

A REVIEW OF BLACK BEAR (*URSUS AMERICANUS*) DIETS OVER A YEAR IN THE NORTHWEST

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Abstract

Northwest Trek Wildlife Park proposed a novel diet to meet nutritional and behavioral needs of their black bears (*Ursus americanus*) over a period of one year. The diet was changed monthly to mimic free-ranging black bear habits by offering whole foods in a nutritionally balanced diet. Additionally, instead of a daily diet plan, an annual diet with weekly ranges of food items was proposed. The diet, therefore, would create enriching feeding opportunities based on seasonal variation by encouraging active foraging and food manipulation as well as providing for the caloric demands based on seasonal metabolic needs ranging from hyperphagia to hibernation. The diet was outlined into the following groups: greens, fruit, vegetables, manufactured food, fish, nuts/seeds, insects, and meat for the analysis. The bears were weighed monthly except during hibernation. Before the diet was analyzed for comparison to a target range, diet changes were proposed and then tested to monitor consumption and body mass changes making this a two-year process. Adjustments are still needed to accommodate individual variations. Overall the bears took to the new diet plan well, and it allowed for seasonal body weight changes that were outlined.

Introduction

Northwest Trek Wildlife Park is an Association of Zoo & Aquariums (AZA) park in the state of Washington. They exhibit 1.1 black bears (both 10 years of age). Their goal was to reduce the use of processed, dry, manufactured foods while including seasonal variation to encourage natural feeding strategies. However, the proposed diet required nutritional assessment to ensure it provided the necessary nutrients and energy appropriate to maintain seasonal body mass changes. Additionally, the diet plan needed to be attainable for the park in terms of food volume and budget for hyperphagia allowing the bears to hibernate if they so choose. The previous diet had seasonal variation in amounts and produce types but relied heavily on commercially manufactured diets to provide the volume of food needed for caloric demands. It was felt that while dry manufactured foods provide good nutrition, they lack perhaps behavioral opportunities for foraging and activity. Prior diet adjustments were made to accommodate seasonal variation but there were challenges with appropriate weight gain and anticipatory pacing during hyperphagia. It was felt the bears were not feeling satiated on fruit, greens, and vegetables and manufactured food. To address this, the new seasonal diet plan included goal amount ranges per food type that could be adjusted within reason to maintain appropriate body weight ranges that were set and address individual behavioral needs.

Materials & Methods

The diet was designed to mimic wild black bear foraging patterns while allowing flexibility to provide for individual bear preferences and needs. The goal of the new diet plan included providing greens upon the bears waking from hibernation, slowly increasing the vegetable portion in the diet starting in February, increasing greens and adding fruit throughout the spring, substituting seasonal

fruit, berries in June, providing the largest quantity of total food in July and August, and decreasing the total type and quantity of food when the bears would hibernate for the winter months. In the late summer and fall, meat, insects and nuts were added to the diet to mimic natural foraging strategy. Meat was added higher in the diet since more meat could be added for less strain on the budget and less volume. Another goal was to provide keepers flexibility in the presentation by having diet totals set as weekly quantity ranges. Based on these principles, the diet was outlined in a spreadsheet with grams per bear per day for each month (Table 1). The diets were analyzed using Zootrition™. Table 2 compares the nutrient analysis to a target set for black bears (AAFCO, 2011; Dog and Cat NRC, 2006).

Results & Discussion

Basic principles were used to mimic free-ranging black bear foraging ecology while designing the diet over a year (Baldwin and Bender, 2009; Poulsen, 2014). The outlined plan was tested on the two bears fed and exhibited together. In February, the vegetable portion of the diet was increased but the bears did not consume what was offered. Historically at Northwest Trek, the black bears did not eat a variety of vegetables which may have explained why the bears had a strong lack of desire to consume the vegetable variety. The goal was to mimic a high root vegetable diet in early spring before fruit would naturally be available in the wild. The diet was adjusted instead to continue increasing leafy greens and to add fruit into diet sooner to accommodate individual preferences. In May, a change in the bear's preferences was observed once more with a reduced desire to consume leafy greens at the maximum goal set; therefore, fruit was increased (mainly berries). Bears at this time also were observed foraging on berries growing in the exhibit. Keepers used this seasonal feeding opportunity to maximize foraging that mimic berry picking, increasing the time the bears spent foraging. In July, the bears surpassed their weight goals but began demonstrating anticipatory pacing behavior. Figure 1 outlines the body mass of the two bears before and after the diet was changed seasonally. Keepers felt this indicated another change was needed in the food types that were being offered (i.e. – the bears still did not appear to be satiated or were not receiving the type of nutrition they needed for this time of year). More protein and fat were added to the diet in the form of meat (manufactured product, whole prey, or carcass). Pacing from the bears disappeared while diet quantity and individual weights stabilized through the continuation of hyperphagia. Keepers recorded the daily weight range of items offered and used it to adjust for larger food items when offered throughout the week (i.e. carcass). If the bears received the weeks' worth of any food item at a single time, then other foods were adjusted on subsequent days to provide a balance of caloric value in the diet (Figure 2). Since the diet was analyzed and a nutrient table provided, changes in food items were possible while still providing appropriate calories for the season/month. This was determined by monitoring their body mass and consumption. This can be subjective in nature with variances in the bears weights and factoring in their age as well. At this facility, flexibility was given to staff to make changes in the diets depending on the bears body mass, consumption, age of bears, and weather conditions making this more of an art rather than a science.

The new diet demonstrated that keepers need to be able to adjust to the behavioral needs of the bears while still able to maintain appropriate body weight. Bear weight ranges cannot be viewed as objectively as many other species can (there is not a clear stagnant set range). An annual cycle that includes hibernation means seasonal weight ranges hinge upon weight and condition changes several months in advance of or behind the actual hibernation/recovery event, thus the ranges are more dynamic in nature. Since diet and body condition flexibility was a goal at Northwest Trek,

diet adjustments were made while tracking weights based on the bear's behavior even if these changes were ahead or behind the set calendar goals for the annual diet. After testing the diet for one year (with flexibility), the diet was analyzed per month the following year.

Mazuri® Wild Carnivore™ Bear Maintenance (5M4R; PMI Nutrition International, St. Louis, MO) was offered all year and was the only food item offered in December and January to provide nutrients to the bears in the smallest volume with good nutrient density. Fruit and leafy green vegetables were offered February through November with a highest quantity of fruit offered May through November. Berries were offered as the highest proportion of any fruit in June to mimic wild foraging. Leafy green vegetables were higher in the diet from February through April. Vegetables were offered March through October while fish was offered April through November year. Insects were offered May through October while meat was offered August through October and increased due to behavioral needs. Nuts or seeds were only offered in a small quantity in August through October. Overall total quantity increased over the year to a peak in August and then tapered off until the end of the year. The start of hibernation varies, but in late September the bears had decreased activity with an increase in bed making and in October the bears started to den up. The process began with the bears denning for a day or two between active bouts and then increased in length until the bears were denned for the season.

Each month's diet met the target nutrient values except for choline, which was slightly under the target from June through October. The two food items that contain choline were the dry manufactured bear food and salmon. During some months when less of these items were offered the choline was slightly lower than the target. Computer-analyzed vitamin A appears high throughout the year due to the beta-carotene content of the produce represented in those data. Beta carotene is not toxic, so this should not be an issue. Overall, the diets provided similar nutrients throughout the year. Along with the computer-generated nutrient content, calories offered per day per bear were hand calculated. Figure 3 provides a depiction of the increase in calories over the months to peak in September preparing the bears for hibernation.

This dynamic approach to seasonal diet formulation requires flexibility and constant attention, however it can be utilized to successfully provide an appropriate diet for captive black bears. Given its complexity, it is recommended that a nutrition professional be part of the design and implementation of such a feeding plan.

Literature Cited

Association of American Feed Control Officials (AAFCO) (2011) Dogs and Cats Nutrient Profiles. Official Publication.

Baldwin RA and Bender LC (2009) Foods and nutritional components of diets of black bear in Rocky Mountain National Park, Colorado. *Can J Zool* 87(11):1000-1008.

National Research Council (NRC) (2006) Nutrient Requirements of Dogs and Cats. The National Academy Press. Washington D.C.

Poulsen E (2014) Environmental enrichment in behavior-based bear husbandry, Part 1: Principles. *The Shape of Enrichment*. 23:1-2.

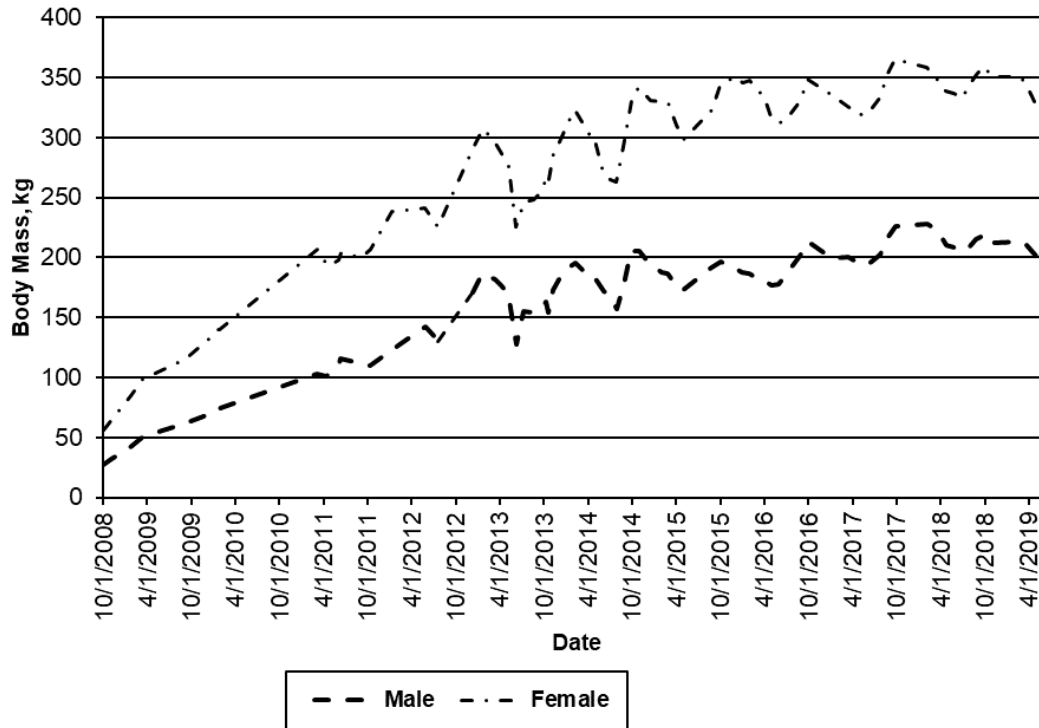


Figure 1. Body mass of two black bears (*Ursus americanus*) over a ten year period to depict seasonal changes after diets were changed.

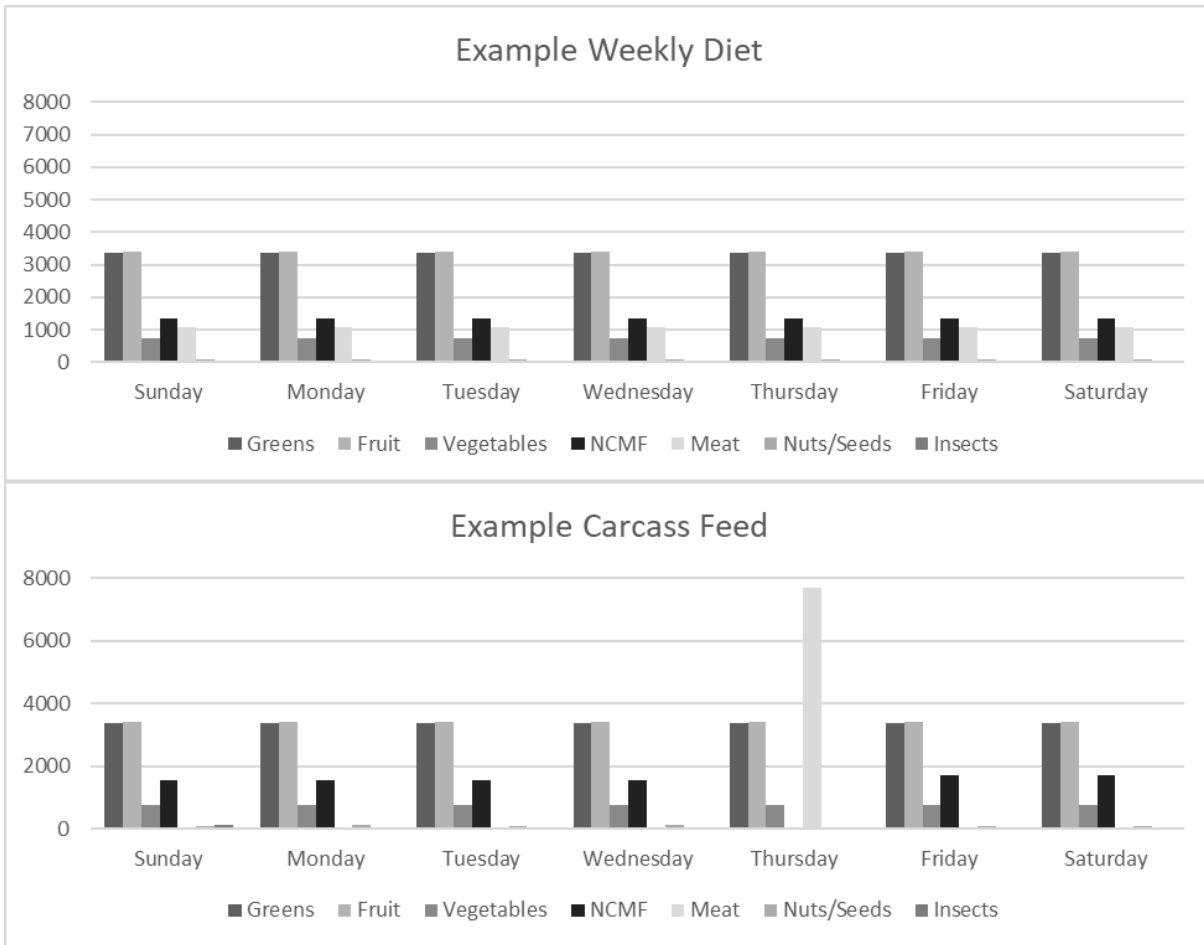


Figure 2. Comparison of a normal diet for one week against changes in quantities offered to the black bear (*Ursus americanus*).

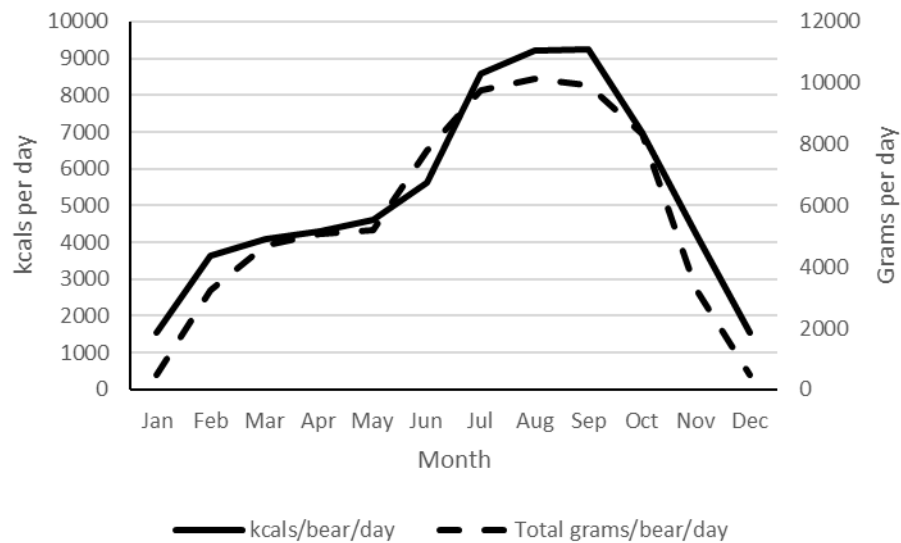


Figure 3. Calories and grams offered per month per black bear (*Ursus americanus*) fed over the course of the year.

Table 1. Black bear (*Ursus americanus*) diet outlined in grams per day per bear per month.

Food Group	Grams/day/bear											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Greens	0	1816	2919	3178	2270	3405	3632	3373	3178	2724	681	0
Fruit	0	506	584	597	1492	2751	3009	3410	3405	3405	1557	0
Vegetable	0	0	298	298	402	603	752	752	752	597	0	0
NCMF ¹	454	908	908	908	908	908	1362	1362	1362	908	908	454
Fish	0	0	0	86	86	86	937	499	499	143	130	0
Nuts/seeds	0	0	0	0	0	0	0	84	84	123	0	0
Insects	0	0	0	0	30	39	50	50	50	21	0	0
Meat ²	0	0	0	0	0	0	0	599	599	400	0	0
Total	454	3230	4709	5067	5187	7792	9743	10129	9930	8321	3275	454

¹NCMF = Nutritionally complete manufactured food was Mazuri® Wild Carnivore™ Bear Maintenance 5M4R PMI Nutrition International, St. Louis, MO.

²Meat could be Milliken feline (Milliken Meat Products Ltd, Markam Ontario Canada), whole prey, or a piece of a carcass.

Table 2. Nutrient analysis of the diets for the black bears (*Ursus americanus*) over one year outlined monthly on a dry matter basis.

Nutrient (DM)	Unit	Target ¹	Northwest Trek Wildlife Park Black Bear Seasonal Diets										
			Jan/Dec	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Protein	%	10.00-22.50	31.10	28.90	27.90	28.80	26.90	24.30	29.90	27.61	27.67	24.07	27.20
Fat	%	5.0-8.5	14.4	12.6	11.5	11.9	11.5	10.0	12.2	12.8	12.9	12.8	12.2
Linoleic Acid	%	1.00-1.30	1.67	1.52	1.43	1.38	1.33	1.23	1.15	2.08	2.09	2.89	1.41
Vitamin A	IU/g	0.5-5.0	14.0	58.7	129.8	131.2	101.3	124.5	109.9	102.3	87.6	102.8	41.2
Vitamin D ₃	IU/g	0.50-0.55	1.83	1.52	1.35	1.29	1.22	1.01	1.02	1.01	1.02	0.89	1.36
Vitamin E	mg/kg	30.0-45.4	191.9	169.8	156.0	151.5	144.2	127.2	131.7	138.7	139.0	136.6	153.4
Thiamin	mg/kg	1.00-2.25	15.50	14.70	14.20	13.80	12.70	11.50	10.80	11.20	11.20	10.90	12.50
Riboflavin	mg/kg	2.2-10.5	18.9	17.6	16.8	16.4	15.2	13.8	12.9	12.9	12.9	12.2	15.2
Niacin	mg/kg	11.4-15.0	166.7	149.0	140.0	135.8	127.4	113.3	108.1	110.7	111.0	105.8	131.7
Pyridoxine	mg/kg	1.0-1.5	11.1	10.3	10.4	10.1	9.4	8.8	8.2	8.4	8.4	8.3	9.4
Folacin	mg/kg	0.18-0.27	1.67	3.70	4.33	4.40	3.66	4.11	3.19	3.14	3.05	3.30	2.13
Vitamin B ₁₂	mg/kg	0.02-0.04	0.12	0.10	0.09	0.09	0.08	0.07	0.07	0.07	0.07	0.06	0.09
Pantothenic Acid	mg/kg	10.0-15.0	63.3	59.0	55.2	53.7	49.6	44.5	42.8	43.9	44.0	42.6	50.5
Choline	mg/kg	1200-1700	1616	1343	1186	1141	1079	891	897	890	896	787	1195
Ca	%	0.30-1.20	2.44	2.12	1.95	1.89	1.75	1.49	1.61	1.57	1.58	1.38	1.90
P	%	0.30-1.00	1.33	1.19	1.10	1.08	1.02	0.89	0.89	0.91	0.91	0.83	1.04
Mg	%	0.04-0.06	0.19	0.18	0.18	0.17	0.16	0.15	0.15	0.16	0.16	0.16	0.16
K	%	0.40-0.60	0.78	1.26	1.52	1.56	1.38	1.54	1.31	1.30	1.29	1.37	1.01
Na	%	0.04-0.30	0.28	0.25	0.25	0.24	0.22	0.20	0.19	0.19	0.19	0.18	0.22
Fe	mg/kg	30-90	377	335	311	302	280	243	245	241	242	219	293
Zn	mg/kg	60-120	305	261	235	227	214	181	183	182	183	164	231
Cu	mg/kg	6.0-12.4	40.0	34.4	31.7	31.3	29.4	25.3	26.2	25.9	26.1	23.7	31.4
Mn	mg/kg	5.0-7.2	138.9	128.3	120.7	117.5	108.8	97.0	92.0	92.2	92.2	86.2	110.8
I	mg/kg	0.90-1.50	1.33	1.11	0.98	0.94	0.89	0.73	0.74	0.73	0.74	0.65	0.99
Se	mg/kg	0.11-0.35	0.33	0.28	0.26	0.25	0.24	0.21	0.20	0.22	0.22	0.21	0.26

¹Target is a combination of targets from AAFCO 2011 and Dog and Cat NRC 2006