

# Preference of wintering sage grouse for big sagebrush

BRUCE L. WELCH, FRED J. WAGSTAFF, AND JAY A. ROBERSON

## Abstract

A study determined sage grouse (*Centrocercus urophasianus*) preference for 3 subspecies and 9 accessions of big sagebrush (*Artemisia tridentata* Nutt.). The subspecies were mountain big sagebrush (*A.t. ssp. vaseyana* Rydb. Beetle), Wyoming big sagebrush (*A.t. ssp. wyomingensis* Beetle and Young), and basin big sagebrush (*A.t. ssp. tridentata* Nutt.). Accessions were collected at various sites in Utah and established in a uniform garden. Eleven plants for each accession or 33 plants for each subspecies were planted at random on a 2.13-m grid for a total of 99 plants. An enclosure with a top was constructed. Six birds were captured and placed in the garden. Preference was measured by the number of bites taken during the study and by estimates of percentage of leaves eaten at the end of the study. Results, by order of preference, were mountain big sagebrush, Wyoming big sagebrush, and basin big sagebrush. Within the most preferred subspecies there was distinct preference among accessions as measured by bite counts. When the forage of preferred subspecies or accessions was exhausted, the birds readily ate other subspecies or accessions.

**Key Words:** *Artemisia tridentata*, big sagebrush, *Centrocercus urophasianus*, sage grouse, preference

Smith (1950) noted during winter feeding trials that mule deer (*Odocoileus hemionus hemionus*) showed definite aversion to certain individual big sagebrush (*Artemisia tridentata* Nutt.) plants. This is the first evidence of differential preference of an animal for big sagebrush. Since then, other researchers have reported differential preference of mule deer not only for individual plants but for subspecies of big sagebrush and accessions within subspecies (Plummer et al. 1968, Scholl et al. 1977, Sheehy and Winward 1981, Welch and McArthur 1986, Personius et al. 1987). Other animal species also express differential preference including domestic sheep (*Ovis aries*) (Sheehy and Winward 1981, Welch et al. 1987) and pygmy rabbit (*Brachylagus idahoensis*) (White et al. 1982). Field evidence shows wintering sage grouse (*Centrocercus urophasianus*) may express differential preference for subspecies (Remington and Braun 1985) and for individual plants within subspecies (Remington and Braun 1985, Welch et al. 1988). Our investigation measured the preference of wintering sage grouse for subspecies and accessions of big sagebrush where the birds have equal access to all subspecies and accessions. Our hypothesis was that captured wild sage grouse prefer mountain big sagebrush (*A.t. ssp. vaseyana* Rydb. Beetle) over Wyoming big sagebrush (*A.t. ssp. wyomingensis* Beetle and Young) and basin big sagebrush (*A.t. ssp. tridentata* Nutt.).

## Methods

The study site is a garden about 3.4 km south of Vernon, Utah. Soils are uniform unconsolidated clay loams, light gray to pale

Authors are, respectively, principal research plant physiologist and principal range scientist, Intermountain Research Station, Forest Service, USDA, located at the Shrub Sciences Laboratory, 735 N 500 E, Provo, Utah 84606; and upland game coordinator, Utah Division of Wildlife Resources, 1596 West Temple, Salt Lake City, Utah 84116-3195.

The use of trade or firm names in this paper is for reader information and does not imply endorsement by the USDA of any product or service.

Special thanks goes to Wendy Bird, Steve Briggs, and Ronald L. Rodriguez for garden maintenance and enclosure construction. We express our thanks and gratitude to Norman I. Bowden, Verr Don Durfee, and Max Burton for capturing the wild sage grouse used in this study.

Manuscript accepted 22 March 1991.

brown, and calcareous. The organic content is relatively low, and there is a dense claypan layer found at about the 43 cm level. Upper horizons of the soil are moderately permeable. Annual average precipitation is 33 cm (Astroth and Frischknecht 1984).

All plants were removed from the garden site by mechanical means. Big sagebrush plants were raised as containerized stock in the greenhouse and transplanted onto the garden (Nelson 1984). Three subspecies of big sagebrush were represented by 3 accessions each. Subspecies were mountain big sagebrush, Wyoming big sagebrush, and basin big sagebrush. Acquisition sites for seed collections of the 9 accessions are given in Table 1. For each

Table 1. Acquisition sites for seed collections of 3 subspecies and 9 accessions of big sagebrush.

Subspecies	Accessions	County and state
<i>vaseyana</i>	Windy Ridge	Utah, Utah
	'Hobble Creek'	Utah, Utah
	Vance Reservoir	Wayne, Utah
<i>wyomingensis</i>	Loa	Wayne, Utah
	Gordon Creek	Carbon, Utah
	Mayfield	Sanpete, Utah
<i>tridentata</i>	Crystal Peak	Millard, Utah
	Elise	Wayne, Utah
	Ridge Road	Duchesne, Utah

subspecies, an accession was included that was near (1.6–2.2 km) the sage grouse capture site. These 3 accessions were mountain big sagebrush Vance Reservoir, Wyoming big sagebrush Loa, and basin big sagebrush Elise. These 3 accessions have a history of sage grouse use, as do Windy Ridge, a mountain big sagebrush, and Ridge Road, a basin big sagebrush. Each of the 9 accessions was represented by 11 plants or 33 plants for each subspecies for a total of 99 plants. Plants were placed at random on a 2.13 m grid. The garden was kept weed free by mechanical means. Plants were watered twice a month during June, July, and August.

An enclosure with a top was built over the garden. The enclosure was constructed of large poultry wire and a wooden frame. Before the wild birds were released in the garden a 1.22 m high strip of burlap was placed around the enclosure. This was done to provide the birds with a visible barrier and a feeling of security. On 1 December 1988, 6 birds were captured using spotlighting and long handled nets. Capture site was a black sagebrush (*A. nova*) flat about 21 km west of Loa, Utah. Both Wyoming and mountain big sagebrush were near the capture site. The birds were transported singly in cardboard boxes to the garden. After fitting each bird with a colored collar and clipping the primary flight feathers on 1 wing, the birds were released into the garden as a group. This would more nearly duplicate the flocking tendencies of wintering sage grouse. Water was provided in a metal tank. An electric stock heater kept the water just above the freezing point.

Preference was measured by bite count taken during the study and estimates of percentage of leaves eaten at the end of the study. Bite counts were recorded with video cameras. The data from bite counts and percentage of leaves eaten were subjected to one-way analyses of variance and for significant "F" tests, multiple range tests. Significance level was set at 5%. Treatments were either

subspecies or accessions with plants (33) within subspecies or with plants (11) within accessions as replications. Data used in the bite-counts analyses of variance were actual number of bites recorded. Data used in the percentage-of-leaves-eaten analyses of variance were percentages that had been transformed (arcsin). Because of fluctuations in total bite counts among days, data presented in the figures of this manuscript are given as a percentage of total bites per subspecies or accessions.

## Results

The birds appeared to adjust rapidly to the confines of the enclosure. We observed that 5 birds challenged the walls of the enclosure once during the 5-day trial and the remaining bird twice. All challenges occurred during the morning of the first day. During the 5 days, the birds appeared to be calm. Bird activity seemed similar to what we have observed in the wilds—that is, general wandering among plants, eating some, and resting (Welch et al. 1988). Sounds had little effect on the birds. Movements above the birds caused them to seek cover and remain motionless for 15 minutes or more after the movement ceased. Movements by people or vehicles around the enclosure would cause the birds to freeze for a minute or 2. Roosting occurred in 3 of the 4 corners of the enclosure. All plants were sampled by the birds sometime during the trial. When the birds came to a plant that they liked they would lie down on their keel and take upward of a hundred bites before moving to the next plant. For less preferred plants, the birds would remain standing and take a few bites (3–20) before moving to the next plant. During the 5 days, the birds ate snow. We did not observe the drinking of water from the metal tank.

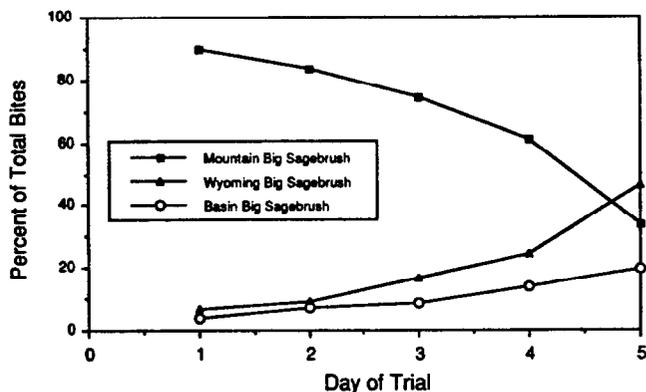


Fig. 1. The percentage of total sage grouse bites per subspecies of big sagebrush per day of trial. The 3 subspecies of big sagebrush are mountain, Wyoming, and basin.

Figure 1 shows the percentage of bites per subspecies per day for the 6 sage grouse. Bites for mountain big sagebrush ranged from a high of 90% for the 1st day to a low of 34% for the last day. This continuous drop in percentage over time reflects early heavy use resulting in a decrease of available leaves and buds. Bites for Wyoming big sagebrush ranged from a low of 7% for the 1st day to a high of 46% for the last day. For basin big sagebrush, bites ranged from a low of 4% for the 1st day to a high of 20% for the last day. These data show that the birds preferred mountain big sagebrush over Wyoming big sagebrush and perhaps Wyoming big sagebrush over basin big sagebrush.

After analyzing the video tapes for bite counts, it became obvious that a shift from mountain big sagebrush to Wyoming and basin sagebrush occurred during day 4 about 1130. From about 0800 on the 4th day until 1130, percentage of bites were 85% for mountain big sagebrush, 7% for Wyoming big sagebrush, and 8% for basin big sagebrush—a proportion that is about the same as for the first 3 days. But after 1130, bites were 52% for mountain big

sagebrush, 31% for Wyoming big sagebrush, and 16% for basin big sagebrush. This shift occurred without any hesitation on the part of the birds. It was not noticeable to the observers until analysis of the video tapes. The shift was due to decrease in available leaves and buds of the Windy Ridge and 'Hobble Creek' accessions of mountain big sagebrush. Wyoming big sagebrush percentage of total bites per day did not exceed mountain big sagebrush until the last day.

Analysis of variance for the bite-count data on a per-day, total study, and a 3.5-day-combination basis all detected significant effects due to subspecies in favor of mountain big sagebrush. As noted, data collected on the 5th day were an exception. Also, analyses of variance for estimates of the percentage of leaves eaten at the end of trial detected significant effects due to subspecies in favor of mountain big sagebrush (Table 2).

Table 2. Estimates of the percentage (means  $\pm$  SD) of leaves eaten by sage grouse for 3 subspecies and 9 accessions of big sagebrush.

Subspecies	Accessions	Percentage of leaves eaten
<i>vaseyana</i>	—	71.8 $\pm$ 13.7 A <sup>1</sup>
<i>wyomingensis</i>	—	28.2 $\pm$ 21.3 B
<i>tridentata</i>	—	15.9 $\pm$ 16.5 C
<i>vaseyana</i>	Windy Ridge	77.7 $\pm$ 13.7 A
	Vance Reservoir	69.1 $\pm$ 19.9 A
	'Hobble Creek'	68.6 $\pm$ 18.6 A
<i>wyomingensis</i>	Loa	29.8 $\pm$ 28.2 B
	Gordon Creek	27.3 $\pm$ 20.4 B
	Mayfield	27.5 $\pm$ 15.0 B
<i>tridentata</i>	Crystal Peak	17.8 $\pm$ 12.4 C
	Ridge Road	17.7 $\pm$ 18.7 C
	Elise	12.5 $\pm$ 18.7 C

<sup>1</sup>Subspecies or accessions sharing the same letters are not significantly different at the 5% level.

Figure 2 shows the percentage of bites per accession per day for the mountain big sagebrush group. Bites for the Windy Ridge accession ranged from a high of 61% on the 1st day to a low of 4% on the last day. For the 'Hobble Creek' accession, the range was from a high of 29% on the 2nd day to a low of 9% on the last day. Vance Reservoir accession showed a different pattern of use, starting at a low of 5% for the 1st day and reaching a high of 22% on day 4, which was no different than the 21% of the last day.

Analysis of variance of actual bite counts on a per-day, total study, and a 3.5 day-combination basis all detected effects due to accessions. Windy Ridge accession was preferred over the other 8 accessions. 'Hobble' Creek' accession was preferred over the remaining 7. No preferences were detectable among the remaining

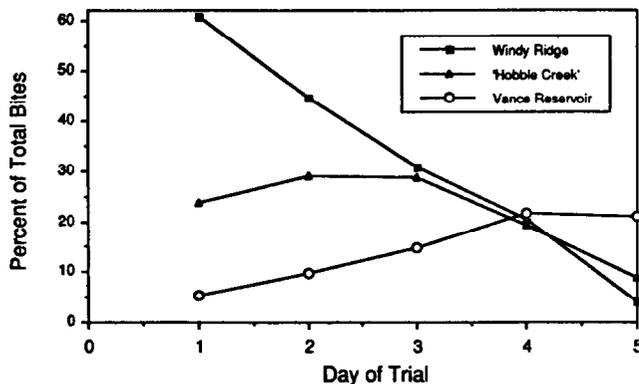


Fig. 2. The percentage of total sage grouse bites per accession within the mountain big sagebrush group per day.

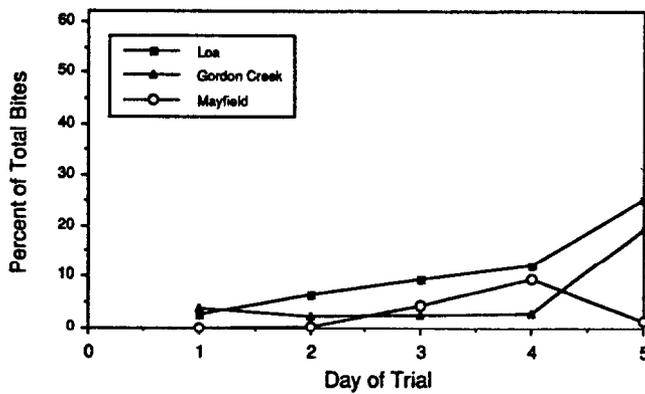


Fig. 3. The percentage of total sage grouse bites per accession within the Wyoming big sagebrush group per day.

7 accessions. Analysis of variance for the percentage of leaves eaten also detected significant effects due to accessions. However, differences were not detected among the accessions of the mountain big sagebrush group (Table 2).

Figure 3 shows the percentage of bites per accession per day for the Wyoming big sagebrush group. The Loa accession ranged from a low of 3% on the 1st day to a high of 25% on the last day. The Gordon Creek accession ranged from a low of 2% for the 2nd day (4% for the 1st day) to a high of 19% for the last day. The Mayfield accession ranged from a low of 0.1% for the 1st day to a high of 10% for the 4th day. There were no detectable differences among accessions of Wyoming big sagebrush. However, trends favored Loa and Gordon Creek over the Mayfield accession.

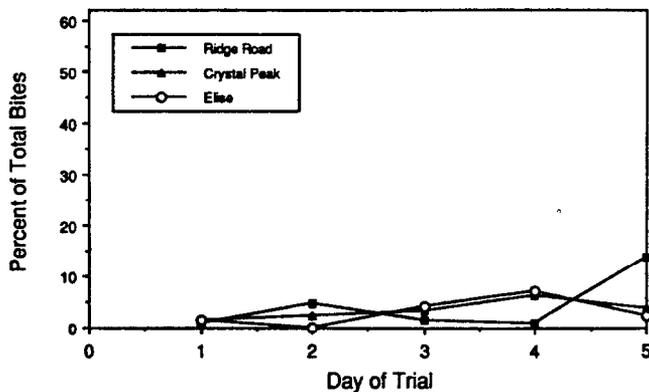


Fig. 4. The percentage of total sage grouse bites per accession within the basin big sagebrush group per day.

Figure 4 shows the percentage of bites per accession per day for the basin big sagebrush group. The Ridge Road accession ranged from a low of 0.7% for the 1st day to a high of 14% for the last day. The Crystal Peak accession ranged from a low 1.4% for the 1st day to a high of 7% the 2nd day. The Elise accession ranged from 0% (just 3 bites all day) for the 2nd day to a high of 7% for the 4th day. There were no detectable differences among accessions of basin big sagebrush. However, trends favored Ridge Road over Crystal Peak and Elise accessions.

## Discussion

Sage grouse preference for mountain big sagebrush agrees with observations noted for wintering mule deer and domestic sheep (Hanks et al. 1971, 1973; Scholl et al. 1977; Sheehy and Winward 1981; Welch and McArthur 1986; Personius et al. 1987; Welch et al. 1987). Pygmy rabbits showed no significant preference at the subspecies level; instead, selection was made at the accession level (White et al. 1982).

Our study results do not support the field observations of Remington and Braun (1985), who cited evidence that wintering sage grouse preferred Wyoming big sagebrush over mountain big sagebrush. Data in their Table 1 suggest that the use of Wyoming and mountain big sagebrush is a function of distribution and may not be due to preference differences between the 2 kinds of big sagebrush. Their random sample method may be biased because some of the sampled mountain big sagebrush plants occurred at the bottom of draws where sage grouse may seldom feed. Consequently, part of their perceived preferential use could be due to uneven bird distribution.

Sage grouse preference for the Windy Ridge and 'Hobble Creek' accessions over the Vance Reservoir accession deserves special comment. The Windy Ridge accession was collected from the Strawberry Valley area of north central Utah, about 225 km north by northeast of the capture site. We had observed sage grouse in this area eating this accession for several years prior to this study. 'Hobble Creek' is a released accession of mountain big sagebrush for use on wintering mule deer and domestic sheep ranges (Welch et al. 1986). It was collected about 209 km north of the capture site. Sage grouse use for this accession was unknown before this study. Vance Reservoir is the accession nearest the capture site, and we had observed sage grouse use of this mountain big sagebrush for several years prior to this study (Welch et al. 1988). If predisposing factors were playing a role in determining sage grouse preference, we would expect the Vance Reservoir accession to be favored. The same would be true for the Loa accession of Wyoming big sagebrush and Elise accession of basin big sagebrush. But we concluded that previous exposure did not play an important role in determining sage grouse preference.

Sage grouse under the conditions of this study showed definite preference for mountain big sagebrush and for certain accessions within this subspecies. However, when leaves and buds of the preferred plants became limited, the birds shifted to lesser liked plants. This shift was not noticeable until after analysis of the video tapes. We concluded that the birds, while expressing preference, are capable of shifting their eating habits. This gives sage grouse a larger food base.

## Management Implications

To improve sage grouse habitat, we recommend the planting of 'Hobble Creek' big sagebrush. Three reasons for this recommendation are: sage grouse preferred 'Hobble Creek' over 7 other accessions, excellent winter nutritive value (Welch et al. 1986), and 'Hobble Creek' is a released selection with commercial sources of seed (Welch et al. 1986). 'Hobble Creek' can be established on sites with the following characteristics: (1) mean annual precipitation of 35.6 cm or more; (2) deep, well-drained soils with an effective rooting depth of at least 1.22 m; (3) soil no finer than a clay loam (40% clay or less); and (4) soil pH between 6.6 and 8.6 (Welch et al. 1986). However, Windy Ridge was the most preferred accession and has proven capacity to support sage grouse. Seed could be obtained from the native site. Establishment requirements of this accession are probably similar to 'Hobble Creek' although probably not adapted to as dry a site as 'Hobble Creek'.

## Literature Cited

- Astroth, K.A., and N.C. Frischnecht. 1984. Managing Intermountain rangelands—research on the Benmore Experimental Range, 1940–84. USDA Forest Serv. Gen. Tech. Rep. INT-175.
- Hanks, D.L., J. Brunner, D.R. Christensen, and A.P. Plummer. 1971. Paper chromatography for determining palatability differences in various strains of big sagebrush. USDA Forest Serv. Res. Pap. INT-101.
- Hanks, D.L., E.D. McArthur, R. Stevens, and A.P. Plummer. 1973. Chromatographic characteristics and phylogenetic relationships of *Artemisia*, section *Tridentatae*. USDA Forest Serv. Res. Pap. INT-141.

- Nelson, D.L. 1984.** Toward producing disease-free container-grown native wildland plants. p. 32-38. *In*: Murphy, P.M. (ed.). Proc. Intermountain Nurseryman's Assoc. 1983 Conf. USDA Forest Serv. Gen. Tech. Rep. INT-168.
- Personius, T.L., C.L. Wambolt, J.R. Stephens, and R.G. Kelsey. 1987.** Crude terpenoid influence on mule deer preference for sagebrush. *J. Range Manage.* 40:84-88.
- Plummer, A.P., D.R. Christensen, and S.B. Monsen. 1968.** Restoring big game range in Utah. Utah Div. of Wildl. Resour. Pub. 68-3. Salt Lake City, Utah.
- Remington, T.E., and C.E. Braun. 1985.** Sage grouse food selection in winter, North Park, Colorado. *J. Wildl. Manage.* 49:1055-1061.
- Scholl, J.P., R.G. Kelsey, and F. Shafizadeh. 1977.** Involvement of volatile compounds of *Artemisia* in browse preference by mule deer. *Biochem. Sys. and Ecol.* 5:291-295.
- Sheehy, D.P., and A.H. Winward. 1981.** Relative palatability of seven *Artemisia* taxa to mule deer and sheep. *J. Range Manage.* 34:397-399.
- Smith, A.D. 1950.** Sagebrush as winter food for mule deer. *J. Wildl. Manage.* 14:285-289.
- Welch, B.L., and E.D. McArthur. 1986.** Wintering mule deer preference for 21 accessions of big sagebrush. *Great Basin Natur.* 46:281-286.
- Welch, B.L., E.D. McArthur, D.L. Nelson, J.C. Pederson, and J.N. Davis. 1986.** 'Hobble Creek'—A superior selection of low-elevation mountain big sagebrush. USDA Forest Serv. Res. Pap. INT-370.
- Welch, B.L., E.D. McArthur, and R.L. Rodriguez. 1987.** Variation in utilization of big sagebrush accessions by wintering sheep. *J. Range Manage.* 40:113-115.
- Welch, B.L., J.C. Pederson, and R.L. Rodriguez. 1988.** Selection of big sagebrush by sage grouse. *Great Basin Natur.* 48:274-279.
- White, S.M., J.T. Flinders, and B.L. Welch. 1982.** Preference of pygmy rabbits (*Brachylagus idahoensis*) for various populations of big sagebrush (*Artemisia tridentata*). *J. Range Manage.* 35:724-726.

Your Computer, helpful though it be, can never eliminate the need for a good personal library of professional publications. Contact the Society headquarters for a list of available publications on the art and science of range management. Write to 1839 York Street, Denver, Colorado 80206 or call (303) 355-7070.