Key words: Red-breasted Nuthatch, *Sitta canadensis*, behavior, water balance, energetics, Montana

Snow and ice may be the only or most readily available sources of free water for birds living in regions experiencing extended periods of subfreezing temperatures. Many species of birds representing a broad diversity of dietary niches have been reported eating snow or ice (see Hendricks 1996 and references therein), but too often published accounts lack details and context for the behavior. It is worth reporting cases of wild birds eating snow and ice because such observations will eventually provide a clearer picture of the reliance of birds on frozen water, the conditions during which the behavior occurs, and insight into the role that ingesting frozen water has on a bird’s daily energy budget.

Water acquisition by nuthatches, including ingestion of snow and ice, appears to have been poorly documented (Pravosudov and Grubb 1993; Matthysen 1998; Withgott and Smith 1998; Ghalambor and Martin 1999; Kingery and Ghalambor 2001). Probably all North American nuthatch species eat snow or ice when conditions favor the behavior, but only Red-breasted Nuthatch (*S. canadensis*) and Pygmy Nuthatch (*S. pygmaea*) have been reported in the literature to do so (Mugaas and Templeton 1970; Kingery and Ghalambor 2001), and details are lacking in both accounts.

At 14:30 on 16 December 2006, I paused to watch with binoculars 3 Red-breasted Nuthatches about 10 m from me while they investigated and foraged on some Ponderosa Pine (*Pinus ponderosa*) snags in the Rattlesnake Creek drainage north of Missoula, Missoula County, Montana (elevation 1128 m, UTM zone 12: 275728E 5203042N). The nuthatches were feeding on pine nuts and caching pine nuts on trunk and limb bark. One of the birds, a male, paused while foraging on a horizontal limb about 4 m above ground and ate 2 bill-loads of granular snow over a 10-s period, then resumed his foraging. The other 2 nuthatches were not observed eating snow during this time, nor during the next 5 min, although each bird visited snow-covered ground and limbs while foraging. Air temperature was −2°C and had remained below freezing for the previous few days, although open flowing water was present in Rattlesnake Creek about 100 m distant.

Daily evaporative water loss for Red-breasted Nuthatches at and below freezing ambient temperatures is approximately 10 to 12% of body mass, or about 1 g (Mugaas and Templeton 1970). Water lost each day must be replaced, and this requires heating the ingested water (recovered as preformed water in food or as free water in the form of snow, ice or liquid) from ambient to core body temperature. To replace liquid water lost each day, when it is ingested in a frozen condition, requires 2.1 J to raise 1 g of ice by 1°C, 335 J to convert 1 g of ice at 0°C to liquid water, and about 4.2 J for every additional 1°C increase until core temperature is reached. Under extreme ambient conditions, where temperatures could reach −40°C, the energy required for Red-breasted Nuthatches to replace water that is lost each day just though respiratory evaporation could cost about 587 J if water is ingested as snow or ice. Under the conditions I observed the cost would be about 507 J. For mice twice the body mass of Red-breasted Nuthatches, approximately 13% of the daily winter energy budget is spent in heating to core temperature water ingested as ice (Bertheaux 2000).

The observations reported here and of Hendricks (1996) indicate that eating snow does not always result in a thermal cost to be avoided whenever possible. Under air temperatures slightly below 0°C, Red-breasted Nuthatch and Pileated Woodpecker (*Dryocopus pileatus*) ate snow rather than presumably making the extra effort to obtain liquid-phase water available nearby. Apparently there was not a sufficient energetic cost for the nuthatch to seek liquid water at the time of my observation, perhaps