

Rigid Sagebrush Scabland Site: Herbage Dominance and Production

This site was selected in 1960 on which to measure vegetation and soil characteristics for developing range condition guides (USDA FS 1963). It is located on the Lookout Mountain District, Ochoco National Forest on the east edge of Big Summit Prairie shown in the background below left. All sampling was done between August 1 and 4 each year from 1977 to the present.



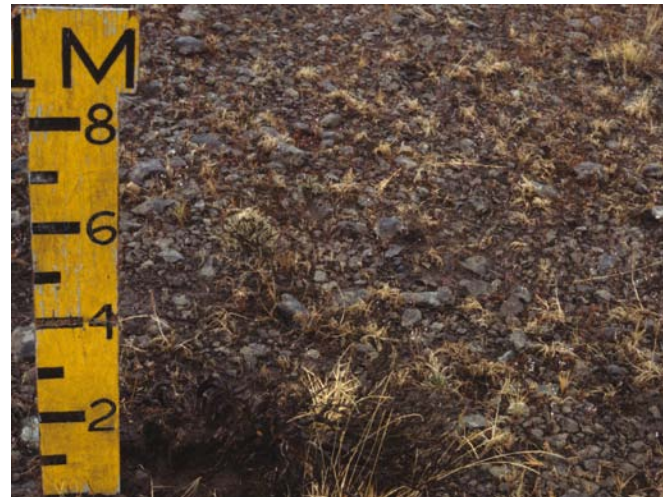
1960: The rigid sagebrush scabland site sampled for range condition guides. It is located within the forest zone supporting ponderosa pine, Douglas-fir and grand fir. Scabland is characterized by very shallow soils shown at the right, which preclude tree establishment.



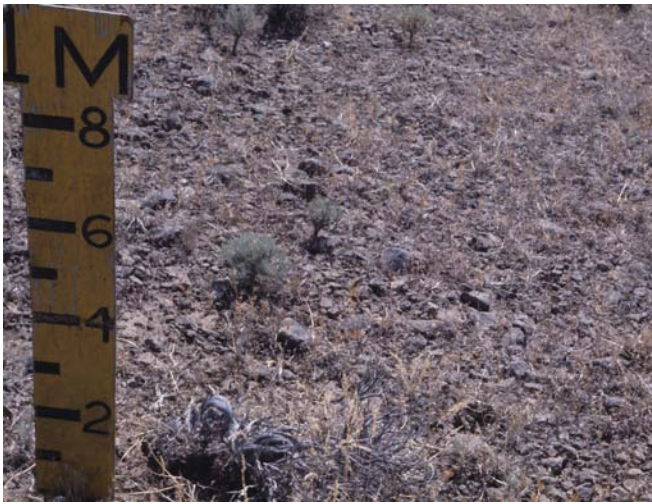
Soil is derived from recent andesite lava flows, and is characteristically only 1.5 to 3 dm deep. Precipitation is enough to cause water logging during much of the winter, which limits plant community diversity.



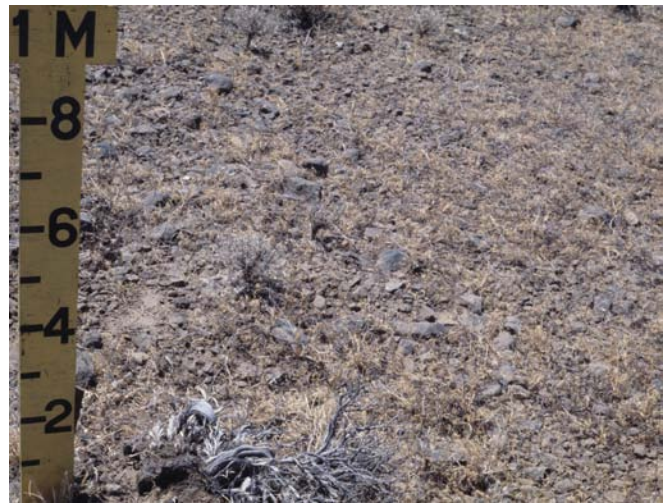
1977: The site at the start of herbage production sampling. It is characterized by a desert pavement of gravel and rigid sagebrush, Sandberg bluegrass, pipe clover, and oatgrass, all capable of surviving saturated soils and frost heaving. Site characteristics are shown at the end of this section. Images were not available for 1986 and 1988.



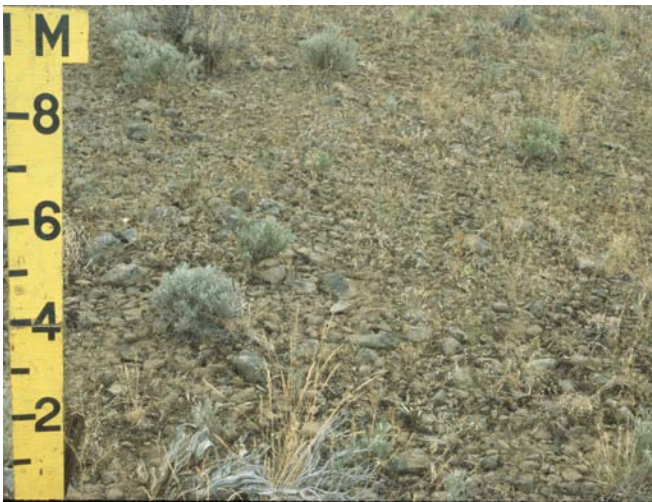
1977: 80 percent seedheads; percent cover: bluegrass 10, pipe clover 6, lomatium 7, oatgrass 6, rigid sage 4; herbage production 150 kg/ha.



1978: 40 percent seedheads; percent cover: bluegrass 10, pipe clover 5, lomatium 8, oatgrass 5, sagebrush 5; herbage production 125 kg/ha.



1979: No seedheads; percent cover: bluegrass 10, pipe clover 4, lomatium 7, oatgrass 4, sagebrush 6; herbage production 125 kg/ha.



1982: 80 percent seedheads; percent cover: bluegrass 10, pipe clover 5, lomatium 6, oatgrass 6, wheatgrass 3, sagebrush 7; herbage production 200 kg/ha.



1983: 100 percent seedheads; percent cover: bluegrass 12, pipe clover 6, lomatium 6, oatgrass 7, wheatgrass 3, sagebrush 7; herbage production 125 kg/ha.



1987: No seedheads; percent cover: bluegrass 9, pipe clover 4, lomatium 6, oatgrass 6, wheatgrass 1, sagebrush 9; herbage production 125 kg/ha.



1989: No seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 5, oatgrass 4, wheatgrass 1, sagebrush 9; herbage production 125 kg/ha.



1980: No seedheads; percent cover: bluegrass 8, pipe clover 4, lomatium 6, oatgrass 4, sagebrush 6; herbage production 100 kg/ha



1981: 50 percent seedheads; percent cover: bluegrass 8, pipe clover 4, lomatium 6, oatgrass 6, sagebrush 6; herbage production 175 kg/ha.



1984: 100 percent seedheads; percent cover: bluegrass 12, pipe clover 6, lomatium 8, oatgrass 7, wheatgrass 3, sagebrush 8, herbage production 200 kg/ha.



1985: 80 percent seedheads; percent cover: bluegrass 10, pipe clover 4, lomatium 9, oatgrass 6, sagebrush 8; herbage production 125 kg/ha.



1990: No seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 4, oatgrass 4, wheatgrass 1, sagebrush 9; herbage production 125 kg/ha.



1991: No seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 4, oatgrass 3, wheatgrass 1, sagebrush 9; herbage production 100 kg/ha.



1992: 30 percent seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 4, oatgrass 3, wheatgrass 2, sagebrush 9; herbage production 170 kg/ha.



1993: 70 percent seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 3, oatgrass 3, wheatgrass 1, sagebrush 10; herbage production 110 kg/ha.



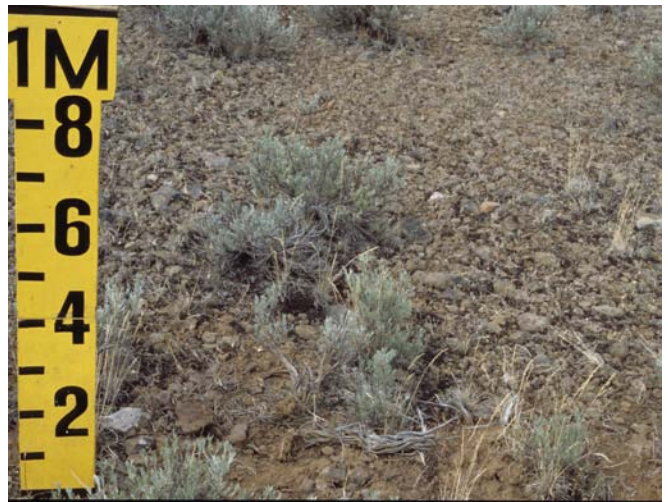
1996: 50 percent seedheads; percent cover: bluegrass 8, pipe clover 3, lomatium 4, oatgrass 3, sagebrush 10; herbage production 75 kg/ha.



1997: 50 percent seedheads; percent cover: bluegrass 8, pipe clover 3, lomatium 3, oatgrass 3, sagebrush 11; herbage production 150 kg/ha.



2000: No seedheads; percent cover: bluegrass 5, pipe clover 2, lomatium 2, oatgrass 2, sagebrush 12; herbage production 75 kg/ha.



2001: 80 percent seedheads; percent cover: bluegrass 5, pipe clover 2, lomatium 2, oatgrass 2, sagebrush 12; herbage production 100 kg/ha.



1994: No seedheads; percent cover: bluegrass 9, pipe clover 4, lomatium 4, oatgrass 3, wheatgrass 1, sagebrush 10; herbage production 150 kg/ha.



1995: 20 percent seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 3, oatgrass 3, wheatgrass 1, sagebrush 10; herbage production 125 kg/ha.



1998: 30 percent seedheads; percent cover: bluegrass 9, pipe clover 3, lomatium 3, oatgrass 3, sagebrush 11; herbage production 125 kg/ha.



1999: No seedheads; percent cover: bluegrass 8, pipe clover 2, lomatium 2, oatgrass 3, sagebrush 11; herbage production 100 kg/ha.



2002: No seedheads; percent cover: bluegrass 6, pipe clover 2, lomatium 2, oatgrass 2, sagebrush 12; herbage production 100 kg/ha.



2003: No seedheads; percent cover: bluegrass 6, pipe clover 2, lomatium 2, oatgrass 2, sagebrush 13; herbage production 100 kg/ha.



2005: The rigid sagebrush scabland after 27 years. Rigid sagebrush seems a little denser, and the pines in the background have grown. This is what “80 percent seedheads” looks like!



2005: 80 percent seedheads; percent cover: bluegrass 9, pipe clover 4, lomatium 3, oatgrass 3, sagebrush 12; herbage production 125 kg/ha.

Comments

Over a 27-year period (table 4-045EPF-rigid sagebrush/scabland):

- Seedheads, limited primarily to bluegrass, were produced only 59 percent of the time. Lack of abundant seedheads over the years suggests a plant community in near maximum competition and thus full occupancy of the site. Pellant et al. (2005), on the other hand, considered seedhead production one criteria for evaluating rangeland health. These data suggest it should be used with caution.
- Herbage production varied from 75 to 225 kg/ha averaging 131 kg/ha, a threefold difference. A crude estimation of herbage production may be obtained by multiplying herbage cover by a factor of 6.3. For the 2005 example above: $9 + 4 + 3 + 3 = 19$; $19 \times 6.3 = 120$ kg/ha. Sagebrush cover is not counted as herbage. Pellant et al. (2005) considered production as another element in evaluating rangeland health. Again it should be used with caution.
- All herbaceous vegetation was dry by August 1. Shallow soil and lack of precipitation after the middle of June preclude active growth. However, the deciduous rigid sagebrush is quite palatable to deer, elk, cattle, and sheep. Note the hedged appearance.

Ungulate use during wet soil periods can damage the biological crust by trampling. Fortunately, insufficient herbage production generally limits heavy use.

Soil is saturated with water during winter and early spring. The change from saturated to summer bone dry seriously limits the variety of plant species capable of competing on this site. Revegetation with domestic species is not possible. It also limits hunters in the fall. They may drive out on frozen soil in early morning only to return in the evening to find their vehicle rim deep in mud.



Frost heaving during saturated soil conditions is common. Water freezes at night and then thaws during the day. The expanding ice crystals push gravels out of the top 1 to 2 in of soil and deposits them on the soil surface, a condition resulting in a “desert pavement.” The “A” horizon is vesicular as a result of frost heaving (Springer 1958). The gravel, in conjunction with microbiotic plants, successfully protect the soil surface (Belnap et al. 2001).



Scabland lichen-encrusted rocks with a biological soil crust successfully protects the soil surface. This is the primary indication of “good range condition” as vascular vegetation cannot protect the soil (Belnap et al. 2001).



Table 4-045EPF—Rigid sagebrush scabland. Yearly canopy cover by species, plants with seedheads per year, and statistics on total yearly herbage production, canopy cover, and ratio of production to canopy cover

Year	Canopy cover by species code ^a							Herb cover	Herbage production	Ratio cover/kg/ha	
	POSE	TRMA3	LOGR	DAUN	PSSPS	ARRI2	Seedheads				
	<i>Percent</i>							<i>Percent</i>	<i>kg/ha</i>	<i>Ratio</i>	
1977	10	6	7	6		4	50	29	150	5.2	
1978	10	5	8	5		5	40	28	125	4.5	
1979	10	4	7	4		6		25	125	5.1	
1980	8	4	6	4		6		22	100	4.5	
1981	8	4	6	6		6	50	24	175	7.3	
1982	10	5	6	6	3	7	80	30	200	6.7	
1983	12	6	6	7	3	7	100	31	225	7.2	
1984	12	6	8	7	3	8	100	36	200	5.6	
1985	10	4	9	6		8	80	29	125	4.3	
1987	9	4	6	6	1	9		26	125	4.8	
1989	9	3	5	4	1	9		22	125	5.6	
1990	9	3	4	4	1	9		21	125	5.9	
1991	9	3	4	3	1	9		20	100	5.1	
1992	9	3	4	3	2	9	30	21	170	8.1	
1993	9	3	3	3	1	10	70	19	110	5.8	
1994	9	4	4	3	1	10		21	150	7.1	
1995	9	3	3	3	1	10	20	19	125	6.6	
1996	8	3	4	3		10	50	18	75	4.2	
1997	8	3	3	3		10	50	17	150	8.8	
1998	9	3	3	3		11	30	18	125	6.9	
1999	8	2	2	3		11		15	100	6.7	
2000	5	2	2	2		12		11	75	6.8	
2001	5	2	2	2		12	80	11	100	9.1	
2002	6	2	2	2		12		12	100	8.3	
2003	6	2	2	2		13		12	100	8.3	
2004	10	4	4	4		13	20	22	125	5.7	
2005	9	4	3	3		12	80	19	125	6.6	
Mean	8.7	3.6	4.6	3.9	1.6	9.2	XXX	Mean	21.4	130.7	6.3
Count	27	27	27	27	11	27	16	SD	6.4	37.1	1.4
Percent	100	100	100	100	41	100	54	5% CI	2.5	14.0	0.5

Note: SD = standard deviation; CI = confidence interval.
^aSee “Species Lists: Codes” for plant definitions.

Summary

Canopy Cover

Over a 27-year period, canopy cover varied as follows: BSPCF pine/pinegrass a 2.2-fold difference, 203EPF pine/fescue 2.3-fold, 088EPF low sagebrush/wheatgrass three-fold, and 045EPF rigid sagebrush scabland at a threefold difference. Reasons for this wide variation are open to speculation because the sites had not been grazed. I suspect growing conditions.

Herbage cover fluctuated widely bringing into question the use of canopy cover as a measure of range condition. This fluctuation coupled with observer variability in estimating canopy cover (Coles-Ritchie et al. 2004) leads me to look for other vegetation measurements for characterizing range condition guides.

Ratio of Cover to Productivity

This study was designed to evaluate yearly changes in shrub and herbaceous cover and herbage productivity. Table 5 summarizes the relationship between percentage of herbage canopy cover and kilograms per hectare herbage production. Herbage production in kilograms per hectare was divided by total herbage percentage of canopy cover to calculate a ratio between the two. The four ratios and their 5 percent confidence intervals are shown in table 5. For each site, the confidence interval was calculated as a percentage of the ratio mean. These ratios are then compared for 50-percent herbage canopy cover. For example, the BSPCF ratio is 6.2: 6.2×50 percent = 310 kg/ha estimated production.

One ratio stands out as significantly different, 203EPF pine/bitterbrush/fescue, at 10.7. I suspect the dense, fine leaves of fescue contribute to increased weight per square decimeter of canopy cover.

Image Evaluation

Interpretation of color images greatly enhanced this investigation. Because season of sampling was constant, August 1 to 4, differences in greenness of the vegetation could be evaluated. Pinegrass was reasonably consistent in color. However wheatgrass and fescue varied from cured brown to bright green reflecting major differences in phenological development and thus nutritive value and palatability to animals.

Careful scrutiny of images also revealed items not measured in this study. Tree regeneration and growth was one. The BSPCF ponderosa pine/pinegrass is an example. In 1979, a pine seedling was present next to the meter board between 6 and 8 dm. By 1982 it was gone. On the same site, a pine had become established in 1982 at the top center of the image. By 1992 it had grown to 1 cm in diameter, and

by 2004 it was 2 cm diameter. In 22 years, this sapling had only grown about 2 cm in diameter.

Another illustration of tree growth is shown in 203EPF ponderosa pine/bit-terbrush/fescue. Saplings in 1957 were about 1 m in height. By 1978, 21 years later, they were only 2 m tall. And by 2002, 45 years later, they were about 4 m tall. They should be 12 m in height according to normal yield tables (Meyer 1938). They were stagnated, growing at about 1 cm/decade in diameter. Years 2003 to 2006 document upward range trend resulting from tree thinning.

Erosion may also be appraised by use of photomonitoring. The low movement of rocks shown in both 088EPF low sagebrush/wheatgrass and 045EPF rigid sagebrush/ scabland suggests no accelerated erosion.

Table 5—Statistical summary of the ratio between herbage cover and kilograms per hectare herbage production illustrated for 50 percent canopy cover

Site	Ratio	5% CI	CI % of mean	Herbage at 50% canopy cover	5% CI variation in production
				Kilograms per hectare	
BSPCF	6.2	0.4	6	310	290 to 330
203EPF	10.7	0.6	6	535	505 to 565
088EPF	7.3	0.3	4	365	350 to 380
045EPF	6.3	0.5	8	315	290 to 340

Note: CI = confidence interval.

Species List: Common Names

Common name	Scientific name	Code
Arnica	<i>Arnica cordifolia</i> Hook.	ARCO9
Bluebunch wheatgrass (old name)	<i>Pseudoroegneria spica</i> ssp. <i>spicata</i> (Pursh) A. Love <i>Agropyron spicatum</i> (Pursh) Scribn. & J.G. Sm.	PSSPS (AGSP)
Dandelion (old name)	<i>Nothocalais troximoides</i> (Gray) Greene <i>Microseris troximoides</i> Gray	NOTR2 (MITR5)
Douglas-fir	<i>Pseudotsuga menziesii</i> var. <i>glauca</i> (Beissn.) Franco	PSMEG
Elk sedge	<i>Carex geyeri</i> Boott	CAGE2
Grand fir	<i>Abies grandis</i> (Dougl. ex D. Don) Lindl.	ABGR
Idaho fescue	<i>Festuca idahoensis</i> Elmer	FEID
Japanese brome	<i>Bromus japonicus</i> Thunb. ex Murr.	BRJA
Junegrass (old name)	<i>Koeleria macrantha</i> (Ledeb.) J.A. Schultes <i>Koeleria cristata</i> auct. p.p., non Pers.	KOMA (KOCR)
Juniper	<i>Juniperus occidentalis</i> Hook.	JUOC
Lomatium	<i>Lomatium grayi</i> (Coult & Rose) Coult & Rose	LOGR
Low sage	<i>Artemisia arbuscula</i> Nutt.	ARAR8
Lupine	<i>Lupinus caudatus</i> Kellog	LUCA
Needlegrass (old name)	<i>Achnatherum occidentale</i> Barkworth ssp. <i>occidentale</i> <i>Stipa occidentalis</i> Thurb. ex S. Wats	ACOCO (STOC2)
Oatgrass	<i>Danthonia unispicata</i> (Thurb.) Munro ex Macoun	DAUN
Onion	<i>Allium acuminatum</i> Hook.	ALAC4
Phlox	<i>Phlox douglasii</i> Hook.	PHDO3
Pinegrass	<i>Calamagrostis rubescens</i> Buckl.	CARU
Pipe clover	<i>Trifolium macrocephalum</i> (Pursh) Poir.	TRMA3
Ponderosa pine	<i>Pinus ponderosa</i> P.& C. Lawson	PIPO
Pussytoes	<i>Antennaria stenophylla</i> (Gray) Gray	ANST2
Rigid sage	<i>Artemisia rigida</i> (Nutt.) Gray	ARRI2
Ross' sedge	<i>Carex rossii</i> Boott	CARO5
Sandberg bluegrass	<i>Poa secunda</i> J. Presl	POSE
Scouler's woollyweed	<i>Hieracium scouleri</i> Hook.	HISC2
Squirreltail (old name)	<i>Elymus elymoides</i> (Raf.) Swezey spp. <i>elymoides</i> (Raf.) <i>Sitanion hystrix</i> (Nutt.) J.G. Sm.	ELELE (SIHY)
Wheatgrass (old name)	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i> (Pursh) A. Love <i>Agropyron spicatum</i> (Pursh) Scribn. & J.G. Sm.	PSSPS (AGSP)
Wheeler's bluegrass	<i>Poa nervosa</i> (Hook.) Vasey	PONE2
Yarrow	<i>Achillea millefolium</i> L.	ACMI2

Species List: Codes

Code	Scientific name	Common name
ACMI2	<i>Achillea millefolium</i> L.	Yarrow
ACOCO	<i>Achnatherum occidentale</i> ssp. <i>occidentale</i> Barkworth	Needlegrass
ALAC4	<i>Allium acuminatum</i> Hook.	Onion
ARAR8	<i>Artemisia arbuscula</i> Nutt.	Low sage
ARCO9	<i>Arnica cordifolia</i> Hook.	Arnica
ARRI2	<i>Artemisia rigida</i> (Nutt.) Gray	Rigid sage
ANST2	<i>Antennaria stenophylla</i> (Grey) Grey	Pussytoes
BRJA	<i>Bromus japonicus</i> Thunb. ex Murr.	Japanese brome
CAGE2	<i>Carex geyeri</i> Boott	Elk sedge
CAROS	<i>Carex rossii</i> Boott	Ross' sedge
CARU	<i>Calamagrostis rubescens</i> Buckl.	Pinegrass
DAUN	<i>Danthonia unispicata</i> (Thurb) Munro ex Macoun	Oatgrass
ELELE	<i>Elymus elymoides</i> spp. <i>elymoides</i> (Raf.) Swezey	Squirreltail
FEID	<i>Festuca idahoensis</i> Elmer	Idaho fescue
HISC2	<i>Hieracium scouleri</i> Hook.	Scouler's woollyweed
KOMA	<i>Koeleria macrantha</i> (Ledeb.) J.A. Schultes	Junegrass
LOGR	<i>Lomatium grayi</i> (Coult & Rose) Coult & Rose	Lomatium
LUCA	<i>Lupinus caudatus</i> Kellog	Lupine
NOTR2	<i>Nothocalais troximoides</i> (Gray) Greene	Dandelion
PHDO3	<i>Phlox douglasii</i> Hook.	Phlox
PONE2	<i>Poa nervosa</i> (Hook.) Vasey	Wheeler's bluegrass
POSE	<i>Poa secunda</i> J. Presl	Sandberg bluegrass
PSSPS	<i>Pseudoroegneria spica</i> ssp. <i>spicata</i> (Pursh) A. Love	Bluebunch wheatgrass
TRMA3	<i>Trifolium macrocephalum</i> (Pursh) Poir.	Pipe clover

English Equivalents

When you have:	Multiply by:	To get:
Centimeters (cm)	.394	Inches
Decimeters (dm)	3.94	Inches
Meters (m)	3.28	Feet
Kilograms per hectare (kg/ha)	.89	Pounds per acre
Millimeters (mm)	.0394	Inches
Square meters (m ²)	1.2	Square yards
Square meters per hectare (m ² /ha)	4.37	Square feet per acre

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