

Saskatchewan Rangeland Ecosystems
Publication 9

Communities on the Dunes Ecosite

Version 2

A project of the Saskatchewan Prairie Conservation Action Plan



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Saskatchewan Research Council
2014 (revised)



NOTES

- This publication describes native grassland, shrubland, and woodland communities found on the Low Dunes and High Dunes Ecosites in the Dry Mixed Grassland, Mixed Grassland, and Aspen Parkland regions of Saskatchewan. Low Dunes and High Dunes were combined because data were insufficient for separate classifications. Communities of more stabilized dunes (characterized by higher plant cover and more soil development) and less stabilized dunes (with more bare sand) are differentiated in some cases.
- In each region, a reference community, typical of ungrazed to lightly grazed areas, and a series of other communities related to increasing grazing impact, are described.
- In assessing rangeland health, this information can be used to pick the community that best fits the area being assessed. The degree of alteration of that community from the reference community can be used to answer Question 1 of the Saskatchewan Rangeland Health Assessment. This may require interpretation, because the area being assessed may not exactly match any of the described types.
- Another approach is to calculate the percent similarity of the area being assessed to the reference community, as a measure of the degree of alteration due to grazing impact. This measure is similar in both concept and result to the traditional range condition scale.
- State-and-transition diagrams are used to show that there may also be transitions related to factors such as dune stabilization or fire regime. These transitions should not be confused with grazing impacts.
- More detailed discussion of the above points can be found in *Publication 1: Ecoregions and Ecosites*.

PHOTO CREDITS: Front Cover –grassland, shrubland, and woodland in the Elbow Sandhills; Page 8 – sagebrush-grassland in the Great Sand Hills, Page 13 – creeping juniper community on High Dunes; Page 22 – aspen parkland on dunes (all photos by Bob Godwin.).

SUGGESTED CITATION

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OBTAINING PUBLICATIONS: *Saskatchewan Rangeland Ecosystems* publications are available on the Prairie Conservation Action Plan website (http://www.pcap-sk.org/?s=9.resources_literature).



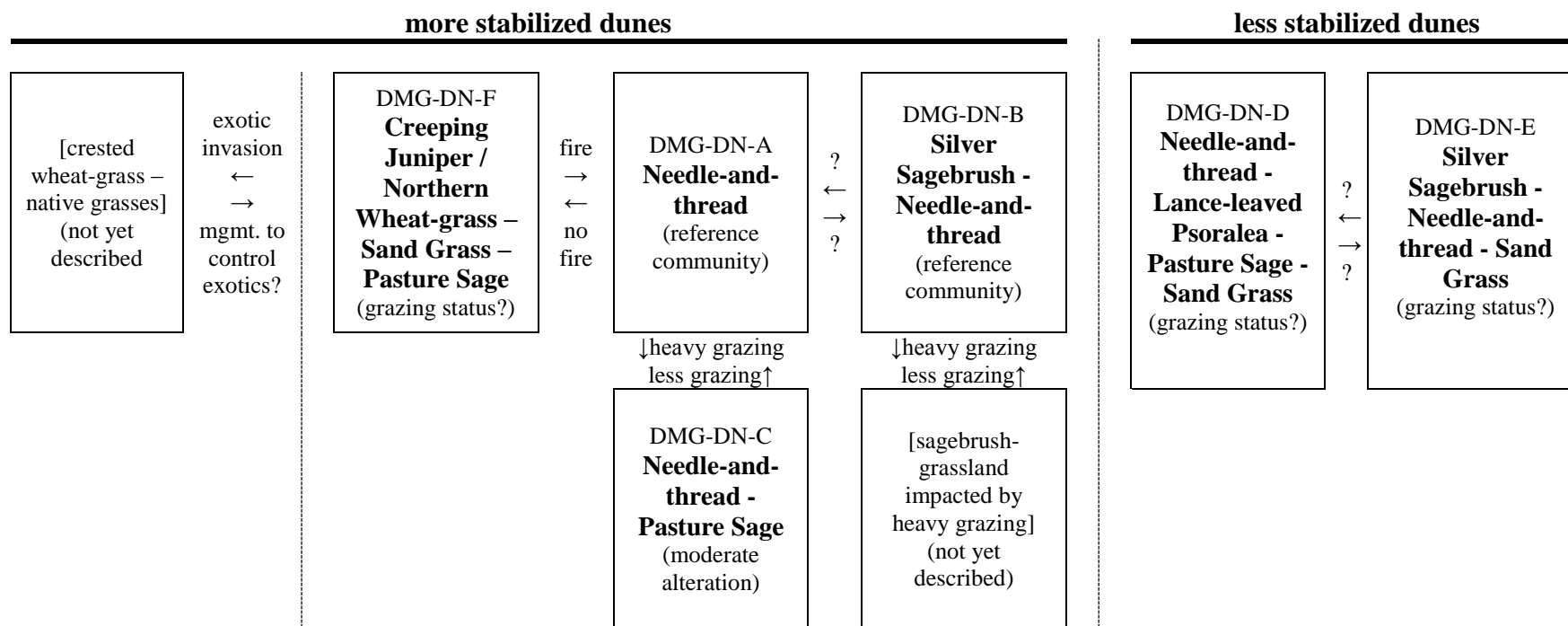
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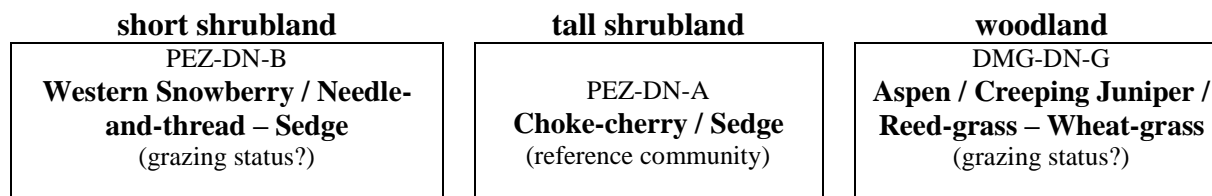


STATE-AND-TRANSITION DIAGRAMS Dry Mixed Prairie: Dunes Ecosite

Drier Microsites



Moister Microsites



Mixed Grassland: Dunes Ecosites

Drier Microsites

more stabilized dunes

[crested wheat-grass – native grasses]
(not yet described)

exotic invasion
←
→
mgmt. to control exotics?

[smooth brome – native grasses]
(not yet described)

exotic invasion
←
→
mgmt. to control exotics?

[leafy spurge]
(not yet described)

exotic invasion
←
→
mgmt. to control exotics?

MG-DN-E
Creeping Juniper – Blunt Sedge – Sand Grass
(grazing status?)

fire
→
←
no fire

MG-DN-A
Needle-and-thread – Sedge
(reference community)

↓heavy grazing
less grazing↑

MG-DN-B
Sedge – Needle-and-thread – June Grass
(minor alteration)

↓heavy grazing
less grazing↑

MG-DN-C
Sedge – June Grass – Needle-and-thread
(moderate alteration)

less stabilized dunes

MG-DN-D
Lance-leaved Psoralea – Sand Grass – Pasture Sage – Needle-and-thread
(grazing status?)

Moister Microsites

short shrubland

PEZ-DN-B
Western Snowberry / Needle-and-thread – Sedge
(grazing status?)

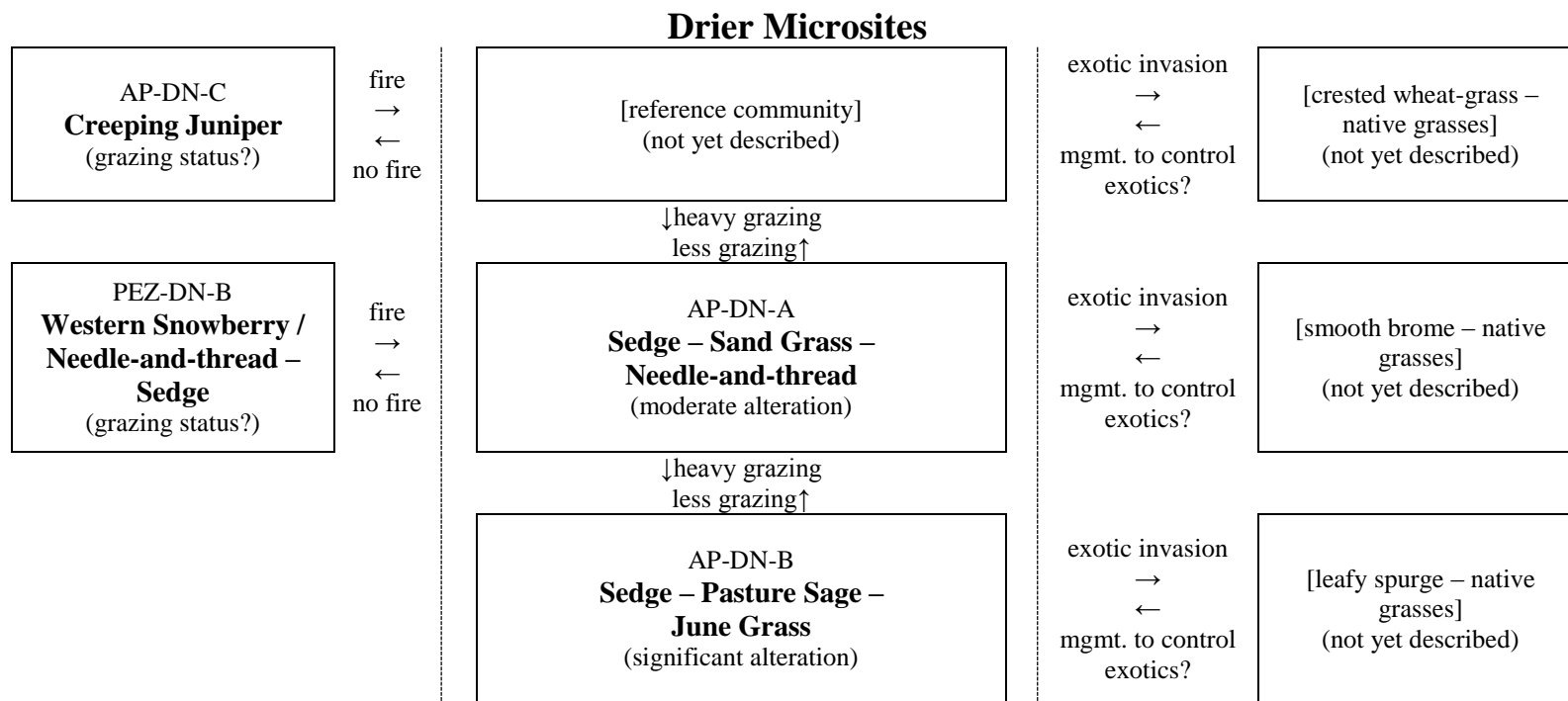
tall shrubland

PEZ-DN-A
Choke-cherry / Sedge
(reference community)

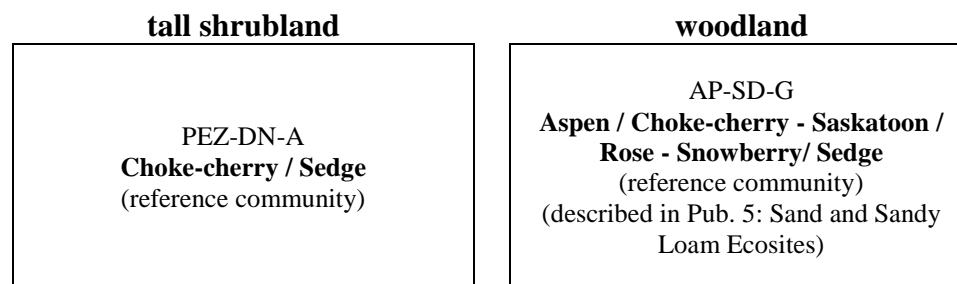
woodland

MG-DN-F
Aspen / Choke-cherry / Snowberry / Sedge
(reference community)

Aspen Parkland: Dunes Ecosite



Moister Microsites



COMMUNITY DESCRIPTIONS

DMG-DN-A

Needle-and-thread

Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Grassland strongly dominated by midgrasses, with lesser amounts of shortgrasses, half-shrubs, and forbs. Usually with scattered shrubs. Interpreted to be a **reference community** on stabilized dunesands, predominantly occurring on Low Dunes Ecosites.

STRUCTURE

herbaceous cover (n=8)	23% (14 – 38)
- midgrasses	approx. 15%
- shortgrasses	approx. 4%
- half-shrubs	approx. 2%
- forbs	approx. 2%

short shrub cover (n=8)	2% (0 – 5)
cactus cover (n=8)	0% (0 – 1)
clubmoss cover (n=8)	3% (0 – 9)
moss cover (n=8)	2% (0 – 6)

SPECIES COMPOSITION (% biomass, n=14)

Major tall shrubs	
choke-cherry (<i>Prunus virginiana</i>)	1% (0 - 0)
saskatoon (<i>Amelanchier alnifolia</i>)	1% (0 - 0)

Major short shrubs	
rose (<i>Rosa spp.</i>)	3% (0 - 12)
silver sagebrush (<i>Artemisia cana</i>)	1% (0 - 5)
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 - 1)

Major graminoids	
needle-and-thread (<i>Hesperostipa comata</i>)	37% (23 - 47)
sand grass (<i>Calamovilfa longifolia</i>)	9% (0 - 20)
june grass (<i>Koeleria macrantha</i>)	8% (0 - 20)
northern wheat-grass (<i>Elymus lanceolatus</i>)	7% (0 - 19)
sedge (<i>Carex spp.</i>)	5% (1 - 9)
western wheat-grass (<i>Pascopyrum smithii</i>)	5% (0 - 11)
blue grama (<i>Bouteloua gracilis</i>)	2% (0 - 8)
sand dropseed (<i>Sporobolus cryptandrus</i>)	2% (0 - 7)
plains reed grass (<i>Calamagrostis montanensis</i>)	1% (0 - 2)

Major cactus	
brittle prickly-pear (<i>Opuntia fragilis</i>)	1% (0 - 2)

Major forbs and half-shrubs	
pasture sage (<i>Artemisia frigida</i>)	9% (2 - 18)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	4% (0 - 11)
hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 4)
scarlet mallow (<i>Sphaeralcea coccinea</i>)	1% (0 - 3)

Minor graminoids	1%
Minor forbs and half-shrubs	1%

SIMILARITY TO REFERENCE COMMUNITY	reference community
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PRODUCTION	herbs 1300 kg/ha; browse 200 kg/ha
RECOMMENDED STOCKING RATE	0.36 AUM/ha 0.15 AUM/ac

DMG-DN-B
Silver Sagebrush - Needle-and-thread
Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Grassland with abundant sagebrush. Herbaceous layer dominated by midgrasses, with lesser amounts of shortgrasses, half-shrubs, and forbs. Interpreted to be a **reference community** on stabilized dunesands in the Dry Mixed Grassland. Occurs on similar microsites to DMG-DN-A.. May also occur in a few locations in the Mixed Grassland Ecoregion. Variation in the abundance of sagebrush (i.e. transition between DMG-DN-A and DMG-DN-B) may be related to fire history or other factors, but more research is needed.

STRUCTURE

herbaceous cover (n=17)	15% (9 – 23)	short shrub cover (n=17)	8% (3 – 14)
- midgrasses	approx. 10%	prostrate shrub cover (n=17)	2% (0 – 7)
- shortgrasses	approx. 2%	cactus cover (n=17)	0% (0 – 1)
- half-shrubs	approx. 1%	moss cover (n=17)	15% (0 – 43)
- forbs	approx. 2%		

SPECIES COMPOSITION (n=17)

Prostrate shrubs (% foliar cover)		Major cactus (% biomass)	
creeping juniper (<i>Juniperus horizontalis</i>)	2% (0 - 7)	brittle prickly-pear (<i>Opuntia fragilis</i>)	1% (0 - 4)
Major tall shrubs (% biomass)		Major graminoids (% biomass)	
choke-cherry (<i>Prunus virginiana</i>)	2% (0 - 12)	needle-and-thread (<i>Hesperostipa comata</i>)	18% (0 - 35)
Major short shrubs (% biomass)		northern wheat-grass (<i>Elymus lanceolatus</i>)	9% (0 - 27)
silver sagebrush (<i>Artemisia cana</i>)	25% (13 - 43)	june grass (<i>Koeleria macrantha</i>)	7% (0 - 14)
western snowberry (<i>Symphoricarpos occidentalis</i>)	2% (0 - 8)	western wheat-grass (<i>Pascopyrum smithii</i>)	4% (0 - 12)
skunk bush (<i>Rhus trilobata</i>)	1% (0 - 5)	sand grass (<i>Calamovilfa longifolia</i>)	3% (0 - 7)
Major forbs and half-shrubs (% biomass)		Kentucky blue-grass (<i>Poa pratensis</i>)	2% (0 - 9)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	7% (1 - 13)	sand dropseed (<i>Sporobolus cryptandrus</i>)	1% (0 - 4)
pasture sage (<i>Artemisia frigida</i>)	6% (0 - 14)	sedge (<i>Carex spp.</i>)	1% (0 - 3)
lamb's-quarters (<i>Chenopodium album</i>)	1% (0 - 3)	blue-grass (<i>Poa spp.</i>)	1% (0 - 0)
hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 2)	sand dune wheat-grass (<i>Elymus lanceolatus</i> var. <i>psammophilum</i>)	1% (0 - 3)
Minor shrubs (% biomass)		plains reed grass (<i>Calamagrostis montanensis</i>)	1% (0 - 1)
	1%	awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	1% (0 - 2)
Minor graminoids (% biomass)			
	1%	Minor forbs and half-shrubs (% biomass)	
			2%

SIMILARITY TO REFERENCE COMMUNITY	reference community	
PRODUCTION	herbs 1100 kg/ha; browse 700 kg/ha	
RECOMMENDED STOCKING RATE	0.29 AUM/ha	0.12 AUM/ac



DMG-DN-C
Needle-and-thread - Pasture Sage
Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Grassland dominated by midgrasses, with lesser amounts of shortgrasses, half-shrubs, and forbs. Occurs on stabilized dunesands, predominantly on Low Dunes Ecosites. Interpreted to show **moderate alteration** from the reference community (DMG-DN-A) as a result of grazing impact. Probably develops from DMG-DN-A by decrease in needle-and-thread and increase in pasture sage and sedges.

STRUCTURE

herbaceous cover (n=10)	33% (14 – 53)	short shrub cover (n=6)	2% (1 – 4)
- midgrasses	approx. 15%	prostrate shrub cover (n=6)	2% (0 – 6)
- shortgrasses	approx. 5%	cactus cover (n=6)	0% (0 – 1)
- half-shrubs	approx. 5%	clubmoss cover (n=10)	2% (0 – 5)
- forbs	approx. 5%	moss cover (n=10)	3% (0 – 8)

SPECIES COMPOSITION

Major tall shrubs (% biomass, n=13)		Major prostrate shrubs (% foliar cover, n=6)	
basket willow (<i>Salix petiolaris</i>)	1% (0 - 0)	creeping juniper (<i>Juniperus horizontalis</i>)	2% (0 - 6)
Major short shrubs (% biomass, n=13)		Major cactus (% biomass, n=13)	
western snowberry (<i>Symphoricarpos occidentalis</i>)	3% (0 - 11)	brittle prickly-pear (<i>Opuntia fragilis</i>)	1% (0 - 3)
rose (<i>Rosa spp.</i>)	2% (0 - 5)	Major graminoids (% biomass, n=13)	
silver sagebrush (<i>Artemisia cana</i>)	1% (0 - 2)	needle-and-thread (<i>Hesperostipa comata</i>)	22% (13 - 28)
wolf-willow (<i>Elaeagnus commutata</i>)	1% (0 - 0)	sedge (<i>Carex spp.</i>)	9% (2 - 17)
Major forbs and half-shrubs (% biomass, n=13)		sand grass (<i>Calamovilfa longifolia</i>)	7% (0 - 13)
pasture sage (<i>Artemisia frigida</i>)	19% (7 - 30)	june grass (<i>Koeleria macrantha</i>)	5% (0 - 12)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	6% (1 - 13)	northern wheat-grass (<i>Elymus lanceolatus</i>)	5% (0 - 10)
lamb's-quarters (<i>Chenopodium album</i>)	2% (0 - 7)	western wheat-grass (<i>Pascopyrum smithii</i>)	4% (0 - 13)
prairie sage (<i>Artemisia ludoviciana</i>)	2% (0 - 5)	blue grama (<i>Bouteloua gracilis</i>)	4% (0 - 10)
hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 3)	sand dropseed (<i>Sporobolus cryptandrus</i>)	1% (0 - 2)
aster (<i>Symphyotrichum spp.</i>)	1% (0 - 2)	smooth brome (<i>Bromus inermis</i>)	1% (0 - 2)
Minor graminoids		Minor forbs and half-shrubs	
1%		3%	

SIMILARITY TO REFERENCE COMMUNITY 72%

RECOMMENDED STOCKING RATE 0.29 AUM/ha 0.12 AUM/ac

DMG-DN-D

Needle-and-thread - Lance-leaved Psoralea - Pasture Sage - Sand Grass

Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Grassland dominated by midgrasses, but with significant amounts of forbs, and lesser amounts of shortgrasses and half-shrubs. Usually with scattered shrubs. Occurs on **less stabilized dunes** compared to DMG-DN-A, on both High Dunes and Low Dunes Ecosites. Less stabilized sites are recognized by lower cover of surface organic matter and clubmoss, absence of soil A-horizon, and abundance of early-seral species such as lance-leaved psoralea, sand dropseed, and annuals. Status in relation to grazing impact is unclear.

STRUCTURE

herbaceous cover (n=14)	25% (10 - 44)	short shrub cover (n=13)	3% (0 - 6)
- midgrasses	approx. 10%	cactus cover (n=13)	2% (0 - 3)
- shortgrasses	approx. 2%	moss cover (n=14)	6% (0 - 11)
- half-shrubs	approx. 4%		
- forbs	approx. 5%		

SPECIES COMPOSITION (% biomass, n=18)

Major short shrubs		Major cactus	
rose (<i>Rosa spp.</i>)	6% (0 - 19)	brittle prickly-pear (<i>Opuntia fragilis</i>)	3% (0 - 5)
wolf-willow (<i>Elaeagnus commutata</i>)	3% (0 - 13)		
silver sagebrush (<i>Artemisia cana</i>)	1% (0 - 7)		
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 - 0)		
Major forbs and half-shrubs		Major graminoids	
lance-leaved psoralea (<i>Psoralidium lanceolatum</i>)	16% (4 - 30)	needle-and-thread (<i>Hesperostipa comata</i>)	18% (3 - 37)
pasture sage (<i>Artemisia frigida</i>)	13% (1 - 30)	sand grass (<i>Calamovilfa longifolia</i>)	12% (0 - 24)
Fendler's cryptanthe (<i>Cryptantha fendleri</i>)	3% (0 - 7)	june grass (<i>Koeleria macrantha</i>)	4% (0 - 13)
low goldenrod (<i>Solidago missouriensis</i>)	2% (0 - 7)	sand dropseed (<i>Sporobolus cryptandrus</i>)	4% (0 - 13)
lamb's-quarters (<i>Chenopodium album</i>)	2% (0 - 5)	sedge (<i>Carex spp.</i>)	3% (0 - 10)
hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 0)	northern wheat-grass (<i>Elymus lanceolatus</i>)	3% (0 - 7)
		western wheat-grass (<i>Pascopyrum smithii</i>)	2% (0 - 3)
		sand dune wheat-grass (<i>Elymus lanceolatus</i> var. <i>psammophilum</i>)	1% (0 - 0)
		smooth brome (<i>Bromus inermis</i>)	1% (0 - 0)
Minor graminoids	1%		
Minor forbs and half-shrubs	2%		

SIMILARITY TO REFERENCE COMMUNITY	unknown
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RECOMMENDED STOCKING RATE	0.36 AUM/ha	0.15 AUM/ac
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DMG-DN-E
Silver Sagebrush - Needle-and-thread - Sand Grass
Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Grassland with abundant sagebrush. Occurs on **less stabilized dunes** compared to DMG-DN-B, on both High Dunes and Low Dunes Ecosites in the Dry Mixed Grassland. May also occur in a few locations in the Mixed Grassland Ecoregion. Predominantly found on High Dunes Ecosites, but also on Low Dunes. Occurs on similar microsites to DMG-DN-D. Variation in the abundance of sagebrush (i.e. transition between DMG-DN-D and DMG-DN-E) may be related to fire history or other factors, but more research is needed. Status in relation to grazing impact is unclear, but probably close to reference composition.

STRUCTURE

herbaceous cover (n=16)	15% (8 – 20)	short shrub cover (n=16)	11% (4 – 21)
- midgrasses	approx. 10%	prostrate shrub cover (n=16)	1% (0 – 2)
- shortgrasses	approx. 1%	cactus cover (n=16)	1% (0 – 2)
- half-shrubs	approx. 1%	moss cover (n=16)	7% (0 – 25)
- forbs	approx. 4%		

SPECIES COMPOSITION (n=16)

Major prostrate shrubs (% foliar cover)		Major tall shrubs (% biomass)	
creeping juniper (<i>Juniperus horizontalis</i>)	1% (0 - 2)	choke-cherry (<i>Prunus virginiana</i>)	1% (0 - 4)
Major trees (% biomass)		Major short shrubs (% biomass)	
trembling aspen (<i>Populus tremuloides</i>)	1% (0 - 0)	silver sagebrush (<i>Artemisia cana</i>)	34% (13 - 52)
Major cactus (% biomass)		western snowberry (<i>Symphoricarpos occidentalis</i>)	3% (0 - 10)
brittle prickly-pear (<i>Opuntia fragilis</i>)	1% (0 - 1)	wolf-willow (<i>Elaeagnus commutata</i>)	1% (0 - 0)
Major graminoids (% biomass)		Major forbs and half-shrubs (% biomass)	
needle-and-thread (<i>Hesperostipa comata</i>)	14% (6 - 30)	lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	7% (1 - 14)
sand grass (<i>Calamovilfa longifolia</i>)	12% (3 - 24)	pasture sage (<i>Artemisia frigida</i>)	5% (0 - 13)
sand dropseed (<i>Sporobolus cryptandrus</i>)	5% (0 - 10)	lamb's-quarters (<i>Chenopodium album</i>)	3% (0 - 8)
northern wheat-grass (<i>Elymus lanceolatus</i>)	3% (0 - 8)	hairy golden-aster (<i>Heterotheca villosa</i>)	2% (0 - 5)
june grass (<i>Koeleria macrantha</i>)	3% (0 - 8)	star-flowered solomon's-seal (<i>Maianthemum stellatum</i>)	1% (0 - 0)
Minor shrubs (% biomass)		common hops (<i>Humulus lupulus</i>)	1% (0 - 0)
	1%	blue-bur (<i>Lappula spp.</i>)	1% (0 - 2)
Minor graminoids (% biomass)		branched pepper-grass (<i>Lepidium ramosissimum</i>)	1% (0 - 2)
	2%	SIMILARITY TO REF. COMM.	
Minor forbs and half-shrubs (% biomass)		unknown	
	1%		

PRODUCTION

herbs 1100 kg/ha; browse 700 kg/ha

RECOMMENDED STOCKING RATE

0.29 AUM/ha 0.12 AUM/ac

DMG-DN-F

Creeping Juniper / Northern Wheat-grass – Sand Grass – Pasture Sage

Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Prostrate shrub/grassland community found on both Low Dunes and High Dunes Ecosites. Occurs on the same microsites as grassland types (e.g. DMG-DN-A). Creeping juniper spreads into dune grassland in the absence of fire, reducing the cover and productivity of grasses, while fire kills the juniper and restores the grassland community. Rhizomatous grasses such as sand grass and northern wheat-grass appear to be more successful than bunchgrasses at growing up through the juniper mat. Status in relation to grazing impact is unclear. Productivity for livestock grazing ranges from none in dense juniper stands to low in more open stands. However, juniper provides valuable winter deer browse.

STRUCTURE (n=12)

short shrub cover	3% (0 - 11)	herbaceous cover	11% (5 - 15)
prostrate shrub cover	31% (20 - 42)	moss cover	8% (0 - 42)

SPECIES COMPOSITION (n=12)

Major trees (% foliar cover)		Major short shrubs (% foliar cover)	
trembling aspen (<i>Populus tremuloides</i>)	1% (0 - 1)	western snowberry	2% (0 - 5)
		(<i>Symphoricarpos occidentalis</i>)	
		silver sagebrush (<i>Artemisia cana</i>)	1% (0 - 4)
Major graminoids (% biomass)		Major prostrate shrubs (% foliar cover)	
northern wheat-grass (<i>Elymus lanceolatus</i>)	12% (0 - 34)	creeping juniper (<i>Juniperus horizontalis</i>)	27% (19 - 42)
sand-grass (<i>Calamovilfa longifolia</i>)	12% (0 - 23)	common bearberry (<i>Arctostaphylos uva-ursi</i>)	4% (0 - 14)
june grass (<i>Koeleria macrantha</i>)	9% (0 - 12)		
western wheat-grass (<i>Pascopyrum smithii</i>)	9% (0 - 26)		
needle-and-thread (<i>Hesperostipa comata</i>)	7% (0 - 11)		
slender wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>)	3% (0 - 0)		
plains reed-grass (<i>Calamagrostis montanensis</i>)	3% (0 - 6)		
sun-loving sedge (<i>Carex inops</i>)	2% (0 - 6)		
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	2% (0 - 0)		
Sandberg's blue-grass (<i>Poa secunda</i> ssp. <i>secunda</i>)	2% (0 - 4)		
sand-dune wheat-grass (<i>Elymus lanceolatus</i> ssp. <i>psammophilus</i>)	2% (0 - 0)		
low sedge (<i>Carex duriuscula</i>)	1% (0 - 3)		
sand dropseed (<i>Sporobolus cryptandrus</i>)	1% (0 - 3)		
blue-grass (<i>Poa</i> spp.)	1% (0 - 0)		
northern reed-grass (<i>Calamagrostis stricta</i> ssp. <i>inexpansa</i>)	1% (0 - 1)		
		Major forbs and half-shrubs (% biomass)	
		pasture sage (<i>Artemisia frigida</i>)	12% (2 - 23)
		lance-leaved psoralea (<i>Psoralidium lanceolatum</i>)	9% (0 - 24)
		Missouri goldenrod (<i>Solidago missouriensis</i>)	4% (0 - 12)
		hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 3)
		early blue violet (<i>Viola adunca</i>)	1% (0 - 0)
		sandwort (<i>Moehringia</i> spp.)	1% (0 - 0)
		blue-bur (<i>Lappula</i> spp.)	1% (0 - 0)
		harebell (<i>Campanula rotundifolia</i>)	1% (0 - 0)
		golden bean (<i>Thermopsis rhombifolia</i>)	1% (0 - 0)
		milk-vetch (<i>Astragalus</i> spp.)	1% (0 - 0)

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Minor graminoids (% biomass)	1%
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Minor forbs and half-shrubs (% biomass)	2%
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SIMILARITY TO REFERENCE COMMUNITY
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unknown

RECOMMENDED STOCKING RATE

none to low



DMG-DN-G
Aspen / Creeping Juniper / Reed-grass – Wheat-grass
 Dry Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Small aspen stands in dune complexes in the Dry Mixed Grassland. These stands tend to be on inter-dune hollows, and may be somewhat subirrigated, as suggested by presence of northern reed-grass, Baltic rush, and scouring-rush. The sampled stands were semi-open, with a prominent ground cover of creeping juniper. It is possible that stands less affected by grazing could have more erect shrubs and herbs. The status of this community with respect to grazing impact is uncertain.

STRUCTURE (n=9)

tree cover	19% (10 - 33)	prostrate shrub cover	13% (9 - 19)
tall shrub cover	3% (1 - 4)	herbaceous cover	10% (5 - 18)
short shrub cover	7% (2 - 12)	bryophyte cover	0% (0 - 1)

SPECIES COMPOSITION (n=9)

Major trees (% foliar cover)		Major prostrate shrubs (% foliar cover)	
trembling aspen (<i>Populus tremuloides</i>)	21% (11 - 33)	creeping juniper (<i>Juniperus horizontalis</i>)	13% (9 - 19)
Major short shrubs (% foliar cover)		Major forbs & half-shrubs (% foliar cover)	
western snowberry (<i>Symphoricarpos occidentalis</i>)	4% (1 - 6)	lance-leaved psoralea (<i>Psoralea lanceolata</i>)	5% (0 - 15)
Major graminoids (% biomass)		tall scouring-rush (<i>Equisetum hyemale</i>)	3% (0 - 8)
northern reed-grass (<i>Calamagrostis stricta</i> ssp. <i>inexpansa</i>)	21% (0 - 53)	pasture sage (<i>Artemisia frigida</i>)	3% (0 - 12)
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	17% (5 - 30)	hairy golden-aster (<i>Heterotheca villosa</i>)	3% (0 - 9)
northern wheat-grass (<i>Elymus lanceolatus</i>)	13% (0 - 32)	sandwort (<i>Moehringia</i> spp.)	2% (0 - 5)
sand-grass (<i>Calamovilfa longifolia</i>)	6% (0 - 12)	American wild licorice (<i>Glycyrrhiza lepidota</i>)	2% (0 - 5)
june grass (<i>Koeleria macrantha</i>)	5% (0 - 11)	golden bean (<i>Thermopsis rhombifolia</i>)	2% (0 - 7)
graceful sedge (<i>Carex praegracilis</i>)	4% (0 - 8)	locoweed (<i>Oxytropis</i> spp.)	2% (0 - 3)
sun-loving sedge (<i>Carex inops</i>)	2% (0 - 5)	harebell (<i>Campanula rotundifolia</i>)	1% (0 - 4)
blue-grass (<i>Poa</i> spp.)	2% (0 - 3)	star-flowered solomon's-seal (<i>Maianthemum stellatum</i>)	1% (0 - 1)
Baltic rush (<i>Juncus arcticus</i> var. <i>balticus</i>)	2% (0 - 3)	early blue violet (<i>Viola adunca</i>)	1% (0 - 2)
hay sedge (<i>Carex siccata</i>)	1% (0 - 1)	smooth blue aster (<i>Symphyotrichum laeve</i>)	1% (0 - 2)
western wheat-grass (<i>Pascopyrum smithii</i>)	1% (0 - 2)	Minor short shrubs (% foliar cover)	
SIMILARITY TO REF. COMM.		1%	
RECOMMENDED STOCKING RATE		Minor graminoids (% biomass)	
none to low		1%	

MG-DN-A
Needle-and-thread – Sedge
Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Mixed prairie dominated by midgrasses, with significant amounts of shortgrasses and lesser amounts of half-shrubs and forbs. Usually with some shrub cover. Interpreted as being the **reference community** for grasslands on stabilized dunes in the Mixed Grassland. Sedges are shown as a group because of data limitations, but probably include a high proportion of taller species such as blunt sedge (*Carex obtusata*).

STRUCTURE

herbaceous cover (n=23)	41% (31 – 58)	short shrub cover (n=5)	3% (0 – 8)
- midgrasses	approx. 25%	clubmoss cover (n=23)	11% (0 – 30)
- shortgrasses	approx. 10%	litter cover (n=22)	43% (26 – 63)
- half-shrubs	approx. 3%	bare soil (n=22)	12% (1 – 21)
- forbs	approx. 3%		

SPECIES COMPOSITION (% biomass, n=23)

Major short shrubs		Major graminoids	
rose (<i>Rosa spp.</i>)	2% (0 - 5)	needle-and-thread (<i>Hesperostipa comata</i>)	30% (10 - 49)
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 - 3)	sedge (<i>Carex spp.</i>)	18% (3 - 31)
Major forbs and half-shrubs		sand grass (<i>Calamovilfa longifolia</i>)	9% (0 - 15)
pasture sage (<i>Artemisia frigida</i>)	6% (1 - 12)	june grass (<i>Koeleria macrantha</i>)	6% (2 - 11)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	2% (0 - 5)	western wheat-grass (<i>Pascopyrum smithii</i>)	4% (0 - 11)
hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 4)	blue grama (<i>Bouteloua gracilis</i>)	3% (0 - 7)
prairie sage (<i>Artemisia ludoviciana</i>)	1% (0 - 3)	sand dropseed (<i>Sporobolus cryptandrus</i>)	3% (0 - 12)
pale comandra (<i>Comandra umbellata</i>)	1% (0 - 0)	western porcupine-grass (<i>Hesperostipa curtipetala</i>)	2% (0 - 8)
Minor graminoids	2%	green needle grass (<i>Nassella viridula</i>)	2% (0 - 0)
Minor forbs and half-shrubs	3%	northern wheat-grass (<i>Elymus lanceolatus</i>)	2% (0 - 6)
		plains rough fescue (<i>Festuca altaica</i> var. <i>hallii</i>)	1% (0 - 4)
		Hooker's oat-grass (<i>Avenula hookeri</i>)	1% (0 - 0)
		plains reed grass (<i>Calamagrostis montanensis</i>)	1% (0 - 2)
		awned wheat-grass (<i>Elymus trachycaulus ssp. subsecundus</i>)	1% (0 - 2)

SIMILARITY TO REFERENCE COMMUNITY	reference community	
RECOMMENDED STOCKING RATE	0.52 AUM/ha	0.21 AUM/ac

MG-DN-B

Sedge - Needle-and-thread - June Grass

Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Mixed prairie with midgrasses dominant and shortgrasses subdominant, and with lesser amounts of half-shrubs and forbs. Interpreted to show **minor alteration** from the reference community on stable dunes as a result of grazing impact. Probably develops from MG-DN-A by decrease of needle-and-thread and wheat-grasses, and increase of sedges, june grass and forbs. The increase of sedges with grazing impact probably also involves replacement of taller species (e.g. *Carex obtusata*) by shorter species (e.g. *C. inops*, *C. duriuscula*).

STRUCTURE

tall shrub cover (n=28)	1% (0 – 1)	short shrub cover (n=28)	3% (0 – 9)
herbaceous cover (n=59)	42% (24 – 63)	prostrate shrub cover (n=28)	2% (0 – 6)
- midgrasses	approx. 20%	clubmoss cover (n=54)	17% (1 – 40)
- shortgrasses	approx. 15%	lichen cover (n=23)	1% (0 – 3)
- half-shrubs	approx. 3%	litter cover (n=54)	36% (15 – 63)
- forbs	approx. 5%	bare soil (n=54)	8% (1 – 16)

SPECIES COMPOSITION (n=59)

Major tall shrubs (% biomass)		Major short shrubs (% biomass)	
choke-cherry (<i>Prunus virginiana</i>)	1% (0 - 2)	western snowberry	2% (0 - 6)
		(<i>Symphoricarpos occidentalis</i>)	
		rose (<i>Rosa spp.</i>)	1% (0 - 4)
Major forbs and half-shrubs (% biomass)		Major graminoids (% biomass)	
pasture sage (<i>Artemisia frigida</i>)	7% (0 - 14)	sedge (<i>Carex spp.</i>)	23% (10 - 37)
lance-leaved psoralea (<i>Psoralea lanceolatum</i>)	2% (0 - 8)	needle-and-thread (<i>Hesperostipa comata</i>)	16% (5 - 27)
hairy golden-aster (<i>Heterotheca villosa</i>)	2% (0 - 5)	june grass (<i>Koeleria macrantha</i>)	10% (0 - 22)
prairie sage (<i>Artemisia ludoviciana</i>)	1% (0 - 4)	sand grass (<i>Calamovilfa longifolia</i>)	8% (0 - 18)
goldenrod (<i>Solidago spp.</i>)	1% (0 - 2)	blue grama (<i>Bouteloua gracilis</i>)	3% (0 - 9)
golden bean (<i>Thermopsis rhombifolia</i>)	1% (0 - 2)	western wheat-grass (<i>Pascopyrum smithii</i>)	2% (0 - 5)
field chickweed (<i>Cerastium arvense</i>)	1% (0 - 3)	plains reed grass (<i>Calamagrostis montanensis</i>)	2% (0 - 5)
pale comandra (<i>Comandra umbellata</i>)	1% (0 - 3)	northern wheat-grass (<i>Elymus lanceolatus</i>)	2% (0 - 5)
		western porcupine-grass (<i>Hesperostipa curtipetala</i>)	2% (0 - 7)
Minor short shrubs (% biomass)	1%	Rocky Mountain fescue (<i>Festuca saximontana</i>)	1% (0 - 3)
Minor prostrate shrubs (% foliar cover)	1%	sand dropseed (<i>Sporobolus cryptandrus</i>)	1% (0 - 1)
Minor graminoids (% biomass)	2%	plains rough fescue (<i>Festuca altaica</i> var. <i>hallii</i>)	1% (0 - 2)
Minor forbs and half-shrubs (% biomass)	5%		

SIMILARITY TO REFERENCE COMMUNITY	76%
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RECOMMENDED STOCKING RATE	0.52 AUM/ha	0.21 AUM/ac
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MG-DN-C

Sedge - June Grass - Needle-and-thread

Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Mixed prairie with midgrasses and shortgrasses codominant, and with significant amounts of forbs and lesser amounts of half-shrubs. Usually with some short shrub cover. Interpreted to show **moderate alteration** from the reference community on stable dunes as a result of grazing impact. Probably develops from MG-DN-B by decrease of needle-and-thread and sand grass, and increase of june grass and forbs.

STRUCTURE

short shrub cover (n=15)	3% (0 – 10)	prostrate shrub cover (n=15)	0% (0 – 1)
herbaceous cover (n=27)	49% (37 – 67)	clubmoss cover (n=23)	21% (0 – 41)
- midgrasses	approx. 15%	lichen cover (n=12)	2% (0 – 3)
- shortgrasses	approx. 15%	litter cover (n=24)	35% (8 – 85)
- half-shrubs	approx. 5%	bare soil (n=24)	6% (1 – 14)
- forbs	approx. 10%		

SPECIES COMPOSITION (% biomass, n=27)

Major short shrubs		Major forbs and half-shrubs	
rose (<i>Rosa spp.</i>)	2% (0 - 5)	pasture sage (<i>Artemisia frigida</i>)	9% (1 - 16)
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 - 3)	lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	5% (0 - 15)
		hairy golden-aster (<i>Heterotheca villosa</i>)	5% (0 - 12)
		golden bean (<i>Thermopsis rhombifolia</i>)	2% (0 - 4)
		field chickweed (<i>Cerastium arvense</i>)	1% (0 - 4)
		common scouring-rush (<i>Equisetum hyemale</i>)	1% (0 - 2)
		prairie sage (<i>Artemisia ludoviciana</i>)	1% (0 - 3)
		moss phlox (<i>Phlox hoodii</i>)	1% (0 - 2)
		goldenrod (<i>Solidago spp.</i>)	1% (0 - 2)
		narrow-leaved puccoon (<i>Lithospermum incisum</i>)	1% (0 - 2)
Major graminoids		Minor shrubs	1%
sedge (<i>Carex spp.</i>)	20% (9 - 30)	Minor graminoids	2%
june grass (<i>Koeleria macrantha</i>)	14% (3 - 24)	Minor forbs and half-shrubs	5%
needle-and-thread (<i>Hesperostipa comata</i>)	12% (3 - 20)		
sand grass (<i>Calamovilfa longifolia</i>)	5% (0 - 9)		
blue grama (<i>Bouteloua gracilis</i>)	4% (0 - 10)		
plains reed grass (<i>Calamagrostis montanensis</i>)	2% (0 - 6)		
Kentucky blue-grass (<i>Poa pratensis</i>)	2% (0 - 7)		
western wheat-grass (<i>Pascopyrum smithii</i>)	1% (0 - 4)		
northern wheat-grass (<i>Elymus lanceolatus</i>)	1% (0 - 4)		
Rocky Mountain fescue (<i>Festuca saximontana</i>)	1% (0 - 4)		
western porcupine-grass (<i>Hesperostipa curtipseta</i>)	1% (0 - 3)		

SIMILARITY TO REFERENCE COMMUNITY 66%

RECOMMENDED STOCKING RATE 0.42 AUM/ha 0.17 AUM/ac

MG-DN-D

Lance-leaved Psoralea - Sand Grass - Pasture Sage - Needle-and-thread
Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Early-successional grassland with midgrasses and forbs codominant, and with lesser amounts of shortgrasses and half-shrubs. Usually with some shrub cover. Occurs on **less stabilized dunesands**, mainly on High Dunes Ecosites. Less stabilized sites can be recognized by lower cover of surface organic matter and clubmoss, more bare soil exposure, absence of a soil A-horizon, and prominence of early-seral species such as lance-leaved psoralea, sand dropseed, and annuals. Status in relation to grazing impact is unclear, but probably near reference composition for these sites.

STRUCTURE

tall shrub cover (n=7)	1% (0 – 2)	short shrub cover (n=7)	2% (0 – 5)
herbaceous cover (n=13)	40% (17 – 55)	prostrate shrub cover (n=7)	2% (0 – 5)
- midgrasses	approx. 15%	cactus cover (n=7)	0% (0 – 1)
- shortgrasses	approx. 5%	clubmoss cover (n=10)	1% (0 – 2)
- half-shrubs	approx. 5%	litter cover (n=9)	37% (16 – 63)
- forbs	approx. 15%	bare soil (n=9)	25% (12 – 47)

SPECIES COMPOSITION (n=13)

Major tall shrubs (% biomass)		Prostrate shrubs (% foliar cover)	
choke-cherry (<i>Prunus virginiana</i>)	1% (0 – 0)	creeping juniper (<i>Juniperus horizontalis</i>)	1% (0 – 3)
		bearberry (<i>Arctostaphylos uva-ursi</i>)	0% (0 – 0)
Major short shrubs (% biomass)		Major cactus (% biomass)	
rose (<i>Rosa spp.</i>)	2% (0 – 4)	prickly-pear (<i>Opuntia spp.</i>)	1% (0 – 2)
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 – 3)		
Major graminoids (% biomass)		Major forbs and half-shrubs (% biomass)	
sand grass (<i>Calamovilfa longifolia</i>)	16% (7 – 29)	lance-leaved psoralea (<i>Psoralea lanceolata</i>)	17% (6 – 25)
needle-and-thread (<i>Hesperostipa comata</i>)	12% (1 – 23)	pasture sage (<i>Artemisia frigida</i>)	12% (1 – 29)
june grass (<i>Koeleria macrantha</i>)	7% (0 – 13)	hairy golden-aster (<i>Heterotheca villosa</i>)	5% (0 – 15)
sedge (<i>Carex spp.</i>)	6% (0 – 16)	goldenrod (<i>Solidago spp.</i>)	2% (0 – 5)
northern wheat-grass (<i>Elymus lanceolatus</i>)	3% (0 – 8)	plains wormwood (<i>Artemisia campestris</i>)	1% (0 – 2)
sand dropseed (<i>Sporobolus cryptandrus</i>)	2% (0 – 5)	golden bean (<i>Thermopsis rhombifolia</i>)	1% (0 – 2)
blue grama (<i>Bouteloua gracilis</i>)	1% (0 – 4)	pale comandra (<i>Comandra umbellata</i>)	1% (0 – 2)
sand dune wheat-grass (<i>Elymus lanceolatus</i> var. <i>psammophilum</i>)	1% (0 – 4)	absinthe (<i>Artemisia absinthium</i>)	1% (0 – 3)
fringed brome (<i>Bromus ciliatus</i>)	1% (0 – 0)		
smooth brome (<i>Bromus inermis</i>)	1% (0 – 0)		
SIMILARITY TO REF. COMM. unknown		Minor shrubs (% biomass) 1%	
		Minor graminoids (% biomass) 1%	
		Minor forbs (% biomass) 5%	
RECOMMENDED STOCKING RATE		0.42 AUM/ha	0.17 AUM/ac

MG-DN-E

Creeping Juniper / Sedge – Sand Grass

Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Prostrate shrub community found on both Low Dunes and High Dunes Ecosites. Occurs on the same microsites as grassland types (e.g. MG-DN-A). Creeping juniper spreads into grassland in the absence of fire, reducing the cover and productivity of grasses, while fire kills the juniper and restores the grassland community. Rhizomatous graminoids such as blunt sedge and sand grass appear to be more successful than bunchgrasses at growing up through the juniper mat. Status in relation to grazing impact is unclear. Productivity for livestock grazing varies from none in dense juniper stands to low in more open stands. However, juniper provides valuable winter deer browse.

STRUCTURE

short shrub cover (n=18)	3% (0 – 5)	clubmoss cover (n=18)	3% (0 – 9)
prostrate shrub cover (n=18)	48% (23 – 70)	lichen cover (n=4)	2% (1 – 3)
cactus cover (n=18)	1% (0 – 2)	litter cover (n=4)	9% (3 – 15)
herbaceous cover (n=18)	15% (6 – 30)	bare soil (n=4)	4% (0 – 11)

SPECIES COMPOSITION (n=18)

Major short shrubs (% foliar cover)		Major prostrate shrubs (% foliar cover)	
wolf-willow (<i>Elaeagnus commutata</i>)	1% (0 - 3)	creeping juniper (<i>Juniperus horizontalis</i>)	39% (17 - 67)
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 - 4)	common bearberry (<i>Arctostaphylos uva-ursi</i>)	9% (0 - 26)
Major graminoids (% biomass)		Major forbs and half-shrubs (% biomass)	
sand-grass (<i>Calamovilfa longifolia</i>)	17% (0 - 31)	lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	10% (0 - 30)
blunt sedge (<i>Carex obtusata</i>)	12% (0 - 30)	golden bean (<i>Thermopsis rhombifolia</i>)	8% (0 - 20)
sun-loving sedge (<i>Carex inops</i>)	9% (2 - 17)	pasture sage (<i>Artemisia frigida</i>)	5% (0 - 12)
June grass (<i>Koeleria macrantha</i>)	5% (0 - 10)	purple prairie-clover (<i>Dalea purpurea</i> var. <i>purpurea</i>)	3% (0 - 1)
needle-and-thread (<i>Hesperostipa comata</i>)	5% (0 - 16)	goldenrod (<i>Solidago</i> spp.)	2% (0 - 5)
hay sedge (<i>Carex siccata</i>)	4% (0 - 14)	bastard toadflax (<i>Comandra umbellata</i> ssp. <i>pallida</i>)	2% (0 - 8)
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	3% (0 - 6)	American vetch (<i>Vicia americana</i>)	1% (0 - 5)
sand-dune wheat-grass (<i>Elymus lanceolatus</i> ssp. <i>psammophilus</i>)	2% (0 - 6)	prairie sage (<i>Artemisia ludoviciana</i>)	1% (0 - 3)
northern wheat-grass (<i>Elymus lanceolatus</i>)	2% (0 - 7)	wild bergamot (<i>Monarda fistulosa</i>)	1% (0 - 2)
sand dropseed (<i>Sporobolus cryptandrus</i>)	1% (0 - 3)	hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 2)
plains reed-grass (<i>Calamagrostis montanensis</i>)	1% (0 - 2)	dotted blazing-star (<i>Liatris punctata</i>)	1% (0 - 2)
Minor cactus (% foliar cover)	1%	northern bedstraw (<i>Galium boreale</i>)	1% (0 - 2)
Minor graminoids (% biomass)	2%	REC. STOCKING RATE none to low	
Minor forbs (% biomass)	4%		

MG-DN-F
Aspen / Choke-cherry / Snowberry / Sedge
Mixed Grassland: Dunes Ecosite

GENERAL DESCRIPTION: Open aspen stands on Dunes Ecosite in the Mixed Grassland Ecoregion. These stands are usually found on inter-dune depressions. The community as described is probably close to the **reference community** for this ecosite, although stands with less grazing impact could have higher cover of choke-cherry and saskatoon.

STRUCTURE

tree cover (n=8)	37% (22 - 55)	prostrate shrub cover (n=8)	16% (5 - 28)
tall shrub cover (n=8)	13% (4 - 21)	herbaceous cover (n=11)	22% (15 - 31)
short shrub cover (n=8)	36% (25 - 45)	litter cover (n=3)	78% (67 - 85)

SPECIES COMPOSITION (n=11)

Major trees (% foliar cover)		Major short shrubs (% foliar cover)	
trembling aspen (<i>Populus tremuloides</i>)	30% (15 - 43)	western snowberry (<i>Symphoricarpos occidentalis</i>)	11% (0 - 26)
Major tall shrubs (% foliar cover)		rose (<i>Rosa</i> spp.)	8% (2 - 17)
choke-cherry (<i>Prunus virginiana</i>)	11% (1 - 22)	northern snowberry (<i>Symphoricarpos albus</i>)	1% (0 - 2)
saskatoon (<i>Amelanchier alnifolia</i>)	5% (0 - 15)	Major prostrate shrubs (% foliar cover)	
twining honeysuckle (<i>Lonicera dioica</i>)	1% (0 - 1)	common bearberry (<i>Arctostaphylos uva-ursi</i>)	7% (0 - 21)
Major graminoids (% biomass)		creeping juniper (<i>Juniperus horizontalis</i>)	5% (0 - 13)
hay sedge (<i>Carex siccata</i>)	30% (10 - 54)	Major forbs and half-shrubs (% biomass)	
blunt sedge (<i>Carex obtusata</i>)	21% (8 - 29)	golden bean (<i>Thermopsis rhombifolia</i>)	6% (0 - 21)
sand-grass (<i>Calamovilfa longifolia</i>)	8% (0 - 20)	northern bedstraw (<i>Galium boreale</i>)	6% (0 - 13)
sun-loving sedge (<i>Carex inops</i>)	5% (0 - 6)	cream-colored vetchling (<i>Lathyrus ochroleucus</i>)	4% (0 - 6)
needle-and-thread (<i>Hesperostipa comata</i>)	2% (0 - 2)	star-flowered solomon's-seal (<i>Maianthemum stellatum</i>)	2% (0 - 5)
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	2% (0 - 4)	bastard toadflax (<i>Comandra umbellata</i> ssp. <i>pallida</i>)	1% (0 - 3)
plains rough fescue (<i>Festuca altaica</i> ssp. <i>hallii</i>)	1% (0 - 0)	lance-leaved psoralea (<i>Psoralidium lanceolatum</i>)	1% (0 - 2)
western porcupine-grass (<i>Hesperostipa curtiseta</i>)	1% (0 - 0)	hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 1)
June grass (<i>Koeleria macrantha</i>)	1% (0 - 2)	goldenrod (<i>Solidago</i> spp.)	1% (0 - 2)
Canada wild-rye (<i>Elymus canadensis</i>)	1% (0 - 0)	horsetail (<i>Equisetum</i> spp.)	1% (0 - 1)
northern reed-grass (<i>Calamagrostis stricta</i> ssp. <i>inexpansa</i>)	1% (0 - 1)	smooth blue aster (<i>Symphyotrichum laeve</i>)	1% (0 - 2)
Minor graminoids (% biomass)		Minor forbs (% biomass)	
3%		3%	

RECOMMENDED STOCKING RATE	0.32 AUM/ha	0.13 AUM/ac
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AP-DN-A

Sedge - Sand Grass - Needle-and-thread

Aspen Parkland: Dunes Ecosite

GENERAL DESCRIPTION: Mixed prairie dominated by midgrasses, with significant amounts of shortgrasses and lesser amounts of forbs and half-shrubs. Usually with some cover of short and prostrate shrubs. Probably shows **moderate alteration** as a result of grazing impact, but more research is needed on reference community composition on Dunes in the Aspen Parkland.

STRUCTURE

herbaceous cover (n=14)	29% (4 – 57)	tall shrub cover (n=12)	1% (0 – 3)
- midgrasses	approx. 20%	short shrub cover (n=12)	1% (0 – 3)
- shortgrasses	approx. 5%	prostrate shrub cover (n=12)	8% (0 – 15)
- half-shrubs	approx. 1%	clubmoss cover (n=12)	5% (0 – 15)
- forbs	approx. 3%		

SPECIES COMPOSITION

% biomass (n=6)

% foliar cover (n=12)

Major shrubs		
choke-cherry (<i>Prunus virginiana</i>)	0% (0 - 0)	1% (0 - 3)

Major prostrate shrubs		
creeping juniper (<i>Juniperus horizontalis</i>)		4% (0 – 15)
bearberry (<i>Arctostaphylos uva-ursi</i>)		2% (0 – 6)

Major graminoids		
sedge (<i>Carex spp.</i>)	26% (20 - 33)	6% (0 - 8)
needle-and-thread (<i>Hesperostipa comata</i>)	7% (2 - 15)	4% (0 - 15)
sand grass (<i>Calamovilfa longifolia</i>)	11% (3 - 18)	4% (0 - 14)
plains rough fescue (<i>Festuca altaica</i> var. <i>hallii</i>)	6% (0 - 12)	3% (0 - 2)
western wheat-grass (<i>Pascopyrum smithii</i>)	4% (0 - 11)	2% (0 - 3)
blue grama (<i>Bouteloua gracilis</i>)	6% (0 - 18)	1% (0 - 2)
sand dropseed (<i>Sporobolus cryptandrus</i>)	3% (0 - 10)	1% (0 - 3)
june grass (<i>Koeleria macrantha</i>)	5% (0 - 9)	1% (0 - 3)
western porcupine-grass (<i>Hesperostipa curtiseta</i>)	9% (0 - 23)	
Hooker's oat-grass (<i>Avenula hookeri</i>)	1% (0 - 2)	
Rocky Mountain fescue (<i>Festuca saximontana</i>)	4% (0 - 11)	
Kentucky blue-grass (<i>Poa pratensis</i>)	2% (0 - 7)	
slender wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>)	1% (0 - 3)	

Major forbs and half-shrubs		
pasture sage (<i>Artemisia frigida</i>)	4% (0 - 6)	2% (0 - 3)
hairy golden-aster (<i>Heterotheca villosa</i>)	2% (0 - 5)	
wild licorice (<i>Glycyrrhiza lepidota</i>)	2% (0 - 5)	
horsetail (<i>Equisetum spp.</i>)	1% (0 - 4)	
plains wormwood (<i>Artemisia campestris</i>)	1% (0 - 4)	
golden bean (<i>Thermopsis rhombifolia</i>)	1% (0 - 3)	
field chickweed (<i>Cerastium arvense</i>)	1% (0 - 3)	
harebell (<i>Campanula rotundifolia</i>)	1% (0 - 2)	

Minor shrubs		1%
Minor graminoids		1%
Minor forbs and half-shrubs	2%	2%

SIMILARITY TO REFERENCE COMMUNITY	unknown
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RECOMMENDED STOCKING RATE		
drier part of region	0.64 AUM/ha	0.26 AUM/ac
moister part of region	0.98 AUM/ha	0.40 AUM/ac



AP-DN-B

Sedge - Pasture Sage - June Grass

Aspen Parkland: Dunes Ecosite

GENERAL DESCRIPTION: Mixed prairie dominated by shortgrasses, with significant amounts of midgrasses and forbs, and lesser amounts of half-shrubs. Usually with some cover of short and prostrate shrubs. Probably shows **significant alteration** as a result of grazing impact, but more research is needed on reference community composition on stabilized dunes in the Aspen Parkland. Probably develops from AP-DN-A by increase of sedges and pasture sage.

STRUCTURE

tall shrub cover (n=20)	1% (0 – 3)	short shrub cover (n=20)	2% (0 – 4)
herbaceous cover (n=28)	40% (18 – 62)	prostrate shrub cover (n=20)	2% (0 – 15)
- midgrasses	approx. 10%	clubmoss cover (n=20)	9% (0 – 15)
- shortgrasses	approx. 15%	lichen cover (n=9)	2% (0 – 2)
- half-shrubs	approx. 5%	litter cover (n=17)	27% (13 – 49)
- forbs	approx. 10%	bare soil (n=17)	12% (3 – 17)

SPECIES COMPOSITION

% biomass (n=17)

% foliar cover (n=11)

Major short shrubs		
rose (<i>Rosa spp.</i>)	3% (0 - 8)	
western snowberry (<i>Symphoricarpos occidentalis</i>)	1% (0 - 2)	
wolf-willow (<i>Elaeagnus commutata</i>)	0% (0 - 0)	1% (0 - 0)

Major prostrate shrubs

creeping juniper (<i>Juniperus horizontalis</i>)	1% (0 – 3)
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Major graminoids

sedge (<i>Carex spp.</i>)	21% (14 - 27)	18% (5 - 33)
june grass (<i>Koeleria macrantha</i>)	9% (4 - 13)	1% (0 - 3)
sand grass (<i>Calamovilfa longifolia</i>)	7% (1 - 13)	2% (0 - 3)
needle-and-thread (<i>Hesperostipa comata</i>)	7% (3 - 11)	2% (0 - 3)
Rocky Mountain fescue (<i>Festuca saximontana</i>)	4% (0 - 8)	2% (0 - 3)
blue grama (<i>Bouteloua gracilis</i>)	4% (0 - 11)	2% (0 - 3)
plains rough fescue (<i>Festuca altaica</i> var. <i>hallii</i>)	2% (0 - 6)	
western wheat-grass (<i>Pascopyrum smithii</i>)	2% (0 - 5)	
plains reed grass (<i>Calamagrostis montanensis</i>)	2% (0 - 4)	
western porcupine-grass (<i>Hesperostipa curtisetata</i>)	1% (0 - 3)	
baltic rush (<i>Juncus arcticus</i> var. <i>balticus</i>)	1% (0 - 1)	
northern wheat-grass (<i>Elymus lanceolatus</i>)	1% (0 - 2)	
northern reed grass (<i>Calamagrostis stricta</i> ssp. <i>inexpansa</i>)	1% (0 - 0)	

Major forbs and half-shrubs		
pasture sage (<i>Artemisia frigida</i>)	11% (4 - 16)	2% (0 - 3)
field chickweed (<i>Cerastium arvense</i>)	4% (1 - 8)	
golden bean (<i>Thermopsis rhombifolia</i>)	4% (0 - 10)	
hairy golden-aster (<i>Heterotheca villosa</i>)	2% (0 - 6)	
low goldenrod (<i>Solidago missouriensis</i>)	2% (0 - 5)	
horsetail (<i>Equisetum spp.</i>)	2% (0 - 4)	
crocus anemone (<i>Pulsatilla patens</i>)	1% (0 - 3)	
prairie sage (<i>Artemisia ludoviciana</i>)	1% (0 - 2)	
three-flowered avens (<i>Geum triflorum</i>)	1% (0 - 2)	
pale comandra (<i>Comandra umbellata</i>)	1% (0 - 2)	
everlasting (<i>Antennaria spp.</i>)	1% (0 - 2)	
fleabane (<i>Erigeron spp.</i>)	1% (0 - 1)	

Minor graminoids	1%	2%
Minor forbs and half-shrubs	5%	1%

SIMILARITY TO REFERENCE COMMUNITY	unknown
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RECOMMENDED STOCKING RATE		
drier part of region	0.48 AUM/ha	0.19 AUM/ac
moister part of region	0.73 AUM/ha	0.30 AUM/ac

AP-DN-C

Creeping Juniper / Sedge

Aspen Parkland: Dunes Ecosite

GENERAL DESCRIPTION: Prostrate shrub/grassland community found on both Low Dunes and High Dunes Ecosites. Occurs on the same microsites as grassland types (e.g. AP-DN-A). Creeping juniper spreads into grassland in the absence of fire, reducing the cover and productivity of grasses, while fire kills the juniper and restores the grassland community. However, recent wind erosion also appears to play a role in occurrence of the juniper type in the Aspen Parkland, where grass growth on stable surfaces is dense enough to shade out juniper. Status in relation to grazing impact is unclear. Productivity for livestock grazing ranges from none in dense juniper stands to low in more open stands. However, juniper provides valuable winter deer browse.

STRUCTURE

tall shrub cover (n=36)	1% (0 – 3)	clubmoss cover (n=36)	3% (0 – 3)
short shrub cover (n=36)	1% (0 – 2)	lichen cover (n=22)	1% (0 – 3)
prostrate shrub cover (n=36)	54% (29 – 74)	litter cover (n=22)	27% (15 – 60)
herbaceous cover (n=36)	15% (3 – 38)	bare soil (n=22)	1% (0 – 1)

SPECIES COMPOSITION

Major tall shrubs (% foliar cover, n=36)		Major prostrate shrubs (% foliar cover, n=36)	
choke-cherry (<i>Prunus virginiana</i>)	1% (0 – 3)	creeping juniper (<i>Juniperus horizontalis</i>)	52% (15 – 74)
		common bearberry (<i>Arctostaphylos uva-ursi</i>)	2% (0 – 4)

Major graminoids (% biomass, n=24)

sun-loving sedge (<i>Carex inops</i>)	13% (3 – 24)	plains reed-grass (<i>Calamagrostis montanensis</i>)	1% (0 – 2)
blunt sedge (<i>Carex obtusata</i>)	12% (4 – 20)	western porcupine-grass (<i>Hesperostipa curtipendula</i>)	1% (0 – 4)
northern wheat-grass (<i>Elymus lanceolatus</i>)	8% (0 – 21)	Rocky Mountain fescue (<i>Festuca saximontana</i>)	1% (0 – 3)
sand-grass (<i>Calamovilfa longifolia</i>)	7% (0 – 16)	thread-leaf sedge (<i>Carex filifolia</i>)	1% (0 – 4)
plains rough fescue (<i>Festuca altaica</i> ssp. <i>hallii</i>)	5% (0 – 18)	low sedge (<i>Carex duriuscula</i>)	1% (0 – 2)
June grass (<i>Koeleria macrantha</i>)	4% (0 – 11)	Hooker's oat-grass (<i>Avenula hookeri</i>)	1% (0 – 3)
needle-and-thread (<i>Hesperostipa comata</i>)	2% (0 – 5)	western wheat-grass (<i>Pascopyrum smithii</i>)	1% (0 – 3)
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	2% (0 – 6)	plains reed-grass (<i>Calamagrostis montanensis</i>)	1% (0 – 2)
false melic grass (<i>Schizachne purpurascens</i>)	2% (0 – 0)	western porcupine-grass (<i>Hesperostipa curtipendula</i>)	1% (0 – 4)
hay sedge (<i>Carex siccata</i>)	1% (0 – 5)	Rocky Mountain fescue (<i>Festuca saximontana</i>)	1% (0 – 3)
Hooker's oat-grass (<i>Avenula hookeri</i>)	1% (0 – 3)	thread-leaf sedge (<i>Carex filifolia</i>)	1% (0 – 4)
western wheat-grass (<i>Pascopyrum smithii</i>)	1% (0 – 3)	low sedge (<i>Carex duriuscula</i>)	1% (0 – 2)

Major forbs and half-shrubs (% biomass, n=24)

pasture sage (<i>Artemisia frigida</i>)	7% (0 - 12)	bastard toadflax (<i>Comandra umbellata</i> ssp. <i>pallida</i>)	1% (0 - 4)
northern bedstraw (<i>Galium boreale</i>)	4% (0 - 13)	prairie crocus (<i>Pulsatilla patens</i>)	1% (0 - 4)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	3% (0 - 12)	silvery groundsel (<i>Packera cana</i>)	1% (0 - 3)
goldenrod (<i>Solidago</i> spp.)	2% (0 - 4)	purple prairie-clover (<i>Dalea purpurea</i> var. <i>purpurea</i>)	1% (0 - 4)
golden bean (<i>Thermopsis rhombifolia</i>)	2% (0 - 9)	tall scouring-rush (<i>Equisetum hyemale</i>)	1% (0 - 3)
American vetch (<i>Vicia americana</i>)	2% (0 - 4)	field chickweed (<i>Cerastium arvense</i>)	1% (0 - 1)
star-flowered solomon's-seal (<i>Maianthemum stellatum</i>)	2% (0 - 4)	hairy golden-aster (<i>Heterotheca villosa</i>)	1% (0 - 3)
Rocky Mountain locoweed (<i>Oxytropis sericea</i>)	1% (0 - 4)	harebell (<i>Campanula rotundifolia</i>)	1% (0 - 1)

Minor short shrubs (% foliar cover)	1%
Minor graminoids (% biomass)	2%
Minor forbs and half-shrubs (% biomass)	4%

SIMILARITY TO REFERENCE COMMUNITY	unknown
RECOMMENDED STOCKING RATE	none to low

PEZ-DN-A
Choke-cherry / Sedge
 Prairie Ecozone: Dunes Ecosite

GENERAL DESCRIPTION: The predominant tall shrub community on the Dunes Ecosite throughout the Prairie Ecozone, often occurring on the north-facing slopes of dunes. It may also appear as a short shrub community where the dominant choke-cherry has not reached its full height potential. This description is based on data from both Mixed Grassland and Aspen Parkland. It is probably close to the **reference community** for this cover type and ecosite. It supports some grassy forage that is used by cattle, but is most valuable as a source of browse used by both livestock and wild ungulates..

STRUCTURE

tree cover (n=25)	1% (0 - 3)	herbaceous cover (n=25)	27% (15 - 38)
tall shrub cover (n=25)	27% (16 - 41)	lichen cover (n=11)	0% (0 - 1)
short shrub cover (n=12)	5% (1 - 10)	litter cover (n=11)	66% (38 - 85)
prostrate shrub cover (n=25)	6% (0 - 16)	bare soil (n=11)	2% (0 - 1)

SPECIES COMPOSITION (n=25)

Major trees (% foliar cover)		Major tall shrubs (% foliar cover)	
trembling aspen (<i>Populus tremuloides</i>)	1% (0 - 2)	choke-cherry (<i>Prunus virginiana</i>)	19% (8 - 36)
		saskatoon (<i>Amelanchier alnifolia</i>)	3% (0 - 8)
Major short shrubs (% foliar cover)		Major prostrate shrubs (% foliar cover)	
western snowberry (<i>Symphoricarpos occidentalis</i>)	3% (0 - 7)	creeping juniper (<i>Juniperus horizontalis</i>)	4% (0 - 14)
rose (<i>Rosa</i> spp.)	3% (0 - 6)	common bearberry (<i>Arctostaphylos uva-ursi</i>)	2% (0 - 7)

Major graminoids (% biomass)

blunt sedge (<i>Carex obtusata</i>)	15% (2 - 27)	northern wheat-grass (<i>Elymus lanceolatus</i>)	1% (0 - 3)
hay sedge (<i>Carex siccata</i>)	14% (1 - 34)	blue-grass (<i>Poa</i> spp.)	1% (0 - 3)
sun-loving sedge (<i>Carex inops</i>)	9% (4 - 15)	smooth brome (<i>Bromus inermis</i>)	1% (0 - 4)
sand-grass (<i>Calamovilfa longifolia</i>)	8% (1 - 15)	western porcupine-grass (<i>Hesperostipa curtipetala</i>)	1% (0 - 1)
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	2% (0 - 7)	rough-leaved rice-grass (<i>Oryzopsis asperifolia</i>)	1% (0 - 3)
needle-and-thread (<i>Hesperostipa comata</i>)	2% (0 - 6)	western wheat-grass (<i>Pascopyrum smithii</i>)	1% (0 - 1)
plains reed-grass (<i>Calamagrostis montanensis</i>)	1% (0 - 4)	June grass (<i>Koeleria macrantha</i>)	1% (0 - 2)
little-seed rice-grass (<i>Piptatherum micranthum</i>)	1% (0 - 2)		

Major forbs and half-shrubs (% biomass)

golden bean (<i>Thermopsis rhombifolia</i>)	9% (0 - 25)
star-flowered solomon's-seal (<i>Maianthemum stellatum</i>)	7% (0 - 17)
northern bedstraw (<i>Galium boreale</i>)	5% (0 - 18)
goldenrod (<i>Solidago</i> spp.)	2% (0 - 5)
pasture sage (<i>Artemisia frigida</i>)	2% (0 - 6)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	1% (0 - 5)
cream-colored vetchling (<i>Lathyrus ochroleucus</i>)	1% (0 - 4)
wild bergamot (<i>Monarda fistulosa</i>)	1% (0 - 2)
smooth blue aster (<i>Symphyotrichum laeve</i>)	1% (0 - 3)
American vetch (<i>Vicia americana</i>)	1% (0 - 2)
horseweed (<i>Conyza canadensis</i>)	1% (0 - 1)
field chickweed (<i>Cerastium arvense</i>)	1% (0 - 2)

Minor short shrubs (% foliar cover)	1%
Minor graminoids (% biomass)	3%
Minor forbs and half-shrubs (% biomass)	5%

SIMILARITY TO REFERENCE COMMUNITY	reference community	
RECOMMENDED STOCKING RATE	0.26 AUM/ha	0.11 AUM/ac

PEZ-DN-B
Western Snowberry / Needle-and-thread – Sedge
 Prairie Ecozone: Dunes Ecosite

GENERAL DESCRIPTION: The predominant short shrub community on the Dunes Ecosite throughout the Prairie Ecozone. This description is based on data from Aspen Parkland, Mixed Grassland, and Dry Mixed Grassland, as the data were insufficient to define separate types for each ecoregion. This community encompasses a range of variation in dominant shrubs, from snowberry stands with no rose, to snowberry-rose mixtures, to occasional stands dominated by rose. The community would probably be considered a **reference community** for this cover type in the Dry Mixed Grassland. In the Mixed Grassland, lightly grazed stands would be expected to have more Western Porcupine-grass, while in the Aspen Parkland, such stands would have more Plains Rough Fescue. This community supports some grassy forage that is used by cattle, but is most valuable as habitat for wildlife requiring short shrubs.

STRUCTURE

tall shrub cover (n=16)	1% (0 - 1)	clubmoss cover (n=15)	1% (0 - 1)
short shrub cover (n=16)	28% (15 - 44)	moss cover (n=14)	0% (0 - 1)
prostrate shrub cover (n=16)	2% (0 - 3)	litter cover (n=10)	50% (35 - 65)
herbaceous cover (n=16)	28% (7 - 63)	bare soil (n=10)	6% (0 - 17)

SPECIES COMPOSITION (n=16)

Major short shrubs (% foliar cover)		Major tall shrubs (% foliar cover)	
western snowberry (<i>Symphoricarpos occidentalis</i>)	20% (0 - 35)	choke-cherry (<i>Prunus virginiana</i>)	2% (0 - 7)
rose (<i>Rosa</i> spp.)	6% (1 - 16)		
wolf-willow (<i>Elaeagnus commutata</i>)	1% (0 - 2)	Major prostrate shrubs (% foliar cover)	
		creeping juniper (<i>Juniperus horizontalis</i>)	1% (0 - 3)

Major graminoids (% biomass)

needle-and-thread (<i>Hesperostipa comata</i>)	14% (2 - 42)	sand dropseed (<i>Sporobolus cryptandrus</i>)	2% (0 - 5)
blunt sedge (<i>Carex obtusata</i>)	10% (0 - 20)	graceful sedge (<i>Carex praegracilis</i>)	2% (0 - 4)
sun-loving sedge (<i>Carex inops</i>)	8% (0 - 15)	western porcupine-grass (<i>Hesperostipa curtiseta</i>)	2% (0 - 7)
sand grass (<i>Calamovilfa longifolia</i>)	7% (0 - 17)	plains rough fescue (<i>Festuca altaica</i> ssp. <i>hallii</i>)	2% (0 - 4)
hay sedge (<i>Carex siccata</i>)	6% (0 - 18)	northern wheat-grass (<i>Elymus lanceolatus</i>)	1% (0 - 4)
June grass (<i>Koeleria macrantha</i>)	4% (0 - 13)	blue grama (<i>Bouteloua gracilis</i>)	1% (0 - 3)
awned wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i>)	3% (0 - 8)	false melic grass (<i>Schizachne purpurascens</i>)	1% (0 - 0)
little-seed rice-grass (<i>Piptatherum micranthum</i>)	3% (0 - 0)	plains reed-grass (<i>Calamagrostis montanensis</i>)	1% (0 - 4)
slender wheat-grass (<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>)	3% (0 - 11)	low sedge (<i>Carex duriuscula</i>)	1% (0 - 5)
western wheat-grass (<i>Pascopyrum smithii</i>)	2% (0 - 8)	sand-dune wheat-grass (<i>Elymus lanceolatus</i> ssp. <i>psammophilus</i>)	1% (0 - 3)
Canada wild-rye (<i>Elymus canadensis</i>)	2% (0 - 3)	Canada blue-grass (<i>Poa compressa</i>)	1% (0 - 0)

Major forbs and half-shrubs (% biomass)

pasture sage (<i>Artemisia frigida</i>)	4% (0 - 12)	goldenrod (<i>Solidago</i> spp.)	1% (0 - 3)
hairy golden-aster (<i>Heterotheca villosa</i>)	3% (0 - 11)	star-flowered solomon's-seal (<i>Maianthemum stellatum</i>)	1% (0 - 1)
lance-leaved psoralea (<i>Psoraleidium lanceolatum</i>)	2% (0 - 6)	prairie sage (<i>Artemisia ludoviciana</i>)	1% (0 - 2)
northern bedstraw (<i>Galium boreale</i>)	1% (0 - 6)	tall scouring-rush (<i>Equisetum hyemale</i>)	1% (0 - 1)
golden bean (<i>Thermopsis rhombifolia</i>)	1% (0 - 4)	rush skeleton-weed (<i>Lygodesmia juncea</i>)	1% (0 - 1)

Minor graminoids (% biomass)	2% (0 - 0)
Minor forbs and half-shrubs (% biomass)	5% (0 - 0)

SIMILARITY TO REFERENCE COMMUNITY	unknown
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RECOMMENDED STOCKING RATE	0.26 AUM/ha	0.11 AUM/ac
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