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Sage Grouse use of snow burrows in northeastern Nevada.—Apparently all species of *Tetraoninae* roost in snow for thermal conservation, provided that the snow is sufficiently deep and no ice crust occurs at the surface (Kuzmina 1961). However, the type of roost may vary with snow conditions or weather. We distinguish between 2 roost types: "snow forms" and "snow burrows." Snow forms are shallow depressions or open bowls in the snow in which the dorsal surface of the bird is exposed. Snow burrows are deep holes or tunnels in which the bird actively burrows completely under the snow surface. The difference in the thermal protection afforded by each roost type may be quite large. Gullion (1970) found that temperatures under 20 cm of soft snow in hardwood stands were between −3° and −12°C when ambient air temperature was as low as −35°C. Snow burrows provide a warmer microenvironment than do snow forms, and the covering of snow reduces radiant heat loss. Because of differences in thermal protection provided by snow forms and snow burrows, we recommend that ambiguous terms such as dug outs, snow roosts, or roost depressions be avoided when describing roost sites or behavior.

The use of snow burrows has been reported for Ruffed Grouse (*Bonasa umbellus*) (Bump et al. 1947), Sharp-tailed Grouse (*Tympanuchus phasianellus*), Greater Prairie Chicken (*T. cupido*) (Ammann 1957), Willow Ptarmigan (*Lagopus lagopus*) (Irving 1960), White-tailed Ptarmigan (*L. leucurus*) (Braun and Schmidt 1971), Capercaillie (*Tetrao urogallus*), Black Grouse (*Lyrurus tetrix*), and Hazel Grouse (*Testrastes bonasia*) (Formozov 1946). Although Sage Grouse (*Centrocercus urophasianus*) are exposed to subfreezing temperatures and snow conditions that are often suitable for snow burrowing, we could find no published reports of snow burrowing by this species. Griner (1939:42), Ihli et al. (1973:75), and Beck (1977: 23) reported Sage Grouse roosting in "holes," "snow caves," and "roost depressions," respectively. Their descriptions suggest that snow forms, rather than snow burrows, were observed. Patterson (1952:179) reported Sage Grouse used snow forms but found no evidence that they burrowed.

We observed 83 snow burrows at 13 different locations while conducting a Sage Grouse winter movement study in northeastern Nevada from 1982 to 1985. On all but one occasion, burrowing occurred within one week of snowfall. Minimum temperatures during the periods of snow-burrow use were < -10°C in all but one instance.

Snow burrows occurred in unpacked, soft drifts on the lee side of shrubs (N = 21) and in open, level areas with no shrub cover visible above the snow (N = 62). "Drift burrows" were made by birds tunneling into the drift on one side and exiting from the other. Entrance holes were plugged by the snow roof collapsing behind the birds. Mean length of drift burrows was 56 cm (range = 48–63 cm, N = 21). Mean depth (from snow surface to bottom of the burrow) was 30 cm (range = 26–35 cm, N = 21). The mean "roof" thickness above the roost site (i.e., above the dropping accumulation) was 9 cm (range = 8–11, N = 14). "Open-snow burrows" were made in soft, dry snow >25 cm deep and had a mean length of 110 cm (range = 74–152 cm, N = 30) and mean depth of 35 cm (range = 25–39 cm, N = 30). The mean roof thickness was 13 cm (range = 10–16 cm, N = 13). Open-snow burrows were longer (*t*-test, df = 49, $P < 0.001$), deeper (df = 49, $P < 0.001$), and had more snow over the burrow (df = 25, $P < 0.001$) than did drift burrows. These differences may have been due in part to the width and depth of snow drifts, which effectively limited the length or depth of a burrow. (Photos of a drift burrow [V06-1-014] and an open-snow burrow [V06-1-015] have been deposited at VIREO.)

The type of burrow observed varied with snow conditions. Drift burrows were used when drifts provided the only deep snow in which to burrow. Open-snow burrows only were observed when soft, dry snow >25 cm was available. Winter (15 November–15 March) weather data for 1983–84 and 1984–85 indicated that in over 75% of the precipitation events, the daily minimum temperature was at least 10°C lower for several days following precipitation. Therefore, dry snow was available for several days after most snow storms.

The widespread occurrence of snow burrowing among tetraonids suggests that the behavior is adaptive (i.e., it affects either survival *or* reproductive performance). Use of snow burrows has been suggested as a factor in survival of Ruffed Grouse (Gullion 1970) and White-tailed Ptarmigan (Braun and Schmidt 1971), and increased losses of Hazel Grouse and Black Grouse have occurred when snow cover was lacking and temperatures were extreme (Kuzmina 1961). But conclusive evidence that snow burrowing increases survival of Sage Grouse or other grouse species has not been reported.

For Sage Grouse, the timing and pattern of weight changes suggest that this behavior is linked to reproductive performance. Sage Grouse gain weight during winter, with most of the increase occurring between January and March, and peak weights occurring just prior to the beginning of breeding activities (Beck and Braun 1978). Male Sage Grouse lose weight during the strutting period, and losses for females are probably associated with incubation. Therefore, late winter weight gain appears related more to energy demands of breeding than to overwinter survival. If this is true, a behavior that conserves energy, such as snow burrowing, would contribute to breeding condition.

For an activity to contribute to energy saving, it must help maintain the body temperature above the temperature below which a resting grouse must increase its metabolic rate to meet environmental demands for heat. This lower critical temperature (LCT) is unknown for Sage Grouse; therefore, the actual contribution of snow burrowing to energy conservation cannot be determined. The LCT for captive Ruffed Grouse, however, ranged from a mean of −6°C in February to 0.3°C in March (Rasmussen and Brander 1973). The birds on our study area were exposed to temperatures below −10°C for 81 and 92 nights between 15 November and 15 March of 1983–84 and 1984–85, respectively. Thus, snow burrowing probably was an effective energy conservation behavior for more than 50% of the winter nights.

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Size of host egg and egg size in Brown-headed Cowbirds.—The North American Brown-headed Cowbird (*Molothrus ater*) is a brood parasite that lays its eggs in a variety of other birds' nests. Cowbirds exhibit variation in egg size both within and among females (Ankney and Johnson 1985), but it is unknown if this variation follows predictable intraclutch patterns as it does in some icterines (Howe 1976, Weatherhead 1985). Several studies on a variety of species have shown that the probability of survival of a particular hatchling increases with egg size or hatchling weight (e.g., Parsons 1970, O'Connor 1979). Here I report the results of a study aimed at determining whether cowbird egg size varies as a function of host egg size.

I measured cowbird eggs in 143 clutches parasitized with one or two (total 168) cowbird eggs in the collections of the Royal Ontario Museum, the National Museum of Canada, and Cornell University. Nests with more that two cowbird eggs were not used as they were assumed to be dump nests (Harrison 1975). Egg sets came from Ontario and Quebec (78%), the northeastern United States (13%), and the Canadian prairie provinces (9%). Although the last group probably included individuals of the race *artemisiae,* they showed no difference in mean size from those of the nominate race. The egg sets were from 42 species of seven families.