Energy Utilization of Natural Prey Items by Southeastern Bobcats

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Abstract: Energy utilization of natural prey items by Mississippi bobcats (*Felis rufus*) was measured and annual prey requirements were estimated. Male and female bobcats were fed 5 diets of natural prey items, December 1990–February 1991. There were significant differences in amount of energy (kcal) in prey items, with white-tailed deer (*Odocoileus virginianus*) meat (5.7295) greater ($P < 0.05$) than fox squirrel (*Sciurus niger*) (5.0304). The deer diet also was significantly greater ($P < 0.05$) than the rodent diet and the rabbit and rodent diets in metabolizable energy (ME) and metabolizable energy content (kcal ME/g DM), respectively. Digestion coefficients for dry matter differed between diet types with the deer diet (81.3%) significantly greater ($P < 0.05$) than the rodent (63.68%) and rabbit (63.88%) diets. There were no significant differences ($P > 0.05$) between male and female bobcats in digestion efficiency of dry matter or energy (kcal). Energy values obtained in this study were used to determine the minimal mean number of prey species an average bobcat would require annually to survive. Based on proportions of prey found in current food habits studies, a female bobcat (8.17 kg) would require 94 rabbits, 101 squirrels, 226 cotton rats, 576 white-footed mice, and 0.7 white-tailed deer while a male bobcat (9.09 kg) would require 102 rabbits, 110 squirrels, 245 cotton rats, 624 white-footed mice, and 0.76 white-tailed deer annually to survive.

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States that allow harvesting (hunting or trapping) of bobcats are required to assess population status and to subsequently manage this species as a result of the

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bobcat's listing in Appendix II of the Convention on International Trade of Endangered Species of Flora and Fauna (CITES). Although bobcat populations are not currently threatened with overharvest because of restrictions on international trade of other spotted cats, close monitoring is necessary to detect any significant changes in population levels. Monitoring changes in prey populations may predict changes in bobcat populations and perhaps provide a means of indirectly monitoring status of the bobcat population. However, there must be a base knowledge of the bobcat's annual prey requirement to determine how fluctuations in prey population size will subsequently impact bobcats. Results from this study will provide a baseline data set for energy utilization of common prey items of bobcats in the Southeast.

Diet of the southeastern bobcat has been well documented using analysis of scats (Kight 1960, Kitchings and Story 1979, Wassmer et al. 1988) and stomach contents (Davis 1955, Hall 1973, Beasom and Moore 1977, Fritts and Sealander 1978, Buttrey 1979, Davis 1981, Maehr and Brady 1986). However, amount of energy bobcats receive from consuming each prey item is not well understood. Determining the amount of a prey species needed to support a bobcat requires knowledge of the amount of energy gained from the prey item (prey assimilation). This study provides baseline data for energy values of common prey items by the southeastern bobcat, establishes guidelines for determining number of prey items a bobcat requires annually, and provides insight into determining nutritional carrying capacity. Funding was provided in part by the Mississippi Agriculture and Forestry Experiment Station, Mississippi Department of Wildlife, Fisheries and Parks (MDWFP), and the Mississippi Chapter of Safari Club International. We thank all the MDWFP personnel for providing prey items, especially E. Cliburn, R. Griffin, and J. Hazelwood. Thanks also to R. Hammer for his help in preparing samples and C. Aultman for completing all lab analyses of samples. Thanks to all the work study students for their care of the bobcats. This is MAFES manuscript number PS-8278.

Methods

Research was conducted at the captive bobcat research facility located on the Mississippi Agricultural and Forestry Experiment Station's Blackjack research site. Each bobcat was housed individually in an outdoor pen approximately 6 x 6 x 3 m in size and containing ramps, tunnels, and scratching posts.

Bobcats used for this study were chosen based on their behavior. Bobcats at the facility habitually urinate and defecate in a litter tray filled with approximately 1.27 cm of water, and it was important that those selected would continue to use this litter pan and adjust to urinating and defecating into a dry litter pan. Bobcats used in this study were randomly assigned to each diet trial. Number of bobcats on each diet and length of each trial was, in part, determined by the amount of available prey items. Therefore, number and sex ratio of bobcats on each diet varied. Bobcats ranged from 1.5 to 9 years of age and weighed between 5.45 and 10.45 kg. Bobcats were not restrained in a metabolism cage, but were free to move about (i.e., walking, running, playing, and jumping) in their pen to better simulate conditions of a wild, free-ranging individual. All bobcats were exposed to the same ambient temperature and photoperiod. Water was provided ad libitum. All bobcats were weighed at the initiation and termination of each diet trial.

Five prey items were used as diet types based on their high occurrence in the diet of southeastern bobcats (Davis 1955, Hall 1973, Beasom and Moore, 1977, Fritts and Sealander 1978, Maehr and Brady 1979). Five diet types were established: gray squirrel (*Sciurus carolinensis*), fox squirrel (*S. niger*), cottontail rabbit (*Sylvilagus floridanus*), white-tailed deer (*Odocoileus virginianus*), and small rodents (approximately 50:50 cotton rats *Sigmodon hispidus* and white-footed mice *Peromyscus* spp). All prey items were collected in central and south-central Mississippi. Squirrels, rabbits, and rats and mice were fed as whole carcasses. However, tails of squirrels were removed prior to feeding because it was found that they were not eaten by bobcats during preliminary trials. Two white-tailed deer were obtained from MDWFP and were cut into 454-g cubes of solid meat or into 113.5 g sections of hide (skin and hair). Previous studies offered ground prey items (Jense 1968, Litvaitis and Mautz 1976, Davison et al. 1978); however, we believed that offering prey items as whole carcasses (or large sections of meat) best simulated what the bobcat would consume in the wild.

All food material for each bobcat was weighed prior to feeding. Bobcats on the gray squirrel diet were fed 2 squirrels/day ($\bar{x}$ = 878 g, SE = 4), while those on the fox squirrel diet were fed 1 squirrel/day ($\bar{x}$ = 805 g, SE = 17). Each bobcat was fed 1 rabbit/day ($\bar{x}$ = 1298 g, SE = 44). Each bobcat was fed 454 g of deer meat with a 113.5-g section of hide each day. A 4:1 meat to hide ratio was used to approximate the proportion of hide that we believed the bobcat might consume in obtaining the meat. Each bobcat was fed a 454-g mixture, approximately 50:50, of cotton rats and white-footed mice daily (individual cotton rat: $\bar{x}$ = 105 g, SE = 3; white-footed mouse: $\bar{x}$ = 24 g, SE = 2). Number of male and female bobcats used in the trials varied for each prey type: rabbit and deer (3M, 5F), rats/mice (2M, 3F), and gray and fox squirrel (1M, 4F and 2M, 2F, respectively). Diet trials were conducted from December–February 1990–1991. Length of each trial varied: gray and fox squirrel, 13 days; rabbit, 9 days; deer and small rodents, 6 days. The first several days on each trial served as an adjustment period.

Any portion of the prey item not consumed (orts) was collected, weighed, and frozen daily. Urine and feces were collected daily (4–9 days) following a 2- to 4-day adjustment period. A preliminary trial with a wire mesh screen covering the litter pan allowing separate collection of urine and feces resulted in bobcats no longer using litter pans. Therefore, urine and feces were not separated during trials. Ten milliliters of 95% hydrochloric acid (50:50) was added to urine and feces at time of collection to prevent loss of nitrogen as ammonia from urine. Urine and feces were stored frozen in sealed plastic containers. Three samples of each prey item were ground with an electric grinder. A bobcat (roadkill) was ground and used to determine proximate and gross energy values and used to adjust for weight gain or loss >3% of initial body mass on any diet trial. Ground material was labeled and frozen until all samples were prepared and ready for analyses. Total orts collected for each bobcat on each diet trial were combined and ground with an electric grinder and frozen for later analysis. Urine and feces collected for each day were dried in a drying oven (105° C) for 48 hours, and daily dry mass was obtained. All urine and feces were pooled for each bobcat on each diet and ground in a Wiley mill with a 1-mm screen. All samples (prey, orts, and urine and feces) were analyzed by the Mississippi State University Animal and Dairy Sciences Nutrition Laboratory. Energy content (kcal/dry g) was determined using a standard adiabatic oxygen bomb calorimeter. Two to 3 replications were completed on each sample to ensure precise results. Nitrogen content also was determined, but will not be reported here.

Gross energy (GE) intake of a prey item by each bobcat was determined by multiplying energy (kcal/g DM) of the prey item by amount (g DM) of prey offered, less total amount of energy remaining in the uneaten orts (kcal GE/g DM). Energy values (kcal/g DM) of orts were used in GE intake determinations to adjust for possible differences in energy values of prey items and the respective orts. Metabolizable energy (ME) of a prey item was calculated as GE (kcal) intake minus energy lost in urine and feces (kcal) divided by GE intake (kcal). Metabolizable energy content (kcal ME/g DM) of the prey item was determined by multiplying gross energy content of the prey item (kcal GE/g DM) by its ME. Daily metabolizable energy intake as a function of bobcat metabolic rate (kcal ME/$kg^{0.75}$) was determined by multiplying daily GE intake (kcal), adjusted for bobcat metabolic rate (kcal/$kg^{0.75}$), by ME.

Because of how urine and feces were collected in this study, digestion efficiency of energy as metabolizable energy efficiency (i.e., percentage of gross energy metabolized) will be reported rather than apparent digestibility. Metabolizable energy efficiency examines total amount consumed (kcal) less amount lost in urine and feces (kcal) as a ratio to total amount consumed whereas apparent digestible energy excludes urine. However, metabolizable energy efficiency would better estimate the animal's requirements for maintenance due to the potentially large amounts of energy lost in urine.

Two-way analysis of variance (factors = sex and diet) using ranks (Conover and Iman 1981) was used to test for differences in digestion efficiency of dry matter and energy, and change in body mass of bobcats (dependent variable) between diets and for interaction between diet and sex. Data were ranked because of small sample sizes. Two-way analysis of variance using ranks also was used to test for differences in mean gross energy intake, energy content of urine and feces, dry mass of urine and feces produced daily, and daily energy lost in urine and feces. Kruskal-Wallis and means separation tests were used to determine differences in energy content (kcal GE/g DM) of the 5 diet types, between energy (kcal GE/g DM) of prey and orts for each prey type, and mean body mass of male and female bobcats across diets. All statistical analyses are evaluated for significance at a probability level of 0.05.

Results

Males were significantly heavier than females ($P < 0.05$) (Table 1). Initial body mass ($kg^{0.75}$) for male and female bobcats across diet type was not significantly different ($P = 0.609$ female, $P = 0.295$ male). Body mass change, from the

Table 1. Mean initial body mass ($kg^{0.75}$) and mean change in mass while on each diet for male and female bobcats during feeding trials between December 1990 and February 1991.

Diet	Sex	*N* Bobcats	Days on Diet	Initial Mass	Mass change
Fox squirrel	M	2	13	4.735 (0.105)[a]	+0.30 (0.09)
	F	2	13	4.825 (0.605)	+0.20 (0.01)
Gray squirrel	M	1	13	5.230	+0.39
	F	4	13	4.165 (0.134)	+0.32 (0.13)
Cottontail rabbit	M	3	9	5.427 (0.113)	−0.03 (0.08)
	F	5	9	4.494 (0.333)	−0.09 (0.01)
Rodent	M	3	7	5.330 (0.290)	−0.21 (0.02)
	F	5	7	4.147 (0.073)	+0.03 (0.09)
White-tailed deer	M	3	6	5.397 (0.180)	−0.10 (0.10)
	F	5	6	4.406 (0.378)	+0.05 (0.12)

[a]Standard error of the mean.

beginning to termination of each diet trial, did not significantly differ ($P \nless 0.05$) among diets or between sexes (Table 1).

Gross energy (kcal/g DM) of prey items differed, with deer (5.73) greater ($P > 0.05$) than fox squirrel (5.03); however, all other diets were similar ($P > 0.05$) (Table 2). Daily dry matter (g) and gross energy (kcal) intake and daily dry matter and gross energy intake per metabolic unit ($g/kg^{0.75}$ and $kcal/kg^{0.75}$) were not significantly different between male and female bobcats ($P > 0.05$) and therefore data were pooled within diet. There was a significant difference in daily dry matter (g and $g/kg^{0.75}$) and gross energy (kcal and $kcal/kg^{0.75}$) intake among diet types ($P < 0.001$ (Table 2). It should be noted that the deer diet was not fed *ad libitum*. Bobcats were offered a pre-weighed amount of deer meat (454 g) and skin and hair (113 g). This amount (g) of deer diet was offered to approximate amount of meat (excluding bone and viscera) offered on the other diet types.

Energy content of orts differed from energy content of diet material offered for rodent ($P = 0.018$) and rabbit ($P = 0.006$) diets. Energy of orts from the rodent diet

Table 2. Energy content (kcal/g DM) of diets fed to captive bobcats from December 1990 to February 1991 (dry matter basis) and mean gross energy intake (kcal and $kcal/kg^{0.75}$) for each diet.

				Dry matter intake		Gross energy intake	
Diet	*N*[a]	% DM	kcal/g DM[b]	g	$g/kg^{0.75}$	kcal	$kcal/kg^{0.75}$
Fox squirrel	4	30.2	5.03 A[c]	231.46 AB	48.92 AB	1161.44 AB	245.55 AB
Gray squirrel	5	30.2	5.31 AB	257.72 AC	59.20 AC	1355.33 AC	312.36 AC
Cottontail rabbit	8	29.7	5.24 AB	320.10 A	66.44 A	1719.84 A	356.38 A
Rodent	5	27.7	5.35 AB	110.20 B	24.05 B	585.07 B	127.64 B
White-tailed deer	8	27.5	5.73 B	143.91 BC	31.00 BC	877.97 BC	188.91 BC
Bobcat	1	31.2	5.28				

[a]Number of bobcats on each diet type.
[b]Three portions (as fed) of each diet type were used to determine energy (kcal/g DM) and dry matter (% DM) values.
[c]Means in a given column followed by like letters are not significantly different ($P > 0.05$).

(5.67 kcal GE/g DM) was significantly greater than energy of the rodent diet offered (5.35 kcal GE/g DM). Energy of orts from the rabbit diet (4.5089 kcal GE/g DM) was significantly less than the rabbit diet offered (5.24 kcal GE/g DM). Energy content of orts from both the gray squirrel and fox squirrel diets did not differ from energy content of respective diets ($P > 0.05$). There were not enough orts from the deer diet to analyze.

Differences in urinary-fecal energy (kcal GE/g DM) existed between the deer diet (highest, 3.75) and the rabbit diet (2.75), fox squirrel diet (2.73), and gray squirrel diet (lowest, 2.57) ($P < 0.001$) (Table 3). There were significant differences among diet type in daily dry mass of urine-feces produced (g DM and g DM/kg$^{0.75}$) and in amount of energy (kcal GE) lost daily in urine-feces, with the rabbit diet significantly greater than the rodent and deer diets ($P < 0.001$) (Table 3). Significant differences did not exist in amount of urinary-fecal energy (kcal GE/g DM, kcal lost daily, and daily g/kg$^{0.75}$) between males and females ($P > 0.05$). Therefore, energy values for urine-feces for males and females were pooled within diet type. Dry matter digestibility ranged from 81.3% for the deer diet to 63.68% for the rodent diet. The dry matter digestion coefficient for the deer diet was significantly ($P < 0.05$) greater than both the rabbit (63.88%) and rodent (63.68%) diets. The fox squirrel (71.44%) and gray squirrel (69.78%) diet dry matter digestion coefficients were not significantly different from each other nor any of the other diet types.

Values for partitioning daily gross energy (GE) represent pooled data from males and females due to no significant difference between sexes (Table 4). Daily metabolizable energy (ME) differed among diet type, with the rodent diet (78.51) less than the deer diet (88.27) ($P < 0.05$) (Table 4). Metabolizable energy (kcal ME/g DM) of prey items differed across diet type, with the deer diet (5.06) significantly greater than the rabbit (4.26) and the rodent (4.20) diets. Daily metabolizable energy intake (kcal/kg$^{0.75}$) differed among diets, with intake on the rabbit diet greater than the rodent and deer diets (289.59, 100.21, and 166.75 respectively) ($P < 0.05$). Daily metabolizable energy intake (kcal/kg$^{0.75}$) consumed on the gray squirrel diet (266.49) also was significantly greater ($P < 0.05$) than the amount consumed on the rodent diet.

Discussion

Gross energy content of rabbits used in this study (5.2396 kcal/g DM) were similar to those reported in other studies for rabbit including Jense (1968): 5.441, and Moors (1977): 4.95. Differences in energy content could possibly be attributed to different species of rabbits used in the studies. Jense (1968) collected rabbits in New Hampshire while Moors (1977) collected in Scotland. Due to regional differences of the rabbits, diet and thus body composition of the rabbits may vary. Energy content of deer (5.7295 kcal GE/dry g) in this study is lower than other reported values for meat and viscera (Davison et al. 1978: 6.631, Litvaitis and Mautz 1980: 5.90, McCullough 1983: 5.807, and Powers 1989: 6.51). Golley et al. (1965) reported gross energy for deer meat free of fat and skin as 5.629 kcal/g DM, which is similar

Table 3. Gross energy content of urine-feces, urine-feces produced daily, and dry matter and gross energy lost daily in urine-feces from captive bobcats fed 5 natural diets in Mississippi during December 1990 to February 1991.

		Urine-feces produced		Dry matter urine-feces		Gross energy urine-feces		Gross energy urine-feces	
Diet	N[a]	g DM[b]	S.E.	$g/kg^{0.75}$[c]	S.E.	kcal	S.E.	kcal/g DM[e]	S.E.
Fox squirrel	3	64.83 AB[f]	14.16	14.83 AB	3.89	176.06 AB	33.97	2.73 A	0.073
Gray squirrel	4	77.29AC	5.08	17.79 AB	1.35	199.40 AB	14.92	2.57A	0.049
Cottontail rabbit	6	115.36A	19.24	24.61 A	2.80	322.32 A	62.40	2.75 A	0.060
Rodent	5	39.07 BC	3.01	8.58 B	0.80	125.76 B	8.39	3.15 AB	0.049
White-tailed deer	6	27.23 B	2.27	6.09 B	0.31	103.00 B	9.12	3.78 B	0.089

[a]Number of bobcats that urine and feces were collected for each diet. Sample size on several diets are smaller than the number of bobcats receiving diets due to 2 of the bobcats only defecating in the litter tray.
[b]Mean daily dry mass (g) of urine and feces (combined) produced by bobcats.
[c]Mean daily urine and feces (combined) produced $g/kg^{0.75}$ by bobcats.
[d]Gross energy (kcal/g DM) of urine and feces (combined) produced by bobcats.
[e]Mean gross energy (kcal/g DM) of bobcat urine and feces (combined) determined by standard bomb calorimetry procedures.
[f]Means in a given column followed by like letters are not significantly different ($P > 0.05$).

Table 4. Partition of daily gross energy (GE) in captive bobcats fed 5 natural diets during December 1990 and February 1991 in Mississippi.

Components	Units	Gray squirrel	Fox squirrel	Rabbit	Rodent	Deer
Sample size (N)[a]		4	3	6	5	6
Daily GE intake	kcal	1,355.33 AC[b]	1,161.44 AB	1,719.84 A	585.07 B	877.97 BC
Daily GE intake	$kcal/kg^{0.75}$	312.46 AC	245.55 AB	356.38 A	127.64 B	188.91 BC
Daily GE lost in urine/feces	kcal	199.40 AB	176.06 AB	322.32 A	125.76 B	103.00 BC
Urinary/fecal energy	%ME	14.71 AB	15.16 AB	18.74 AB	21.49 A	11.73 B
Metabolizable energy	%ME	85.29 AB	84.84 AB	81.26 AB	78.51 A	88.27 B
Metabolizable energy content	kcal ME/g DM	4.53 AB	4.27 AB	4.26 A	4.20 A	5.06 B
Daily metabolizable energy intake	$kcal/kg^{0.75}$	266.49 AC	208.32 AB	289.59 A	100.21 B	166.75 BC

[a]Number of bobcats on each diet which calculations are based.
[b]Means in a given row followed by like letters are significantly different ($P > 0.05$).

in this study. There are limited studies that have used white-footed mice, cotton rats, and squirrels as diets. The value obtained for the rodent diet (5.35 kcal GE/g DM) falls between 5.17 and 5.51 for white-footed mice reported by Davison et al. (1978) and Powers (1984). A value for cotton rats from another study could not be found. The gray squirrel energy content (5.3137 kcal GE/g DM) is slightly lower than that reported by Powers (1989) (5.54 kcal GE/g DM) in New Hampshire.

The high dry matter digestibility values for the deer diet can be attributed to the absence of bone in the diet, whereas low dry matter digestibility of the rodent diet may be from the higher proportion of bone and hair. Daily gross energy intake (kcal/ $kg^{0.75}$) ranged from 356.4 for the rabbit diet to 127.6 for the rodent diet. The wide range of daily gross energy intake could be attributed to differences in gross energy content of prey items, as well as consumption (g DM) of each prey item. The expectation that bobcats require lower quantities of prey items with high energy values and larger quantities of those prey items with lower energy values was not consistent with the eating habits of the bobcats. Consumption rates and feeding behavior differed among diets. Bobcats typically did not eat viscera of rabbits, and left many whole rodents uneaten. Intake of rodents was low, possibly indicating that rodents are perhaps a less palatable diet type. Bobcats spent more time mock killing and playing with the rodents than with other prey types.

Energy content of rabbit and rodent orts differing from the respective diet material implied that bobcats were either selecting energy-high portions of the diet or consuming or leaving more palatable or unpalatable portions regardless of energy content. For the rabbit diet, orts were lower in energy content than the diet material. Most rabbit orts consisted of viscera, feet, hair, and occasionally the head, material a bobcat would typically discard. However, rodent diet orts were significantly greater in gross energy content than the diet material offered. These orts mainly consisted of intact rats and mice and viscera. Difference in gross energy content could be a result of the bobcats selectively consuming only the smaller (*Peromyscus*) or larger (*Sigmodon*) of the rodents offered.

Golley et al. (1965) reported that bobcats partitioned energy in cottontail rabbits similar to values found in this study. They reported metabolizable energy (ME) as 84.8%, compared to 81.3% in this study. However, daily GE intake (kcal/$kg^{0.75}$) for bobcats was 239.4 from Golley's study, much lower than the 357.4 in this study. This indicates that the bobcats on Golley's study did not consume as much of the prey item, but assimilated prey material similarly. Although the bobcats on this study were not fed the deer diet *ad libitum,* daily gross energy intake (188.91 kcal/ $kg^{0.75}$) was within the range of values reported in other studies of carnivores fed white-tailed deer (Golley et al. 1965, Jense 1968, Litvaitis and Mautz 1976, Davison et al. 1978, Litvaitis and Mautz 1980, Powers 1989). Of the 2 other studies using bobcats fed white-tailed deer, Powers (1984) reported a higher intake value (251.6) while Golley et al. (1965) reported a lower value (115.7) than we observed (188.9). Metabolizable energy (88.27) (ME) was higher in this study than all others reported for carnivores fed a deer diet (79.5%–87.9%). Overall, values on the rodent diet found were slightly lower than values reported in other studies, especially in daily

GE intake (Moors 1977, Davison et al. 1978, Litvaitis and Mautz 1980, Powers 1989). Powers (1989) reported a value of 181.8 kcal/kg$^{0.75}$ for daily GE intake for bobcats fed small mammals (56% woodland jumping mice, 25% meadow voles and red-backed voles, and 19% white-footed mice), which is higher than our value 127.6 kcal/kg$^{0.75}$. However, ME for this study (78.51%) was slightly higher than the value reported by Powers (1989) (71.6). The low GE intake of the rodent diet along with feeding behavior again suggests that the bobcats did not "prefer" a rodent diet. Only 1 other study used gray squirrel as a diet type and none used fox squirrel as a diet type. Powers (1989) reported a daily GE intake of gray squirrels by bobcats of 143.7 kcal/kg$^{0.75}$, much less than our value of 312.5 kcal/kg$^{0.75}$. Given this wide variance in intake of squirrel, it is difficult to compare other values.

Metabolizable energy efficiency was highest for the deer diet (88.3%) and lowest for the rodent diet (78.5%). Most other digestion efficiency studies reported apparent digestible energy, making comparisons difficult. However, Moors (1977) examined metabolizable energy efficiency rates for weasels (*Mustela nivalis*) fed 4 natural diets. Values from this study and those reported by Moors (1977) are similar.

Metabolizable energy efficiency and gross energy values were used to estimate numbers of each prey species an average male and female bobcat would require for survival. Mass of male and female bobcats used differed significantly; therefore, required amount of prey is reported separately for each sex. Annual requirements for bobcats were determined using methods of Powers (1989). Fasting metabolic rate (FMR) of bobcats was 86 kcal/kg$^{0.75}$/day for all seasons of the year (Gustafson 1984) and 89 kcal/kg$^{0.75}$/day for spring and summer (Mautz and Pekins 1989). Active metabolic rate for Mississippi bobcats was 172 kcal/kg$^{0.75}$/day (VanDomelen 1992), determined by measuring oxygen consumption of adult male and female bobcats (non-post absorptive state) while walking on a treadmill at 3.2 kmph. This value (172 kcal/kg$^{0.75}$/day) which is approximately twice FMR values reported by Gustafson (1983) and Mautz and Pekins (1989) was used in calculations to determine annual prey requirements. Metabolizable energy (kcal ME/g DM) was used to determine energy content of the prey species (kcal/g fresh).

A female bobcat (4.83 kg$^{0.75}$) in the Southeast would require either 185 rabbits, 512 gray squirrels, 292 fox squirrels, 2,469 cotton rats and 11,075 white-footed mice, or 8.0 white-tailed deer (60% of live mass of a 45.45 kg) to sustain itself for 1 year. A male bobcat (5.23 kg$^{0.75}$) would require either 200 rabbits, 554 gray squirrels, 316 fox squirrels, 2,674 cotton rats and 11,992 white-footed mice, or 8.7 white-tailed deer to sustain itself for 1 year. Based on results from studies of percent occurrence of prey species in stomachs of southeastern bobcats (David 1955, Fritts and Sealander 1978), the 5 prey items used in this study comprise 86.8% of the bobcat's diet (51.1% rabbit, 12.6% squirrel, 9.15% cotton rat, 5.2% white-footed mouse, 8.75% white-tailed deer). If it is assumed that the southeastern bobcat's diet is composed of only these 5 diet types, then a female bobcat (4.83 kg$^{0.75}$) would require 94 rabbits, 101 squirrels, 226 cotton rats, 576 white-footed mice, and 0.70 (approximately 32 kg) white-tailed deer to sustain itself for 1 year. A male bobcat (5.23 kg$^{0.75}$) would require 102 rabbits, 110 squirrels, 245 cotton rats, 624 white-

footed mice, and 0.76 (approximately 35 kg) white-tailed deer. The following is an example calculation for gray squirrel:
metabolic weight:

$$9.09 \text{ kg male bobcat} = 5.23 \text{ kg}^{0.75}$$

annual kcal required by male bobcat:

$$5.23 \text{ kg}^{0.75} \times 172 \text{ kcal/kg}^{0.75}\text{/day} \times 365 \text{ days/year} = 328339 \text{ kcal/year}$$

kcal/g fresh gray squirrel:

$$4.5305 \text{ kcal ME/g DM} \times 30.2126\% \text{ dry matter} = 1.3688 \text{ kcal/fresh g gray squirrel}$$

kcal/gray squirrel:

$$1.3688 \text{ kcal/fresh gray squirrel} \times 432.61 \text{ g/gray squirrel} = 592.156 \text{ kcal/gray squirrel}$$

annual gray squirrel required to sustain a male bobcat:

$$328339 \text{ kcal/year/male bobcat} \div 592.156 \text{ kcal/gray squirrel} = 554.5 \text{ gray squirrels/year/male bobcat}$$

Estimates presented here are minimal values. These values are for captive animals allowed some activity, but activity levels of wild, free ranging bobcats may be quite different. These estimates should be inflated to better estimate energy needs of a wild, free-ranging bobcat, especially to accommodate pregnancy and lactation. Periods of extreme weather (hot or cold) and food shortages (e.g., during drought) also will influence basic food requirements of the bobcat. Surviving these harsh conditions involve additional energy requirements for thermoregulation and traveling farther distances to find adequate supplies of food and water.

Although deer would appear to be the optimal food for bobcats based on the high metabolizable energy content and the large amount of food provided, deer are a seasonal food source, usually found in southeastern bobcat's diet only in fall and winter. Based on results from this study, 1 deer (45 kg with 60% edible meat and viscera) would provide the same amount of metabolizable energy as 23 rabbits or 100 squirrels. The small body size of southeastern bobcats further limits the consumption of deer. Depending on availability and ease of capture, rabbits would be the most energy "conscious" prey for bobcats to chase, capture, and consume. If consuming only 1 type of prey, a bobcat would need to capture 1 rabbit to every 4.3 squirrels.

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