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## WEIGHTS OF COLORADO SAGE GROUSE

THOMAS D. I. BECK

AND

CLAIT E. BRAUN

Sage Grouse (*Centrocercus urophasianus*) are the largest North American grouse, both in body dimensions and weight. Their weight differs between sexes and varies strikingly among regions and seasons (Table 1). Weight has been used as a criterion for sex determination (June 1967). However, there is little systematic information on seasonal weight change. Before weight can be assessed as a physiological index, a taxonomic criterion, or a factor in behavioral development the seasonal pattern of weight change must be documented.

### METHODS

Body weights of 320 Sage Grouse captured during 1965-69 and 1,102 during 1973-76 were recorded. All grouse were captured in North Park, Colorado, the northernmost of Colorado's four large intermontane parks. Elevation of sagebrush (*Artemisia* spp.) lands varies from 2,400 to 2,585 m, with surrounding mountain ranges rising steeply to 3,850 m. Although birds were captured during winter, spring, and summer, over 92% were caught during the breeding season (Apr.-May). Detailed capture procedures were described by Braun and Beck (1976). Birds were classed as adults (>18 months) or yearlings (<18 months) based on wear of primary feathers (Eng 1955, Beck et al. 1975). Birds were weighed on spring scales or triple-beam balances.

### RESULTS

Weights were grouped by age and sex class (adult and yearling males and females) and by season (Jan.-Mar., Apr.-May, June-Sept.). Annual variation was compared by *t*-test. No significant differences ( $P > 0.05$ ) were detected in average weight among years during 1973-76 for any of the groups. Significant differences ( $P < 0.05$ ) among years were detected for some groups during 1965-69 but reasons for the differences are unknown. The date when courtship began varied greatly among years (Mar. 15-Apr. 20) and may have affected annual variation. Data from all years were pooled to facilitate analysis. Weight relationships between groups were identical for both the pooled data and the 1973-76 data (when there was no significant variation and larger sample size); thus pooling of all years was considered justified.

Average weights of each age and sex class differed significantly ( $P < 0.01$ ) from other classes during each seasonal period (Table 2). Average weights between seasons differed significantly ( $P < 0.05$ ) for each age and sex class (Table 2). Average weights of adult and yearling male and female Sage Grouse were greatest during the breeding season. Lowest weights were recorded in summer, while late winter weights were relatively high. Weight gains from January to March accounted for nearly 55%

of the October to March gain. Small samples limit analysis of progressive weight change in fall and winter.

Maximum weight in males was attained by both age classes during the first 2 weeks of April and mean weight of adults was 15.1% (428.2 g) greater than that of yearlings (Fig. 1). Differences between age classes were greater in both the preceding winter and subsequent summer. Male Sage Grouse do not reach maximum body weight until at least 22 months of age. All males lost weight through the strutting season (Fig. 1) but weight loss was greater in adult males than in yearlings (153.5 vs. 64.1 g). Losses from early-April to late-April and from late-April to late-May were highly significant ( $P < 0.01$ ) in adult males but not in yearlings ( $P > 0.05$ ).

Maximum weight of females occurred in spring but 4-6 weeks later than in males (Fig. 1). Increases in weight from winter to spring were similar for both adult (161 g) and yearling (155 g) females, with yearlings increasing later in the breeding season than adults.

### DISCUSSION

Males exhibited larger changes in body weight seasonally than did females, presumably because of the large mass of specialized courtship tissue. Specialized breast and neck feathers, an enlarged esophagus and gular sacs, and a large mass of vascularized fascia beneath the dermal muscles of the neck attain maximum development prior to the strutting season and are integral components of the male's strut display (Honest and Allred 1942, Clarke et al. 1942).

In contrast to reports by Patterson (1952) and Dalke et al. (1963) that males gain weight during

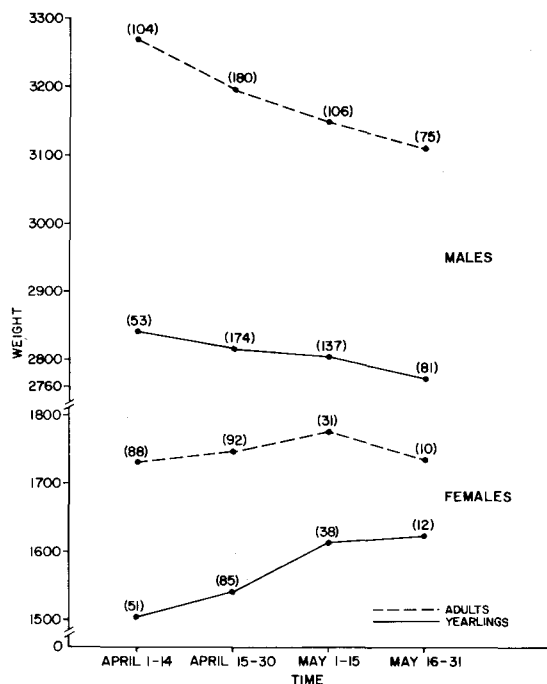


FIGURE 1. Changes in mean Sage Grouse weights (g) during the breeding season, North Park, Colorado. Sample size in parentheses.

TABLE 1. Comparison of seasonal Sage Grouse weights (kg) from various regions.

Region	January–March		April–May				June–September			
	AM <sup>a</sup>	YM	AM	YM	AF	YF	AM	YM	AF	YF
North central Colorado (this study)	2.99 (20) <sup>b</sup>	2.39 (9)	3.19 (465)	2.81 (445)	1.74 (221)	1.55 (186)	2.32 (7)	1.71 (13)	1.36 (27)	1.23 (9)
Central Montana (Wallestad 1975)			2.86 (80)	2.50 (52)	1.59 (193)	1.45 (181)				
Central Montana (Eng 1963)	2.95 (19)	2.41 (12)	2.90 (28)	2.53 (18)						
Eastern Idaho (Dalke et al. 1963)			2.45 (25)	2.18 (6)			1.96 (18)		1.14 (18)	
Southwest Wyoming (Patterson 1952)	2.84 (2)	2.02 (3)	2.70 (31)	2.09 (5)			2.06 <sup>c</sup> (25)	1.93 <sup>c</sup> (unk) <sup>d</sup>	1.17 <sup>c</sup> (57)	
Southwest Wyoming (June 1963)			2.44 (unk) <sup>d</sup>				2.27 (43)	2.18 (75)	1.28 (60)	1.27 (98)
South central Wyoming (Girard 1937)							2.57 (8)		1.43 (8)	

<sup>a</sup> AM = adult male, YM = yearling male, AF = adult female, YF = yearling female.

<sup>b</sup> Sample size in parentheses.

<sup>c</sup> October weights.

<sup>d</sup> Unknown.

the strutting season, average weights of males declined steadily during this period (Fig. 1). Both of these studies were based on small samples (<40) unevenly distributed through April and May. Their reported trend of weight gain probably reflected inherent variability in a population and small sample size.

Greater weight loss in adult than in yearling males was probably a reflection of longer and more regular attendance on leks (Hartzler 1972, Wiley 1973). Weight loss during the April–May season probably results from depletion of body reserves. All specialized courtship tissues are still present in late-May, although the post-nuptial molt does begin in some males at that time. Greater maintenance of weight by yearling males supports Wiley's (1974) view that young males devote less time and energy to courtship activities than do adults. Adult males arrive on leks earlier than yearlings and essentially all matings on the lek are done by adult males although yearling males are physiologically mature (Eng 1963). The use of average weights may underestimate changes undergone by the small percentage of adult males who attend leks daily and perform over 75% of the mating (Hartzler 1972). Wiley (1974) suggested that delayed reproduction, as in male Sage Grouse, should be accompanied by higher survival of the yearling class. The average annual survival rate of adult males was considerably lower than for yearling males (33.7 vs. 56.1%) in North Park (Braun and Beck 1977). We suspect that differential survival may be occurring during early summer and may be weight-related. Other measures of body condition are needed for substantiation.

The combination of weight loss during breeding season and atrophy of specialized courtship tissues in June is partly responsible for the summer weights being the lowest of any season. We do not know when in the summer male Sage Grouse begin to gain weight.

Weight changes in both age classes of females were similar in the breeding season (Fig. 1). In contrast to males, yearling females do not commonly delay reproduction, although not all ovulate. Females

continue to gain after the peak of mating (usually 10–25 April). The decline in weight of adult females in late-May could be due to the inclusion in the sample of hens whose nests had been destroyed. Several females with brood patches were captured on strutting grounds in 1975 and 1976. Although the difference between adult and yearling female spring weights was 194 g, in contrast to males the pattern of weight change during the breeding season was similar. Coincident with similarities in behavior and weight change, survival rates of yearling and adult females are nearly identical in North Park (57.9 vs. 55.8%) (Braun and Beck 1977). Low summer weights of females were probably related to the assumed physiological stress of incubation and brood defense.

TABLE 2. Average weights of Sage Grouse by season, North Park, Colorado, 1965–76.

Age and sex class	Time period		
	January–March	April–May	June–September
Adult male			
Weight (g)	2,987	3,190	2,319
Sample size	20	465	7
Std. deviation (g)	188	183	73
Yearling male			
Weight (g)	2,389	2,809	1,709
Sample size	9	445	13
Std. deviation (g)	143	204	174
Adult female			
Weight (g)	1,584	1,745	1,364
Sample size	15	221	27
Std. deviation (g)	88	151	128
Yearling female			
Weight (g)	1,396 <sup>a</sup>	1,551 <sup>a</sup>	1,223
Sample size	5	186	9
Std. deviation (g)	71	123	47

<sup>a</sup> Difference between winter and spring weights significant at  $P < 0.05$ ; all other differences, both within and between age and sex groups, significant at  $P < 0.01$ .

Interpretation of regional differences in Sage Grouse body weight is difficult. Although regional differences occur, weight relationships between age and sex classes and seasons are similar; yet absolute differences vary as much as 24% from North Park weights (which were the highest). Lower weights reported may result from regional differences in populations and/or habitat quality. The relationship of habitat to body weight should be investigated in association with survival rates. Weight data from a specific region or population should not be extrapolated to other Sage Grouse populations. The marked seasonal differences in body weights throughout Sage Grouse range hinder the use of weight as a comparative parameter among populations.

#### SUMMARY

Weights of Sage Grouse from North Park, Colorado are presented. Yearling and adult males and females gained weight during late winter (January–March). Males were heaviest prior to onset of breeding activities, with adults having greater weight losses than yearlings during the breeding period (April–May). Females of both age classes gained weight through the breeding season. Lowest weights for both age classes of males and females occurred in summer and early fall (June–September).

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Colorado Division of Wildlife, 526 Pine, Glenwood Springs, CO 81601. Address of second author: Wildlife Research Center, P.O. Box 2287, Fort Collins, Colorado 80522. Accepted for publication 11 August 1977.

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## BODY TEMPERATURE AND HEART RATE OF THE SNOWY OWL

JAMES A. GESSAMAN

The Snowy Owl (*Nyctea scandiaca*) is a permanent resident in the arctic tundra of North America and Eurasia. Besides the Snowy Owl, the Common Raven (*Corvus corax*), the Rock Ptarmigan (*Lagopus mutus*), the Willow Ptarmigan (*L. lagopus*) and

occasionally the Common Redpoll (*Carduelis flammea*) and the Gyrfalcon (*Falco rusticolus*) inhabit the arctic tundra in winter. When food is available, the Snowy Owl may live farther north than these other birds. It has been seen 82°N on Ellesmere Island (Hart 1880) during winter months. Eskimos report seeing the owls on Banks Island in the Canadian Archipelago in winter (Manning et al. 1956). The bioenergetics of captive Snowy Owls during an arctic winter was reported earlier (Gessaman 1972). This report explores the precision of body temperature regulation and the pattern of heart