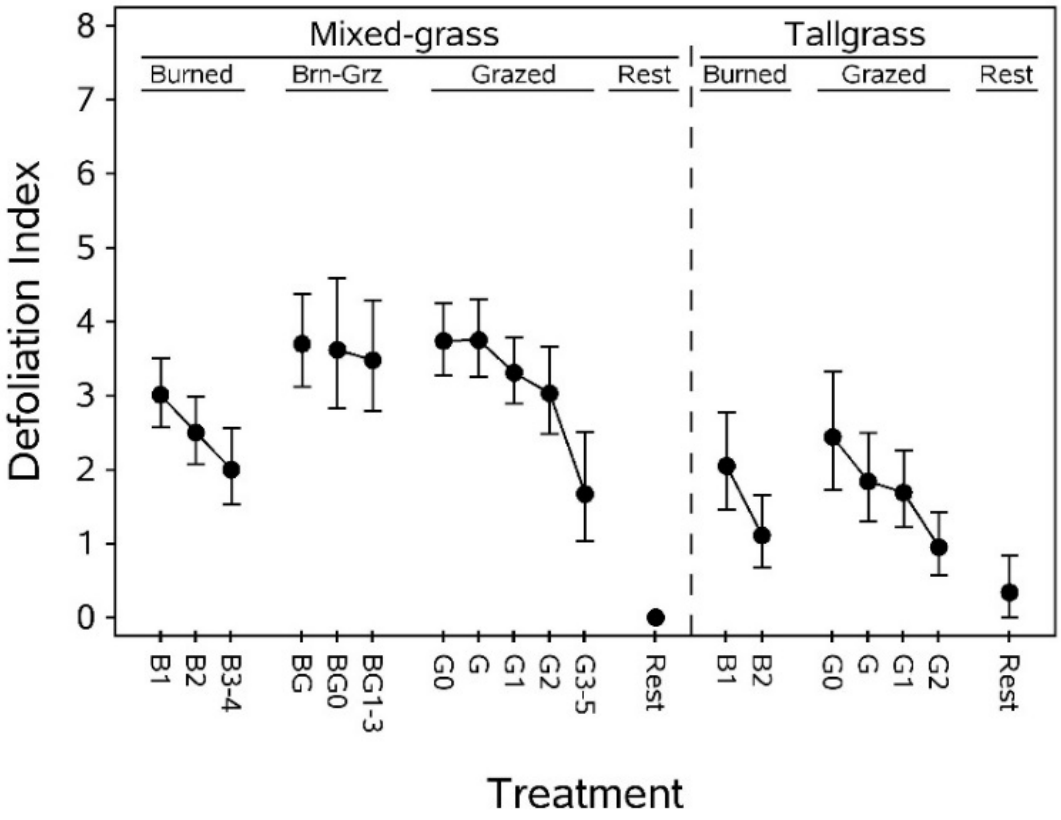
[1]Sources of variation for the model: Y=Unit(Grass type) + Grass type × Treatment + Residual, where Unit(Grass type) and Residual are random effects and Grass type × Treatment is a fixed effect in a mixed-model framework. Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).
[2]Degrees of freedom are based on Kenward-Roger correction for repeated-measures models (Littell and others, 2006).

Table 4.26. Least squares mean (standard error) Defoliation Index and back-transformed least squares mean (95-percent confidence intervals) Defoliation Index, by grassland type (mixed-grass, tallgrass) and post-management treatment, on Federal lands managed under an adaptive-management framework by the U.S. Fish and Wildlife Service (Gannon and others, 2013) in North Dakota, South Dakota, Minnesota, and Montana, 2011–13.

[LSMean, least squares mean; SE, standard error; LCL, lower confidence limit; UCL, upper confidence limit]

				Back-transformed		
					95-percent confidence intervals	
Grass	Treatment[1]	LSMean	SE	LSMean	LCL	UCL
Mixed	B1	1.39	0.06	3.01	2.57	3.51
	B2	1.25	0.07	2.50	2.07	2.99
	B3-4	1.10	0.09	2.00	1.53	2.56
	BG	1.55	0.07	3.70	3.12	4.37
	BG0	1.53	0.10	3.62	2.83	4.59
	BG1-3	1.50	0.08	3.48	2.79	4.29
	G0	1.56	0.05	3.74	3.28	4.25
	G	1.56	0.06	3.75	3.25	4.30
	G1	1.46	0.05	3.31	2.89	3.78
	G2	1.39	0.07	3.03	2.48	3.66
	G3-5	0.98	0.14	1.67	1.03	2.51
	Rest	−0.69	0.34	-0.50	0.00	-0.02
Tall	B1	1.12	0.11	2.05	1.46	2.78
	B2	0.75	0.12	1.11	0.67	1.66
	G0	1.24	0.12	2.44	1.73	3.33
	G	1.04	0.11	1.84	1.30	2.50
	G1	0.99	0.10	1.69	1.22	2.26
	G2	0.67	0.11	0.95	0.57	1.42
	Rest	0.29	0.16	0.34	0.00	0.84

[1]Post-management treatments were generally defined by the number of growing seasons after the management treatment (for example, B1 = first growing season after burn; B3-4, three to four growing seasons after burning; G0 = grazed during growing season; BG3 = third growing season after burned-grazed; rest = no management treatment within previous 5 years).



[Brn-Grz, burned-grazed]

Figure 4.13. Back-transformed least squares mean Defoliation Index on Native Prairie Adaptive Management (NPAM) units managed by the U.S. Fish and Wildlife Service in North Dakota, South Dakota, Minnesota, and Montana, 2011–13. Bars represent 95-percent confidence limits. Treatments are defined in tables 4.25 and 4.26.

References

Gannon, J.J., Shaffer, T.L., and Moore, C.T., 2013, Native Prairie Adaptive Management—A multi-region adaptive approach to invasive plant management on Fish and Wildlife Service owned native prairies: U.S. Geological Survey Open-File Report 2013–1279, 184 p. [Also available at *https://dx.doi.org/10.3133/ofr20131279*.]

Littell, R.C., Milliken, G.A., Stroup, W.W., Wolfinger, R.D., and Schabenberger, O., 2006, SAS® for mixed models (2d ed.): Cary, N.C., SAS Institute, Inc., 814 p.