

# Feeding wild American black bears in Virginia: a survey of Virginia bear hunters, 1998–99

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**Abstract:** Some bear hunters in Virginia, primarily houndsmen, feed American black bears (*Ursus americanus*) to attract them to hunting sites, but also because some hunters believe that supplemental food improves bear reproduction and survival. However, a regulation prohibiting unauthorized feeding of bears, deer (*Odocoileus virginianus*), and turkey (*Meleagris gallopavo*) on national forest and state-owned lands in Virginia became effective 1 July 1999. We sent a survey to all members of the Virginia Bear Hunters Association (VBHA) ( $n = 459$ ) to determine the amount of food provided to bears by hunters between 1 July 1998 and 30 June 1999. Survey response rate was 52%. One hundred thirteen of 238 (48%) survey respondents spent \$18,378 on supplemental food during that time. One hundred twenty-eight respondents provided 2,942,394 kilograms of food to bears between 1 July 1998 and 30 June 1999. Whole-shelled corn, pastries, and rendered animal fat (grease) accounted for 58% of the total mass; however, whole-shelled corn, pastries, and bread were the 3 most common foods offered. July, August, and September were the months during which most respondents fed bears. Food supply can affect reproduction, survival, harvest rates, nuisance occurrences, population size, and distribution of bears. If supplemental feeding has an effect on bear population dynamics, changes in regulations regarding feeding may negatively impact black bear populations, as well as public relations and future cooperation between wildlife agencies and hunters.

**Key words:** American black bear, baiting, human dimensions, hunting, supplemental feeding, survey, *Ursus americanus*, Virginia

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Bear hunters in western Virginia have a long tradition of feeding American black bears on public and private lands. Their intent is to attract bears to areas they plan to hunt, but also to improve reproduction and survival by improving nutritional condition and to observe and photograph or videotape bears in their natural habitat. The amount of supplemental food provided to bears by bear hunters in Virginia (Ryan 1997), and the effects of supplementary food on black bear population dynamics, are unknown.

Feeding bears in Virginia is different from baiting, which usually implies intent to kill an animal while it is using a bait site. In 1983, baiting was allowed in 9 of 29

states that had a bear hunting season (Meyer 1983). Recent ballot initiatives in Colorado, Oregon, Massachusetts, and Washington banned baiting as a method to hunt bears. Michigan and Idaho voted in 1996 to continue using baiting as a method to hunt bears. Baiting is illegal in Virginia, and feeding was banned on public lands in 1999.

Feeding sites close to roads may increase chances of unwanted bear encounters with humans, such as collisions with vehicles or campsite visitations. Habituation, though not always dependent on food conditioning (McCullough 1982), is a possible consequence of feeding and can lead to encounters dangerous to humans as well as bears.

In addition, feeding may improve the nutritional condition of black bears, which purportedly affects their age at first reproduction (Bunnell and Tait 1981, Eiler et al. 1989), litter size (Jonkel and Cowan 1971, Rogers 1976, Bunnell and Tait 1981), inter-birth interval (Rogers 1976, Bunnell and Tait 1981), cub survival (Matson

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1951, Rogers 1976, Eiler et al. 1989), growth rates (Cowan et al. 1957, Rogers 1976), home range sizes (Beeman and Pelton 1980, Garner 1986), and hunter harvest success (Beeman and Pelton 1980). The purpose of this study was to quantify the amount and determine the distribution of food provided to black bears in Virginia annually and to investigate the effects of feeding on black bear reproduction and morphology.

## Methods

### Feeding survey

We sent a survey to all members of the VBHA ( $n = 486$ ) to collect quantitative and qualitative data relating to feeding bears. We administered the survey using a modified version of Dillman's (1978) total design method (we did not adhere strictly to guidelines for timing of survey mailings). Questions were designed to determine the types of foods offered to bears, frequency of feeding, average amount of food placed at each feeding site, and total number and distribution of feeding sites in Virginia. The survey was also designed to evaluate response to the change in legislation which made it illegal to feed wildlife on public land beginning 1 July 1999. We used a Likert scale to determine hunters' opinions about the effects of feeding on bears as well as on public image. The VBHA was chosen as the target audience because, after discussion with its officers, we believed this group to include most people who fed bears in Virginia. Survey packets were mailed on 28 October 1999, and again on 8 December 1999 to those who had not returned surveys.

### Determination of total food estimate

Survey respondents were asked to report amount and frequency for all food types they fed to bears at least twice per month (Gray 2001). To estimate the minimum amount of supplemental food provided to bears by bear hunters annually, all responses to this question were added together. In addition, each food type was tallied separately, and the average amount of food per person and per county was determined.

### Non-response bias

In April 2000, we randomly selected 29 VBHA members who had not returned their surveys as a sample of non-respondents to be compared with those who had returned their surveys to evaluate non-response bias. Non-respondents were contacted by telephone and asked 14 questions from the original survey. In addition, 2 completed questionnaires returned in spring 2000 were

included with the non-respondent follow-up survey responses. We used  $t$ -tests and  $\chi^2$  tests ( $\alpha = 0.05$ ) to compare responses from the first and second survey mailings, and responses from the combined survey mailings and the follow-up telephone survey.

## Results

### Response rate

Twenty-seven of the original 486 survey packets were undeliverable and were returned, reducing the effective sample size to 459. We received 179 (39%) surveys from the initial mailing and 59 surveys from the second mailing, totaling 238 (52%) completed responses.

### Non-response bias

The proportion of respondents from the first mailing (66%) who fed bears between 1 July 1998 and 30 June 1999 was greater than the proportion of feeders from the second mailing (43%;  $\chi^2 = 9.16$ ,  $P = 0.003$ ). Similarly, the proportion of overall mail respondents (60%) who fed bears was greater ( $\chi^2 = 129.64$ ,  $P < 0.001$ ) than the proportion of non-respondents (48%) who fed bears between 1 July 1998 and 30 June 1999. The proportion of respondents from the second mailing who fed bears (43%) did not differ from the proportion of non-respondents who fed bears (48%;  $\chi^2 = 0.27$ ,  $P = 0.605$ ). Respondents (50%) were more likely to feed bears on both public and private land than non-respondents (33%) and less likely to feed on private land only (24%) than non-respondents (60%; Fisher's exact test  $P = 0.020$ ). The proportion of feeding on public land by those who fed on both public and private lands did not differ between respondents from the first and second mailings ( $\chi^2 = 7.42$ ,  $P = 0.060$ ) or between respondents and non-respondents (Fisher's exact test  $P = 0.358$ ).

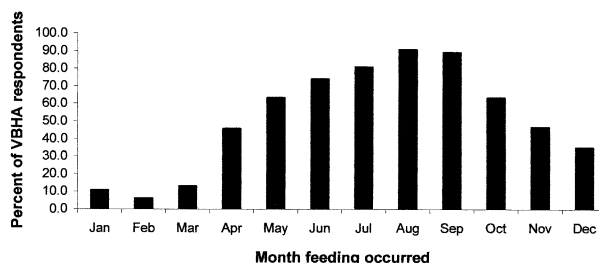
Respondents (76%) and nonrespondents (73%; Fisher's exact test  $P = 0.167$ ) classified the amount of feeding they did between 1 July 1998 and 30 June 1999 as typical of most years. Seventy-one (50%) of 141 mail respondents and 11 (73%) of 15 non-respondents indicated they would continue providing the same amount of food to bears on private land as they provided prior to the change in feeding regulations. A higher proportion of respondents than non-respondents felt it should be illegal to feed bears ( $\chi^2 = 11.153$ ,  $P = 0.004$ ). The majority in both cases (81% and 68%, respectively) felt that feeding bears should be legal. The majority of respondents (61%) and non-respondents (61%; Fisher's exact test  $P = 0.194$ ) felt that feeding bears during the bear harvest season should be illegal.

**Table 1. Opinions of members of Virginia Bear Hunters Association on the effects of feeding bears in Virginia, 1999. Numbers other than mean score represent percents for each answer choice; *n* = number of respondents for each statement. (A = agreed = 2; N = neutral = 3; D = disagreed = 4)**

Supplemental feeding of bears...	<i>n</i>	Mean score	Mean score		
			A	N	D
...Helps bears in years of mast crop failure.	160	1.38	94.4	1.9	3.7
...Creates a healthier bear population.	159	1.48	88	9.4	2.5
...Results in more chases in training season.	159	1.64	88.6	5	6.3
...Increases reproduction.	160	1.7	81.3	15.6	3.1
...Increases survival.	158	1.72	82.9	11.4	5.7
...Increases population levels.	160	1.76	82.5	12.5	5
...Keeps bears in the area.	159	1.77	86.8	8.2	5
...Increases the chance of viewing bears.	159	1.92	82.4	7.5	10.1
...Results in bigger bears.	157	1.97	73.3	19.7	7
...Increases bowhunters' success.	153	2.1	64.1	20.9	15.1
...Reduces crop damage.	159	2.12	71.1	20.8	8.1
...Results in more chases in hunting season.	156	2.17	68.2	14.6	17.2
...Concentrates bears in certain areas.	158	2.53	59.5	19.6	20.9
...Gives bear hunters a good image to other hunters and non-hunters.	159	2.81	33.4	42.1	24.5
...Creates a negative public image.	159	3.4	17.6	38.4	44
...Makes bears less afraid of people.	155	3.72	14.9	17.4	67.7
...Results in littering.	157	3.75	16.6	17.8	65.6
...Increases chance of bear/vehicle collisions.	159	3.86	13.2	13.2	73.6
...Increases danger to campers.	159	3.98	6.3	16.4	77.3
...Creates nuisance bears.	158	4.01	9.5	13.3	77.2
...Makes bears dependent on artificial food.	158	4.03	7.6	12.7	79.8
...Causes disease problems for bears and/or other wildlife.	160	4.19	1.8	17.5	80.7

### Hunters' opinions of feeding bears

A majority of VBHA members believed feeding bears benefits reproduction (81%), survival (83%), and opportunities for recreation such as bowhunting (64%), chasing bears with hounds (89%), or viewing bears (82%). Likewise, 75% of respondents disagreed that feeding contributes to nuisance problems or makes bears depend on artificial food. VBHA members were neutral about the effects of feeding bears on their public image, occurrence of littering, crop damage, and hunting success (Table 1).



**Fig. 1. Monthly pattern of black bear feeding in Virginia by Virginia Bear Hunters Association (VBHA) members between 1 July 1998 and 30 June 1999.**

### Location of feeding sites

One hundred thirty-six (60%) respondents fed bears between 1 July 1998 and 30 June 1999. Half of respondents who fed bears did so on both public and private lands, whereas nearly equal proportions fed bears only on public land (26%) or only on private land (24%). For those respondents who fed bears on both public and private land, 55% fed more on public land than on private land and 45% fed more on private land than public land. Most feeding occurred in the mountainous western and southwestern portions of Virginia (Gray 2001).

### Feeding expenditure

One hundred thirteen (48%) of 238 respondents spent \$18,378.00 on supplemental food for bears between 1 July 1998 and 30 June 1999 (mean = \$162.64/person, median = \$100.00, SD = \$209.10). This value includes 55 respondents who did not feed bears directly but donated money to a hunt club or other group to feed bears. The largest amount of money spent by an individual on supplemental food in 1 year was \$1,040.00. Two other individuals spent \$1,000.00 each. Nine people indicated they fed bears but spent no money on food. Most respondents spent \$76.00–100.00 on food for bears between 1 July 1998 and 30 June 1999.

### Temporal distribution of feeding

Most respondents fed bears in July (81%), August (91%), and September (89%) (Fig. 1). Only 35% of respondents fed bears in December, during the general firearms season when hunting with hounds is legal. Hunters who fed bears >3 months/year fed mostly during July (55%), August (72%), and September (67%) as well.

Thirty-eight (29%) of 133 respondents placed different types of food out at different times of year. The primary reason for feeding different food types at

**Table 2. Percent of Virginia Bear Hunters Association members who knew of animals other than bears that used black bear feeding sites in Virginia between 1 July 1998 and 30 June 1999 ( $n = 104$  respondents).**

Animal	%
Raccoon ( <i>Procyon lotor</i> )	90.4
Squirrel ( <i>Sciurus</i> spp.)	52.9
Raven ( <i>Corvus corax</i> )	42.3
Whitetail deer ( <i>Odocoileus virginianus</i> )	34.6
Fox, red ( <i>Vulpes vulpes</i> ), gray ( <i>Urocyon cinereoargenteus</i> )	29.8
Turkey ( <i>Meleagris gallopavo</i> )	25.0
Bobcat ( <i>Lynx rufus</i> )	25.0
Coyote ( <i>Canis latrans</i> )	22.1
Opossum ( <i>Didelphis marsupialis</i> )	3.8
Crow ( <i>Corvus brachyrhynchos</i> )	2.9
Mice ( <i>Peromyscus</i> spp.)	1.9
Striped skunk ( <i>Mephitis mephitis</i> )	1.9
Eastern chipmunk ( <i>Tamias striatus</i> )	1.0
Songbirds	1.0

different times of year was availability of the food items (64%), followed by preference of the bears (44%), cost (21%), to help bears gain weight after winter (3%), and other reasons (3%), not all of which were stated.

### Restocking feeding sites

The average maximum number of days/month feeding sites were stocked with at least 1 food type was 13; average visitation was 9 days/month to restock all food types ( $n = 130$ ). The decision to restock a feeding site usually occurred when no old food was remaining (46%); however, 42% of 132 respondents restocked feeding sites whenever they visited the site, regardless of how much food remained from previous visits. One hundred twelve respondents (84%) reported that 76–100% of the food from the previous visit to that site was usually eaten by the time they returned to that site. Six percent of respondents stated that less than a quarter of the food from the previous visit was usually consumed by the time they returned to that feeding site. Forty-seven (84%) of the 55 respondents who put food out at each visit to their feeding sites, regardless of how much food was remaining from the previous visit, stated that >75% of the old food was usually consumed by the time they returned to their sites.

### Amount and types of food provided

One hundred twenty-eight hunters reported feeding 2,942,394 kg of food to bears between 1 July 1998 and 30 June 1999, averaging 22,987 kg/person; the median amount of food was 6,232 kg. Twelve respondents reported feeding over 50,000 kg of food each, including

one outlier who reported feeding an unlikely 20% (577,579 kg) of the total. Excluding these 12, the mean amount of food provided by an individual was 10,437 kg. Shelled corn (23%), pastries (21%), and rendered animal fat (13%) were the 3 most commonly offered foods by mass and accounted for 58% of the total yearly amount of food provided. Other foods offered included apples (11%), bread (9%), sweet feed corn (6%), livestock feed (5%), ham (4%), meat (2%), cracked corn (2%), cob corn (1%), poultry feed (<1%), and animal carcasses (<1%). Twenty-eight respondents (22%) fed foods to bears that were not listed on the survey, including dog food, honey, peanut butter, molasses, syrup, baked chickens, caramel, sorghum, peaches, pears, cantaloupes, tomatoes, watermelons, and strawberry daiquiri mix; all accounted for <2% of the total food mass. Dry weights, which would have made weights of all food types comparable, were not determined.

### Non-target animals

Most respondents (77% of 133) reported that animals other than bears consumed food from their feeding sites (Table 2). Fourteen species other than bears reportedly used black bear feeding sites, as evidenced by tracks (80%) and sightings (68%); squirrels, raccoons, and ravens were the most common.

### Response to new feeding law

Respondents were asked how the law (4 VAC 15-40-281), which made feeding wildlife on public lands in Virginia illegal after 30 June 1999, would affect their feeding efforts on private land. Half of 141 respondents who answered this question reported they would continue feeding the same amount as before on private land, whereas 25% would cease feeding altogether, 23% would increase, and 2% would decrease the amount of feeding on private land. These numbers included 18 people who did not feed bears between 1 July 1998 and 30 June 1999 and were therefore instructed not to answer this question, but did so anyway. Similar trends existed when these 18 respondents were left out of the analysis. We did not ask respondents about their future feeding activities on public land, although several indicated in the comments section that they would ignore the new law and continue to feed on public land.

## Discussion

### Accuracy of total food estimate

Our estimate of the total amount of food provided to bears by bear hunters may be underestimated due to low

response rate, inopportune timing of mailings, and limited answer choices. However, the small sample size may be subject to an avidity bias, in which only the more avid feeders (who presumably fed more than less avid feeders) responded to the survey (Fisher 1997, Dillman 1978:53).

The 52% response rate for the survey was lower than the response rate of 2 surveys completed by bear hunters who hunted in the same study area in 1995–96 (73%; Higgins 1997). Higgins (1997) attributed her high response rate to hunters' interest in black bear management and perhaps to the working relationship she established with VBHA members. Possible reasons for the lower response rate in this survey were the length of the survey (131 questions), a long recall period that may have discouraged some respondents from completing the survey, and the time of year (hunting and holiday seasons) that surveys were administered. Concise and simple surveys referencing a recent period should have better response rates overall as well as for individual questions within the survey (Romberg 1999).

The timing of the first mailing was not ideal because we asked respondents to recall their feeding efforts 3–15 months prior. As recollection time increases, survey responses become less accurate, resulting in recall bias (Dillman 1978). The timing of the second mailing (December 1999) was less than ideal because respondents received it in the midst of the general firearms season, arguably their busiest time of year. In addition, survey response rates may be lower in December because many people are busy with the holiday season (Dillman 1978).

Only 60% of respondents fed bears. The amount of feeding done by non-respondents who fed bears (48%) was not included in the total food estimate. Extrapolating the 48% of phone questionnaire non-respondents who fed bears to all non-respondents ( $n = 221$ ) would add 107 feeders to the total food tally. Multiplying the average annual amount of food provided by an individual with (21,635 kg) or without (10,437 kg) the 12 outliers who reported feeding >50,000 kg would add 1,116,759 kg to 2,314,945 kg to the total annual supplemental food estimate. Extrapolating the median annual amount of food provided by an individual (6,232 kg) to the nonrespondents would add 666,824 kg of food to the total annual supplemental food estimate. The average amount of food/person, subject to an avidity bias, may not represent non-respondents. Unfortunately, to ensure the brevity of the telephone survey, we did not determine the amount of food or frequency of feeding by non-respondents.

Eighty-eight respondents (64%) knew of at least 1 non-VBHA member who did not share their feeding routes, but fed bears. Only VBHA members received surveys, so we may have missed a substantial number of non-VBHA constituents who fed bears; however, many respondents could have been referring to the same person.

Respondents were not asked to report amounts of all foods they provided to bears, just those they fed at least every 2 weeks; the total annual food estimate is conservative in this regard. The answer choices on the survey for amounts of foods were given in ranges. For tallying purposes, when possible, we took the median of the answer choice ranges.

We asked respondents how typical the amount of feeding they did between 1 July 1998 and 30 June 1999 was in comparison to other years. Most respondents (76%) reported it was typical of most years, whereas 11% said their feeding was less than most years, and 13% said it was more than most years. The fact that the numbers of people who fed less or more than usual are nearly equal suggests that this is not a concern with the accuracy of the total annual food estimate. However, we do not know how much more or less feeding than usual was done.

VBHA members helped compile the list of food type choices on the survey. Many of the food types listed on the survey were in accordance with those suggested by Meyer (1983) for baiting bears, including ham scraps, bacon grease, pastry, beef and pork scraps, and apples. Many of the foods listed by hunters in the 'other' category were not calculated into the total annual mass.

#### **Non-response bias**

A large non-response bias does not seem apparent in these data. Rather, the follow-up phone survey provided subjective reasons that many of the nonrespondents did not respond to the mail questionnaire. A smaller proportion of non-respondents fed bears, possibly indicating less interest in the feeding survey. A higher percent of non-respondents fed only on private land (60%), as opposed to 24% of respondents who fed only on private land. Non-respondents may have had less interest in the mail questionnaire because the change in feeding regulations did not affect them as much as it affected respondents. In addition, a smaller proportion of nonrespondents felt that feeding bears should be legal, which may reflect less interest in feeding bears and in completing the mail questionnaire. Nonrespondents spent fewer days hunting bears without dogs than respondents (Gray 2001), which may indicate less interest in hunting and feeding in general.

### **Food consumption**

One hundred three respondents (77% of 133) reported evidence that 14 species other than bears consumed food from their feeding sites, though the amount of scavenging was unknown. Many survey respondents cover their feeding sites with heavy logs or boards weighted with rocks to prevent smaller animals from stealing food. It is not known whether other methods, such as hanging the food (Meyer 1983) or placing feeding containers above the ground (Ziegltrum 1994) to deter rodents and prevent water contact with the food, were used by hunters in our study areas. Scavenging by animals other than bears does not affect the overall estimate of annual food provided to bears; however, it does affect the amount available to bears. Animals other than bears may have left evidence of their presence at feeding sites, but this does not imply that they consumed food. In some circumstances, animals may have been attracted by the smell of food but unable to retrieve it. If scavenging was substantial, it could reduce such benefits as increased fitness and greater weight gain before denning.

### **Annual feeding pattern**

The bear hound training season runs from the last weekend in August through September; thus, it is not surprising that most feeding occurred during August and September. Increased bear activity at active feeding sites purportedly leaves more scent around feeding sites and enables dogs to detect bear trails more easily. Many bear hunters believed that feeding bears during the harvest season was illegal and therefore, did not feed during December. Feeding rates declined during the winter months, especially following the general firearms season; however, some individuals fed throughout the winter. Den emergence in western Virginia occurs in mid to late April (Godfrey 1996). Feeding rates increased in April, as many hunters wanted to provide a food source to bears when natural food is less abundant.

### **Effect of feeding on reproduction**

In the comments section at the end of the survey, bear hunters repeatedly stated that feeding helps bears survive the den season and helps females with cubs (i.e., provides energy for lactation). Supporting their view, Alt (1989) reported that supplemental food supplied to bears by humans likely would have a positive effect on reproduction. Several studies have related nutritional condition to survival and reproduction (Brody and Pelton 1988, Eiler et al. 1989, Elowe and Dodge 1989, McLaughlin et al. 1994), and some have identified threshold weights below which females fail to produce

cubs (Rogers 1976). For instance, juvenile females in Minnesota weighing <41 kg by March did not produce cubs the following year, and cubs and yearlings of females weighing <65 kg were less likely to reach threshold survival weights than those of heavier mothers (Noyce and Garshelis 1994). Herrero (1983) suggested that food from dumps in Jasper National Park, Canada, may have positively affected reproduction in black bears that fed at the dumps, and Rogers (1976) found that bears that fed at dumps in Michigan had better reproductive success than bears that ate only natural food. Finally, Elowe and Dodge (1989) suggested that pregnant bears that do not put on sufficient weight or that do not have access to high fat and carbohydrate diets prior to denning may fail to produce cubs.

Preliminary tests revealed no changes in average litter sizes in Virginia's bears after feeding on public land became illegal (Klenzendorf 2002); however, this does not discount the potential impact of supplemental feeding on bear reproduction. A change in reproduction may only be detectable in years of mast crop failure (Landers et al. 1979). Many hunters maintain that bears will not use feeding sites, or will greatly reduce their rate of use, when acorns begin dropping from trees in late summer and early fall. Ziegltrum (1994) found that bears lost interest in supplemental feeding stations (which were successfully used as forest damage management tools in Washington) at the onset of the natural berry crop. Use of feeding sites may be compensatory rather than additive, and may only affect reproduction when acorns and other natural foods are scarce. Other studies have witnessed total reproductive failure or substantial decreases in cub production and survival following years of poor mast crop or mast crop failure (Eiler et al. 1989, Costello et al. 2003). During this study, acorn crops ranged from near failure to good (Virginia Department of Game and Inland Fisheries [VDGIF] mast survey, 1994–2000), while reproduction remained consistently good (Godfrey 1996, Ryan 1997, Echols 2000). Supplemental food may provide from 7% up to 8,200% of the amount of natural acorn mast available in years of mast shortage in Virginia (Hewitt et al. 1992, Kasbohm 1994, Gray 2001), but may only amount to 2% of the natural acorn crop during good or excellent mast years (McConnell 1988).

### **Implications of terminating feeding**

In Yellowstone National Park, Wyoming, sudden elimination of garbage dumps as a food source for grizzly bears resulted in greater nuisance occurrences in campgrounds rather than a quick adjustment to natural

food sources (Craighead and Craighead 1971). Though feeding sites in Virginia do not concentrate bears in numbers as large as in Yellowstone, the abrupt removal of feeding sites on public land could have similar effects, especially in areas close to human habitation. Dumps provided bears with a predictable, concentrated, prolonged feeding source (Herrero 1983). In North Carolina, hunters maintained baiting sites for many years that were used year around by bears (Landers et al 1979). If bears became dependent on supplemental feeding sites in Virginia that were suddenly removed, they may be unsuccessful at finding sufficient natural foods, especially if they learned to feed on supplemental food as cubs. However, since bears are opportunistic feeders (Eiler 1981, Lunn and Stirling 1985), and most feeding sites in Virginia are not maintained year round, the chance of bears becoming dependent on them is low. Supplemental feeding may also result in an artificially high bear population, or in higher skeletal-lean body mass size (Robbins et al. 2004), which native foods alone cannot support. If bears reach a skeletal-lean body mass size too great to be supported solely by native foods, closure of concentrated, supplemental food sources will likely result in starvation or increased nuisance occurrences or removals as bears seek other anthropogenic food sources (Robbins et al. 2004). However, VBHA members maintained that supplemental feeding did not cause bears to cease their natural feeding activities (minutes from VDGIF board meeting 4-5 March 1999).

Feeding bears may increase their chances of becoming food-conditioned and habituated to people. Human scent undoubtedly remains at feeding sites after restocking by humans, and bears likely associate humans with the food they find at feeding sites. Bears that feed on garbage are more likely to encounter humans than bears that do not feed on garbage (Herrero 1985). Bears may make other associations with odors in supplemental food, such as domestic animal carcasses, which may cause bears to kill livestock (Huber and Reynolds 2001). Nutritional benefits to habituated bears feeding at dumps in national parks may be negated by increased mortality if these bears are destroyed by park officials for causing nuisance occurrences or human injury (Herrero 1983).

Supplemental feeding is used as a management tool in some circumstances. In Romania, supplemental food is provided to bears to limit bear conflicts with human use at specific sites (Huber and Reynolds 2001). Agricultural damage is reduced, and accurate counts are possible at feeding sites. A supplemental bear feeding program in Washington reduced damage to timber and

reduced the use of lethal control methods for bears (Ziegler 1994). Supplemental food sites in Virginia during years of mast failure may prevent some bears from feeding in and causing damage to agricultural crops. Managers must consider the economic feasibility of maintaining long-term ecocenters, and realize the probable consequences and risks to bears and people if they are ultimately removed (Robbins et al. 2004).

### **Management implications and recommendations for further study**

Successful bear management requires understanding the relation between bear populations and nutritional processes, habitat composition, and silvicultural practices (Noyce and Coy 1990). To determine management procedures, biologists and managers must know the kinds of foods important to bears in addition to their quantity, quality, and utilization (Beeman and Pelton 1980). The best way to evaluate the need for and success of supplemental feeding programs may be through cooperative research efforts among professional wildlife agencies, universities, and private landowners (Ziegler 1994).

We suggest that major policy changes, such as prohibition of supplemental feeding in Virginia, be accompanied by testable hypotheses. These tests should include both pre- and post-policy change data. Hypothesis testing can assist land and wildlife managers to better understand the ramifications of their decisions. Parameters such as average litter size, percent of females breeding, and denning weights of females and cubs should be monitored for changes, especially following years of mast crop failure, when supplemental food is more likely to affect black bear reproduction. In addition, data collection and analysis prior to regulation changes is essential not only to justifying the changes and understanding biological processes, but also maintaining good public relations with constituents.

A second feeding regulation (4 VAC 15-40-282) under the Virginia Administrative Code came into effect July 2003, prohibiting unauthorized feeding of bears on private land in Virginia, as a further measure by VDGIF to deal with increasing problems of bears coming in to suburban and urban areas for food (e.g., bird feeders, garbage).

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