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Bioenergetics Of Canada Geese At Rend Lake, Illinois

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ABSTRACT

Time budgets, daily energy expenditures, and food availability were estimated for Canada geese (*Branta canadensis*) wintering at Rend Lake, Illinois during October-February, 1984-87. Activities varied ($P < 0.05$) among habitats, seasons, years, and time-of-day, whereas daily energy expenditures varied < 5% among seasons or years. Waste grain and forage within 16 km of Rend Lake Refuge exceeded the energy needs of an estimated 4 million days of goose use. However, refuge foods supplied < 50% of the energy needed during hunting seasons when geese restricted 99% of foraging activities to the refuge and lost an average of 312 g/bird of total body weight.

INTRODUCTION

The ability of birds to secure sufficient food resources to meet energy needs determines much of their life history (Kendeigh et al. 1977). Using time-activity studies in conjunction with caloric equivalents of activities, an energy budget can be estimated (Frederick and Klaas 1982, Reinecke and Krapu 1986, Tacha et al. 1987). Evaluation of available food energy and total energy required by a population can reveal how well an area supports a population. A negative energy balance has been associated with decreased over-winter survival of waterfowl (Hepp et al. 1986, Perry et al. 1986); maintaining a positive energy balance among waterfowl is prudent.

Rend Lake Refuge is one of four southern Illinois areas providing most of the refuge wintering habitat for Canada geese of the Mississippi Valley Population. The dependency of geese on agricultural crops for food, relatively large wintering goose population (60,000-120,000), and small cropland area (315 ha) suggest that this refuge may not provide adequate food resources (Paine 1985). Our objectives were to estimate goose time and energy budgets, examine food availability on and off Rend Lake Refuge, and relate goose energy requirements to refuge food resources.

STUDY SITE AND METHODS

Rend Lake is a 7,650 ha impoundment of the Big Muddy River located in south central Illinois. Rend Lake Refuge comprises about 2025 ha of inviolate habitat (1410 ha lake, 315 ha cropland) on the northern portion of the lake. Paine (1985) and Pritchert (1988) described the study site in more detail.

Time budgets were calculated from diurnal and nocturnal behavioral observations and daily flight time estimates obtained October-February, 1984-87. Diurnal time allocations were estimated from instantaneous observations of flocks encountered along a survey route representative of available habitats, and nocturnal time allocations were estimated from data collected at roost sites (see Pritchert 1988). Daily flight time was determined from monitoring radio-marked geese two days per week from morning roost departure until evening roost return.

Diurnal time budgets were summarized for seven habitats (alfalfa/clover, corn, milo, soybean, wetland, winter wheat, and other), four seasons (Early Fall, Late Fall, Early Winter, and Late Winter), and 3 years (1984-85, 1985-86, and 1986-87). Daily flight data was summarized by season and year. Data were analyzed for significant variation ($P < 0.05$) using Analysis of Variance from the Statistical Analysis System (Ray et al. 1982); differences among means were identified using Tukey's Multiple Range Test.

Seasonal mean existence energy expenditures (EE) were estimated on the basis of goose body weights using Kendeigh et al. (1977:142-143) equations for nonpasserines at 30°C and 0°C for a 10-hour photoperiod. Time-budget data was converted to daily energy expenditures (DEE) using metabolic cost coefficients (MCC) for each activity (Frederick and Klaas 1982, Tacha et al. 1987). Proportion of time geese spent engaged in each activity was multiplied by the product of EE x MCC of that activity, and energy expenditures were summed to estimate seasonal DEE. Population energy requirements were estimated by multiplying goose-day-use (GDU) by DEE for that season. GDU was derived from weekly aerial survey data obtained from the Illinois Department of Conservation.

Goose weights (±10g measured with a spring scale) used to calculate EE were taken from specimens live-trapped and/or collected at the beginning of hunting season (October-November), shortly after hunting season (December), and just prior to spring migration (February). Weights were adjusted to reflect the same age and sex ratios in each collection period; these standardized age and sex ratios, (representative of the population of geese at Rend Lake) were derived from the average of trapped samples and Spitzkiet (1984), respectively.

Food availability was estimated using cropland records obtained from county Agricultural Stabilization and Conservation Service offices for an area within 16 km of Rend Lake Refuge. Grainfields were sampled to quantify waste grain availability immediately after harvest and after goose departure in spring during 1984-87 (Pritchert 1988). An additional sample was collected at the end of goose hunting season in December 1986. Forage fields were sampled during each season in 1986-87. Samples were oven dried and weighed to the nearest 0.1g. Dry weights were used to estimate kg/ha food available on and within 16 km of the refuge. Apparent metabolizable energy of foods were calculated from published values (Bushbaum et al. 1986, Fredrick et al. 1987).

RESULTS AND DISCUSSION

Time and Energy Budgets

Habitat, season, and year explained about 60% of the variation in diurnal goose activities. Activities differed more by habitat than any other variable. Rest, locomotion, and comfort totaled 86% of activities in wetlands, while feed, rest, and alert made up 89% of activities in uplands. Percentage of time allocated to alert and feed were highest and locomotion and rest were lowest in Early Fall (Table 1). Conversely, resting was highest in Early Winter when alert and feed were lowest. Foraging activity increased 43% in 1986-87 over that observed in 1984-85, while resting declined 57% between those years.

Rest comprised 95% of nocturnal activities, while comfort, locomotion, and alert made up the remaining 5%. Flight comprised a consistent 1% of diurnal activities.

Diurnal, nocturnal, and daily flight activities were combined into a 24-hour (diel) time budget (Pritchert 1988). About 70% of diel time was spent resting, 13% feeding, 8% engaged in locomotor activities, 4% comfort, 4% alert, and 1% in other activities.

Activities differed among seasons and years in direct response to changes in habitat use as reported by others (Pritchert 1988, Caithamer 1989). Wetlands were used as resting areas because they provide security from predators (Raveling et al. 1972). Resting was also the primary activity during nocturnal periods; however, it was not the only night activity as has been assumed by other authors (Fredrick and Klaas 1982).

Overall mean weights of geese were 3,545 g in 1984-85, 3,433 g in 1985-86, and 3,457 g in 1986-87. Comparison of weights taken at beginning and end of hunting revealed declines of 13% and 4% during October-December in 1985 and 1986, respectively. Weights obtained in December-February showed increase of 6% in 1985-86 and 4% in 1986-87.

Existence energy was highest in Early Winter (Table 2), 14% higher than observed in Early Fall. Conversely, MCC for daily activities declined 12% during the same period (Pritchert 1988). However, daily energy expenditures varied < 5% among seasons or years.

Walsberg (1983) suggested avian existence energy expenditures are completely obligatory and influence productive energy expenditures (activities); results from this study support his theory. Seasonal energy budgets indicated EE increased as temperatures declined through Late Fall and Early Winter (Table 2). Geese responded to increased EE demands by engaging in less costly activities (e.g., rest) to reduce productive energy expenditures.

Energy Needs and Availability

Aerial surveys suggested about 4 million GDU per year for the Rend Lake area during October-February, 1984-87 (Table 2). Population levels peaked near 60,000 geese during Early Winter. Population energy expenditures were an estimated 2.1 billion kcal per year.

Waste corn on and within 16km of Rend Lake refuge averaged 139 kg/ha immediately after harvest and ranged from a low of 122 kg/ha in 1984-85 to 158 kg/ha in 1985-86 (Pritchert 1988). Soybean totals were 233 kg/ha in 1985-86 and 119 kg/ha in 1986-87. An additional 2,280 kg/ha of green forage was provided by forage foods (alfalfa/clover and winter wheat).

Forage represented about 58% of the total energy available to geese in 1986-87 (Table 3). Corn provided 24% and soybeans the remaining 18%. Total forage declined 82%, corn 87%, and soybean 96% by time geese departed in spring (Pritchert 1988).

Available metabolizable energy within 16km of Rend Lake Refuge, as calculated from 1986-87 food availability data totaled about 29 billion kcal (Table 3). This exceeded population energy requirements (2.1 billion kcal) needed for geese to maintain body weight through winter.

Although adequate energy was available within 16km, the refuge was unable to support geese in a positive energy balance during hunting. About 99% of the geese observed during each hunting season were on the refuge (Pritchert 1988). The refuge supplied only 34% of energy required by geese during the 1986 hunting season (Table 4). Assuming forage availability (kg/ha) was equal between years, the refuge supplied about 41% and 42% of the energy needed during the 1984 and 1985 hunting seasons, respectively.

Refuge crops were harvested prior to hunting in 1986, making about 290 million kcal of metabolizable energy available on Rend Lake Refuge. Geese lost weight during the 1986 hunting season, despite reductions in productive energy expenditures, because refuge foods provided only a third of the energy needed for geese to maintain body weight.

Crop harvest chronology on the refuge could be in part responsible for a negative energy balance observed in 1985. During that year, harvest did not occur until hunting was almost over. Although geese further reduced energy-costly activities, weight loss was over 3 times that observed in 1986.

CONCLUSIONS AND RECOMMENDATIONS

Rend Lake Refuge could not support the energy needs of Canada geese when they were restricted to the refuge during hunting. If management goals are to maintain birds in good physical condition in an effort to increase over winter survival and/or reduce possible declines in subsequent productivity, then adequate food resources must be available to meet population needs during hunting. To insure this it may be necessary to increase refuge cropland or modify refuge farming practices to provide needed foods.

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Table 1. Percentage diurnal time allocations and the habitats and seasons with the highest percentages of each goose activity. Data are from observations of 1,958 flocks of Canada geese at Rend Lake, Illinois, October-February, 1984-87.

Activity	Percent Time	Habitat High	Seasonal High
Alert	8	Corn/Milo	Early Fall
Comfort	6	Wetland	Late Fall
Feed	31	Alfalfa/Clover	Early Fall
Locomotion	15	Wetland	Late Fall
Rest	39	Wetland	Early Winter
Other	1	---	--
Total	100	---	--

Table 2. Mean seasonal existence and daily energy expenditures, goose-day-use, and population energy requirements of Canada geese using Rend Lake, Illinois, October-February, 1984-87.

Season	Existence Energy (kcal/bird/day)	Energy Expenditures (kcal/bird/day)	Goose-Day-Use (x 1000)	Population Energy Needs (mill kcal)
Early Fall	273	469	148	70.7
Late Fall	308	490	341	166.3
Early Winter	318	479	2087	976.6
Late Winter	317	496	1524	764.9

Table 3. Food available on and within 16 km of Rend Lake Refuge during fall, 1986.

Habitat	Hectares	kg/ha	Metabolizable Energy (kcal/kg)	Available Energy (mill kcal)
Corn	12,995	137	3,960	7,050
Soybean	12,683	119	3,660	5,224
Wheat	7,533	235	1,220	2,160
Alfalfa/Clover	5,839	2,047	1,240	14,821
Total				29,255

Table 4. Available food energy and goose energy requirements of Rend Lake Refuge during the 1984-86 hunting seasons.

Year	Goose Day-Use (x 1000)	Population Energy Needs (mill kcal)	Available Energy (mill kcal)	Percent Weight Loss
1984	288	110	46	---
1985	996	513	212[a]	13
1986	1,665	854	288	4

[a] Grain crops were harvested during last week of goose hunting.