BLACK BEAR SEASONAL FOOD HABITS AND DISTRIBUTION BY ELEVATION IN BANFF NATIONAL PARK, ALBERTA

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Abstract: The food habits and distribution by elevation of black bears (*Ursus americanus*) in Banff National Park, Alberta, were investigated during a 3-year radio-telemetry study. Analysis of feeding signs indicated that the typical year is divided into the following bear food seasons: 1) green-up (den exit to mid-June), when horsetails (*Equisetum* sp.) and graminoid vegetation (grasses, sedges and rushes) formed the major portion of the diets of bears, with importance values of 38.2 and 34.2%, respectively; 2) ant (mid-June to mid-July), when bears consumed ants (Formicidae) and ant larvae to a large extent (69.3%); 3) buffaloberry (mid-July to end-August), when bears fed upon buffaloberries (*Shepherdia canadensis*: 91.4%) once they ripened in mid-summer; 4) post-buffaloberry (end-August to den entry), when, once buffaloberries had fallen from the bushes, bears switched to alternate foods such as crowberries (*Empetrum nigrum*: 85.1%), bearberries (*Arctostaphylos uva-ursi*: 11.1%) and juniper (*Juniperus communis*) berries (0.7%). Some bears were found to feed primarily upon crowberries during this season, while others mainly ate bearberries. The mean elevation at which all collared bears were located ranged from 1,500 - 1,543 m during the first 3 seasons, but increased to 1,694 m during the post-buffaloberry season. Some bears, however, stayed at low elevations ($\bar{x}$ = 1,463 m) during the fall and fed upon bearberries.

Those that fed upon crowberries during the post-buffaloberry season had a mean elevation of 1,768 m, while those that fed upon high-elevation bearberries and white-bark pine (*Pinus albicaulis*) nuts had a mean elevation of 1,818 m.

Int. Conf. Bear Res. and Manage. 8:297–304

Although the food habits of black bears have been studied in many areas of their range, few studies have been conducted in the main ranges of the Canadian Rockies. In this report we present the findings on the seasonal food habits and elevation use by black bears in Banff National Park (BNP) Alberta. This research was conducted as part of a 3-year study that investigated the habitat use characteristics and population levels of black bears in BNP (Kansas et al. 1989).

We thank Park Wardens M. Gibeau and D. Martin for their assistance in field work, and R. Kunelius and W. Browne for supervising the study. The study was conducted by Beak Associates Consulting Ltd., a member of the Stanley Group of Companies, under contract to the Canadian Parks Service.

STUDY AREAS

Two study areas, the North Saskatchewan and the Bow Valley study areas, were investigated in north and south BNP, respectively. The eastern two-thirds of both study areas occur in the front ranges of the southern portion of the Rocky Mountain Thrust Belt (Holland and Coen 1982). River valley bottoms from 1,350 m to 1,600 m in elevation are situated within the Montane ecoregion. The Lower Subalpine ecoregion occurs on valley slopes ranging from 1,600 m to 2,000 m in elevation, while the Upper Subalpine ecoregion is found on upper valley slopes at an elevational range of from 2,000 m to 2,300 m. The Alpine ecoregion occurs above 2,300 m, but is of very limited areal extent within the study areas.

Bow Valley Study Area

Lodgepole pine forests predominate on glacial till terraces and lower slopes on both sides of the Bow Valley. Dry, open, south-facing slopes with Douglas-fir (*Pseudotsuga menziesii*)/hairy wild rye (*Elymus innovatus*) vegetation are characteristic of the Montane zone, whereas lodgepole pine (*Pinus contorta*) stands dominate the Lower Subalpine. Fluvial bottomlands are a mix of mature white spruce (*Picea glauca*), dry, open spruce forest and moist shrubland. Some extensive traces of Engelmann spruce (*Picea engelmannii*)-subalpine fir (*Abies lasiocarpa*) forest occur on steep north-facing slopes of the Upper Subalpine zone. White-bark pine and larch (*Larix laricina*) forests are localized at or near tree line.

North Saskatchewan Study Area

Subalpine and Alpine ecoregions dominate the North Saskatchewan area, with a limited Montane influence present along the lower North Saskatchewan and Howse River valleys. This study area is dominated by Engelmann spruce-subalpine fir forests, although forest fires (White 1985) have created localized lodgepole pine and lodgepole pine-spruce forests in some areas. Some shrub-dominated burns occur in the Upper Subalpine ecoregion, and shrub and shrub aspen (*Populus tremuloides*) comprise south- to west-facing avalanche tracts that are moderately common in the Lower Subalpine ecoregion.

Contrast Between the Study Areas

The 2 study areas differ considerably in terms of their habitat features. A dry, montane influence is more prevalent in the Bow Valley study area than in the North Saskatchewan study area. The greater extent of this montane climatic influence in the Bow Valley is reflected

by a greater occurrence of typical montane vegetation such as Douglas-fir forest, xeric grassland and aspen forest. Roadside vegetation in the Bow Valley study area is less herbaceous and lush as a result of this climatic difference. Avalanche tracts (especially south-facing) are more prevalent in the North Saskatchewan area, whereas in the Bow Valley study area tracts of riparian white spruce/horsetail and montane wet shrub vegetation types are more extensive.

METHODS

Feeding Sign Observation and Scat Collection

Feeding sign observations were made and scats collected during investigations of sites where radio-collared bears had been recently located. Only the 2 most heavily utilized food item species were recorded and 1 scat collected per bear per day so that some degree of independence of data was maintained. Although bears were only located during daylight hours, they were essentially located at random during field work. The following criteria were imposed to ensure that all scats collected could be confidently attributed to black bears rather than grizzly bears:

- Scats found were collected only if a collared bear had been located within 200 m of the scat and the estimated age of the scat was within 2 days of the date of location; and/or
- If recent black bear tracks were found in close association with the scat.

As bears were generally located on a daily basis, aging of scats to assign them to specific bears was usually not difficult. Portions of the scat were collected in plastic bags and subsequently stored in 70% alcohol. If several scats of similar age were found at 1 site, a portion of each scat was combined into 1 composite sample.

Scat Analysis

Scats were analyzed using methods similar to those of Hatler (1972) and Aune et al. (1986). They were washed several times in sieves to remove most of the preservative and berry dyes. They were then suspended in approximately 1.0 L of water and vigorously swirled. Two 100-ml subsamples were withdrawn from this solution and placed in enamel pans measuring 22 by 32 cm for analysis. Subsamples of small scats, such as those from cubs, were obtained by suspending the scat in 200 ml of water and dividing this solution into 2 equal portions. The relative percent volume of each item was ocularly estimated for each subsample by superimposing a grid on the enamel pan. Debris (e.g., spruce needles, wood chips) was noted but not given a volume figure unless it composed a large proportion of the scat. Items found in trace amounts were given an arbitrary volume of 1%. The percent volume of each item for the scat as a whole was calculated by averaging the results of the 2 subsamples. A list of the components (e.g., leaf, stem, berry, root) of each item was made, and the relative percent volume of each component was estimated.

Items were identified by comparison with the researchers' plant, berry, and hair collections, and with the aid of reference texts and keys (e.g., Adorjan and Kolenosky 1969, Moss 1983).

Results were tabulated by percent frequency of occurrence, percent volume and percent importance value of each item.

$$\text{Frequency} = \text{Number of scats having the same item}$$

$$\text{Percent frequency of occurrence} = \frac{\text{Frequency of item}}{\text{Total number of scats}} \times 100$$

$$\text{Percent volume} = \frac{\text{Total percent volume of item}}{\text{Total number of scats}}$$

$$\text{Importance value} = \frac{(\text{Percent volume})(\text{percent frequency occurrence})}{100}$$

$$\text{Percent importance value} = \frac{\text{Importance value of an item}}{\text{Sum of all importance values}} \times 100$$

Both frequency of occurrence and volume of food remains in scats should be taken into consideration when analyzing scats. Hatler (1972) and Poelker and Hartwell (1973) found that animal matter in scats is greatly reduced in volume as it passes from a bear's stomach through its digestive system, whereas green vegetation is not altered as much. Thus, volumetric analysis of scats tends to overestimate the amount of green vegetation consumed, while underestimating the amount of animal foods eaten.

Distribution of Bears by Elevation

Standard telemetry procedures were used (Kansas et al. 1989) to determine the distribution of collared bears by elevation. Altimeters and 1:50,000 scale topographic maps were used in the field to obtain elevations. Only 1 location was made per bear per day.

RESULTS AND DISCUSSION

Bear Food Seasons and Food Habits

Field Observations of Feeding Sign.—Seven hundred and sixty-two observations of feeding sign were made during investigation of 1,316 bear locations (Table 1).

Four bear food seasons (green-up, ant, buffaloberry and post-buffaloberry) were derived by analysis of these observations.

Season 1 – green-up: Bears were found to feed mainly upon dandelion (*Taraxacum* sp.) flowers and stems, ants, spruce, fir and pine, cambium, graminoid vegetation and horsetails during this season. Other foods consumed included twisted stalk (*Streptopus roseus*), hedysarum (*Hedysarum* sp.), locoweed (*Oxytropis* sp.), fireweed (*Epilobium angustifolium*), clover (*Trifolium* sp.) and coltsfoot (*Petasites palmatus*). Cow parsnip (*Heracleum lanatum*) was relatively uncommon in BNP and was seldom found to be eaten by black bears. On several occasions, bears were found to have selectively cropped *Equisetum arvense* plants over *Equisetum pratense* plants. Bears were found to have consumed, and possibly killed, elk (*Cervus elaphus*) on 2 occasions, while 1 bear fed upon an elk carcass in an avalanche path for over a week, and another fed upon a road-killed mule deer (*Odocoileus hemionus*) for several days.

Table 1. Observations of black bear feeding sign (by food item) made in Banff National Park, 1986-1988.

	Season			
Food item	Green-up	Ant	Buffaloberry	Post-buffaloberry
Horsetail	18	1	1	
Juniper	2			3
Spruce cambium	23	8		
Fir cambium	5			
Pine cambium	9			
Aspen cambium	2			
White-bark pine nuts				3
Grass	21	4		
Twisted stalk	1			
Willow catkin	1			
Gooseberry			7	
Hedysarum	4			
Locoweed	1		1	
Crowberry				23
Buffaloberry		21	168	
Fireweed		1		
Cow parsnip		1	1	
Bearberry	1			22
Blueberry			12	
Lousewort	1		1	
Honeysuckle			1	
Clover	3			
Coltsfoot	1			
Dandelion	71	25		
Ant	64	113	77	3
Wasp		1	1	
Ungulate	12	1		15
Garbage	2		2	2
Unidentified roots	1			

Season 2 – ant: The ant season was found to occur from mid-June to mid- to late July, when berries began to ripen. Ants and ant larvae were the main food items observed to be eaten by bears during this season. Bears searched for ants in old logs and under stones. They also consumed some dandelions, grasses, buffaloberries and wasps (Vespidae) during this season.

Season 3 – buffaloberry: This season was found to run from mid- to late July to mid-August to mid-September. Ripening of the buffaloberry crop was delayed in 1986 due to late snow melt and plant development. In 1987, the buffaloberry season ended earlier than in other years due to the widespread failure of the buffaloberry crop. Buffaloberries were the main food of bears during this season. Bears were also found to eat ants and blueberries (*Vaccinium* sp.) during this season.

Season 4 - post-buffaloberry: When buffaloberries began to drop from the bushes in mid-September, bears were found to switch to alternate foods such as crowberries, bearberries, white-bark pine nuts, and juniper berries. This season started earlier in 1987 due to the low availability of buffaloberries. Because it is difficult to detect feeding sign on juniper and white-bark pine, bears may utilize these food items more than our observations suggest. In 1987, some bears spent a great deal of time in habitats where these 2 species were abundant (i.e., moderate to steeply sloping, south-facing, sub-xeric pine forests). These bears were also located in the Banff townsite sewage treatment plant, where they consumed sewage effluent. One bear was located in close proximity to this plant on 26 different days.

Scat Analysis by Percent Volume. — Four hundred and sixty-six scats were collected during the course of the study. Eight food items not found to be utilized by bears during site-specific fixes were found in the scats collected. These were willow (*Salix* sp.) catkin, saskatoon (*Amelanchier alnifolia*), strawberry (*Fragaria virginiana*), mountain ash (*Sorbus scopulina*), peavine (*Lathyrus*

ochroleucus). red osier dogwood (*Cornus stolonifera*), unidentified bird and small mammals. One scat contained hair and bone from a snowshoe hare (*Lepus americanus*), and 2 scats had hair from small mammals that were probably *Peromyscus*. Hatler (1972) also found that black bears ate snowshoe hares in Alaska. He felt that they were consumed as carrion.

Bears were found to consume graminoid vegetation (26.9 - 36.2% volume), horsetails (26.0 - 34.1%) and dandelions (0.3 - 39.3%) in the spring (Table 2, Fig. 1). Observations of bear feeding sign indicated that spruce, fir, and pine cambium were utilized by bears, but these food items did not occur in the scats due to their high digestibility.

Horsetails were also found to be the main spring food of black bears in Alaska (Hatler 1972), and common in the diets of bears in Montana (Tisch 1961).

The importance of ants in the diets of bears increased in July, when ants and ant larvae composed up to 49.7% of the scats by volume (Table 2, Fig. 1). As ant larvae are easily digested (Beeman and Pelton 1980), it is likely that their use by bears was underestimated by percent volume analysis.

Although ants were found to be a common food for

Table 2. Percent volume of food items found in black bear scats collected in Banff National Park, bi-weekly, 1986-1988.

Food item	May		June		July		August		September		October	
	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31
n =	17	47	76	75	31	31	42	40	39	36	15	17
Horsetail	26.7	26.0	34.1	29.7	23.1	0.2			0.8	tr[a]		
Juniper	6.1			0.9			0.1		0.8	tr	21.4	
White-bark pine									1.4		6.7	
Graminoid	35.7	36.2	26.9	13.1	7.9	1.9	0.6	1.3	5.6	1.2	13.9	5.8
Willow catkin	tr	1.8										
Gooseberry					0.2	4.1	5.3	6.2	7.6	tr		
Serviceberry							0.4					
Strawberry						2.7						
Mountain ash									0.3	0.4		
Hedysarum		4.3										
Peavine		0.2	1.2	1.3			1.4					
Crowberry	5.2							10.0	20.3	52.2	26.6	70.3
Buffaloberry				tr	3.3	39.9	79.2	66.5	52.4	19.8	0.3	0.2
Cow parsnip					3.1							
Red osier dogwood							0.2	1.4	2.5			
Bearberry		0.9	0.3		4.7	tr			1.5	18.2	27.1	17.8
Blueberry							2.3	6.2	3.2			
Clover		0.3		0.2		1.1				1.7		
Dandelion	0.3	12.7	22.0	39.3	12.2							
Ant	1.8	3.9	9.3	12.1	45.5	49.7	8.9	5.1	3.4	2.7		
Wasp								0.1				
Bird	tr			tr		tr						
Small mammal	6.2			1.3		0.4	1.5					
Ungulate	6.0	6.4	5.1					0.1		3.8		
Garbage	tr	tr						2.8				5.9
Debris	11.8	2.1										
Unidentified vegetation	tr	4.9	0.7	2.1	tr		0.1		0.2		4.0	

[a] tr: percent volume < 0.1%

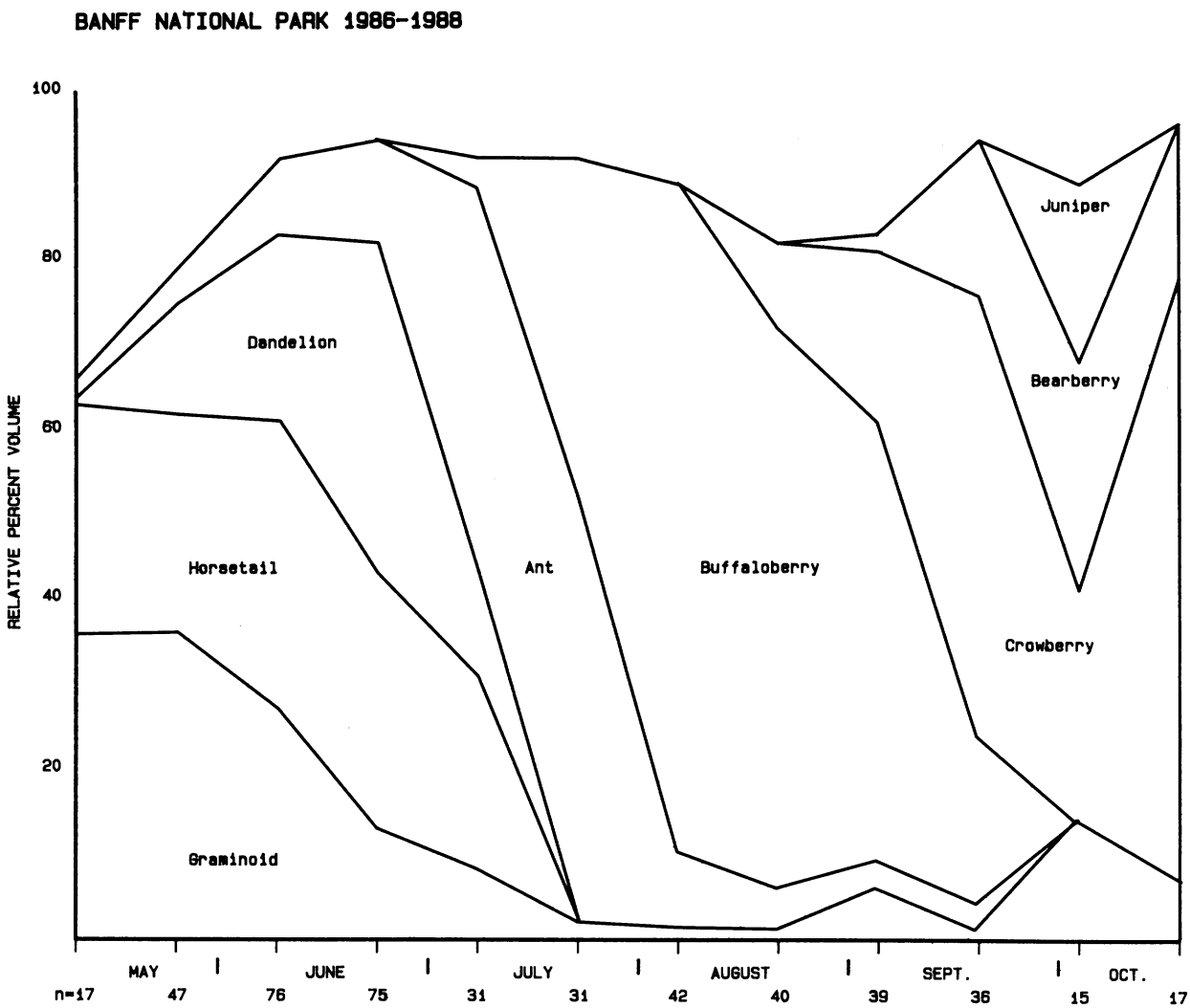

Fig. 1. Percent volume of food items found in black bear scats in Banff National Park, 1986-1988.

black bears in Alaska (Hatler 1972), Alberta (Holcroft 1986), Montana (Tisch 1961) and Wyoming (Irwin and Hammond 1985), none of these studies found bears fed upon ants as extensively as they did in this study.

When buffaloberries ripened in late July and early August of most years, they became more prominent in bear diets. Buffaloberries composed 39.9% of the volume of scats deposited in late July. This figure rose to 79.2% for early August, and was still high at 52.4% by early September (Table 2, Fig. 1).

Crowberries became important in the diets of bears in early September. They had a percent volume occurrence of from 20.3 - 70.3% during the months of September and October (Table 2). Bearberries (17.8 - 27.1%), juniper berries (0.0 - 21.4%), graminoid vegetation (1.2 - 13.9%) and white-bark pine nuts (0.0 - 6.7%) were also important to bears in the fall. Some bears consistently moved to north-facing avalanche paths in the fall where crowberries were abundant, while others stayed in south-facing, sub-xeric pine forests where bearberries and juniper berries were common.

Hatler (1972) also determined that black bears in Alaska ate crowberries in the fall. Up to 18% of the volume of scats collected in Wyoming was composed of white-bark pine nuts in autumn (Irwin and Hammond 1985), while Kendall (1983) found that both black bears and grizzly bears in Yellowstone National Park fed upon white-bark pine nuts in spring and fall. We and Kendall (1983) found that bears raided red squirrel (*Tamiasciurus hudsonicus*) caches to obtain pine nuts.

Scat Analysis by Importance Value. — During the green-up season, horsetails comprised the largest portion of the diet of bears with an importance value of 38.2% (Table 3, Fig. 2). Graminoids and dandelions were also important with values of 34.2% and 19.1%, respectively. Ants were the principal food item of bears during the ant season (69.3% importance value), while horsetails (13.9%) and dandelions (7.6%) were still consumed by bears (Table 3, Fig. 2). Buffaloberries (91.4%) and crowberries (85.1%) had the highest percent importance values during the buffaloberry and post-buffaloberry seasons, respectively.

Table 3. Percent importance values of food items found in black bear scats in Banff National Park, 1986-1988.

Food item	Season			
	Green-up $n = 198$	Ant n = 64	Buffaloberry $n = 126$	Post-buffaloberry $n = 78$
Horsetail	38.2	13.9	tr[a]	tr
Juniper	tr		tr	0.7
White-bark pine				tr
Graminoid	34.2	5.0	0.3	2.6
Willow catkin	tr			
Gooseberry		tr	2.4	tr
Serviceberry			tr	
Strawberry		tr		
Mountain ash				tr
Hedysarum	tr			
Peavine	tr		tr	
Crowberry	tr			85.1
Buffaloberry		4.0	91.4	0.5
Cow parsnip		tr		
Red osier dogwood			tr	tr
Bearberry	tr	0.2		11.1
Blueberry			0.3	tr
Clover	tr	tr		tr
Dandelion	19.1	7.6		
Ant	7.4	69.3	5.6	tr
Wasp			tr	
Bird	tr			
Small mammal	tr	tr	tr	
Ungulate	0.7	tr	tr	tr
Garbage	tr		tr	tr
Debris	tr			
Unidentified vegetation	0.4	tr	tr	tr

[a] tr: percent importance value < 0.1%

Distribution of Bears by Elevation

We obtained 1,701 telemetry locations to which elevation data could be attributed with confidence (Table 4). Of these, 66% were obtained at the site of the location through the use of altimeters and 1:50,000 scale topographic maps. The remainder were estimated from maps without site visits being made. The mean elevation of locations ranged from 1,500 - 1,543 m during the first 3 seasons, but increased to 1,694 m during the post-buffaloberry season. This was because many of the foods preferred by bears during this season, such as crowberries, white-bark pine nuts, and bearberries, are found at higher elevations in the park. This change in the use of elevation, however, was not found for certain bears. Two bears remained at low elevations ($\bar{x}$ = 1,463 m) to feed upon bearberries in the fall (Table 4). The mean elevation of bears that fed mainly on crowberries during the post-buffaloberry season was 1,768 m, while that of bears that fed on white-bark pine nuts and high elevation bearberries was 1,818 m. The use of different elevations by bears did not appear to be correlated with their sex.

Irwin and Hammond (1985) and Kendall (1983) also found that bears moved to higher elevations to feed upon pine nuts, while Graber and White (1983) found that bears utilized higher elevations in mid-summer where human foods were more abundant.

Table 4. Mean elevation (m ± 95% confidence limits) of black bear telemetry locations in Banff National Park, by season, 1986-1988.

Bear group	Season			
	Green-up	Ant	Buffaloberry	Post-buffaloberry
Crowberry bears ($n = 7$)	1507 ± 24 (130)[a]	1532 ± 19 (141)	1541 ± 23 (136)	1768 ± 18 (144)
White-bark pine-bearberry bears ($n = 4$)	1610 ± 32 (90)	1562 ± 34 (61)	1587 ± 30 (113)	1818 ± 57 (104)
Low elevation bearberry bears ($n = 2$)	1392 ± 42 (84)	1407 ± 20 (32)	1547 ± 44 (80)	1436 ± 22 (62)
All bears	1500 ± 13 (488)	1509 ± 13 (329)	1543 ± 14 (480)	1694 ± 24 (404)

[a] sample size

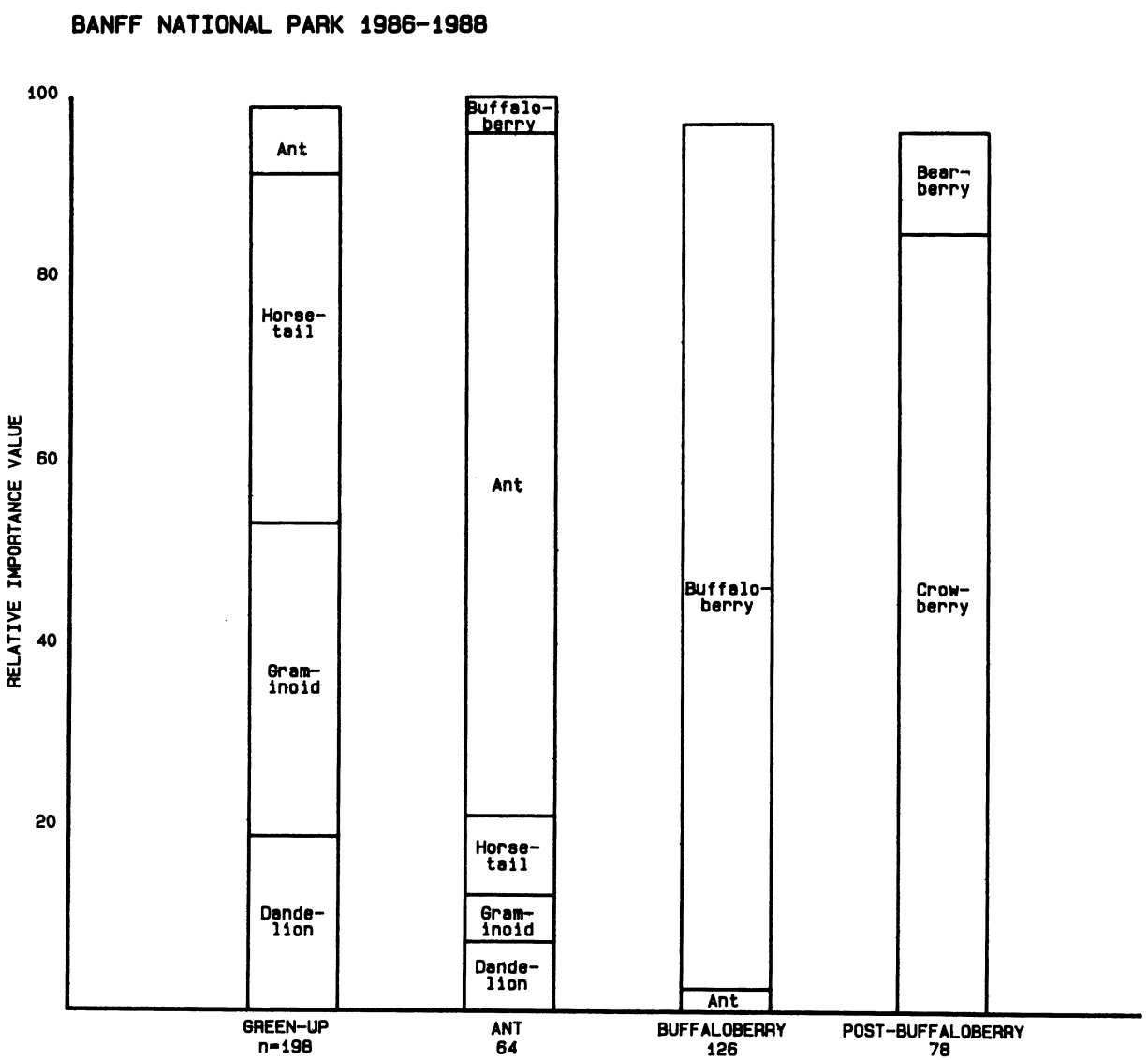

Fig. 2. Percent importance values of food items found in black bear scats in Banff National Park, by season, 1986-1988.

LITERATURE CITED

ADORJAN, A.S., AND G.B. KOLENOSKY. 1969. A manual for the identification of hairs of selected Ontario mammals. First ed. Ont. Dep. Lands and For. Res. Rep. 90. 64pp.

AUNE, K., M. MADEL, AND C. HUNT. 1986. Rocky Mountain Front grizzly bear monitoring and investigation. Mont. Dep. Fish, Wildl. and Parks, Helena. 175pp.

BEEMAN, L.E., AND M.R. PELTON. 1980. Seasonal foods and feeding ecology of black bears in the Smoky Mountains. Int. Conf. Bear Res. and Manage. 4: 141-147.

GRABER, D.M., AND M. WHITE. 1983. Black bear food habits in Yosemite National Park. Int. Conf. Bear Res. and Manage. 5: 1-10.

HATLER, D.F. 1972. Food habits of black bears in interior Alaska. Can. Field-Nat. 86:17-31.

HOLCROFT, A.C. 1986. Aspects of black bear ecology and campground planning in southwestern Alberta. Master of Environ. Design, Univ. of Calgary, Alta. 90pp.

HOLLAND, W.D., AND G.M. COEN. 1982. Ecological (Biophysical) land classification of Banff and Jasper National Parks. Volume I: summary. Alta. Inst. of Pedology. Publ. M-83-2. 193pp.

IRWIN, L.L., AND F.M. HAMMOND. 1985. Managing black bear habitats for food items in Wyoming. Wildl. Soc. Bull. 13:477-483.

KANSAS, J.L., R.M. RAINE, AND M.L. GIBEAU. 1989. Ecological studies of the black bear in Banff National Park, Alberta. Final Report. Prep. for Parks Can. Banff Natl. Park by Beak Assoc. Consulting Ltd. 118pp.

KENDALL, K.C. 1983. Use of pine nuts by black and grizzly

bears in the Yellowstone area. Int. Conf. Bear Res. and Manage. 5:166-173.

MOSS, E.H. 1983. Flora of Alberta. Second ed. Univ. of Toronto Press, Toronto, Ont. 687pp.

POELKER, R.J., AND H.D. HARTWELL. 1973. Black bear of Washington. Wash. State Game Dep. Bull. 14. 180pp.

TISCH, E.L. 1961. Seasonal food habits of the black bear in the Whitefish Range of northwestern Montana. M.S. Thesis. Mont. State Univ., Missoula. 108pp.

WHITE, C. 1985. Wildland fires in Banff National Park 1880-1980. Occas. Pap. No. 3. Natl. Parks Branch, Parks Can. Ottawa. 106pp.