

SUMMARY OF POLAR BEAR NUTRITION GUIDELINES

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Abstract

Polar bears, the most carnivorous of the Ursidae family, prey primarily on ringed seals.^{2,6,12} When brought into captivity, maintaining their nutritional and psychological health can be challenging. Due to the lack of in-depth species-specific research, dietary recommendations for polar bears are formulated considering known requirements of related domestic animals, the diets, and nutrients consumed by healthy captive bears. A balanced diet for captive bears could include a combination of nutritionally complete items (dry, raw, and/or gel), fish, bones, whole prey, and produce. All bears should be offered a diet that would maintain appropriate body condition across all seasons.

Introduction

Polar bears prey primarily on ringed seals.^{2,6,12} However, other seals (bearded and harp), some whales (white and narwhal), walrus, reindeer, sea birds, carrion, and vegetation are consumed.^{5,6,7,9,10} Consumption varies depending on the season and location. Some high arctic bears prey on seals year-round.⁵ In locations where ice recedes and bears are restricted to land for up to 6 months, seasonal adaptations may include fasting or very limited food intake.⁷ Though bears prefer the energy rich blubber of seals, whole carcasses still contribute to the overall diet and may be especially important to subadults and orphaned cubs.¹³

The stomach of Ursidae is simple, a cecum is absent, and there is no obvious external differentiation between small and large intestine.¹¹ Similar to other carnivores, polar bears efficiently digest protein and fat.² This simple digestive tract is well suited for their meat diet.

Due to the lack of species-specific data, it is reasonable to consider the known requirements of related domestic animals. Domestic models have been studied in great detail, and thus provide a database from which to extrapolate. A range of probable requirements can be established for polar bears based on animals with similar feeding ecology and gastrointestinal tracts. Domestic cats and dogs are used as models for polar bears.^{1,8} Cats and dogs are considered strict carnivores and omnivores, respectively. Polar bears are primarily carnivorous but occasionally consume plant matter and evolved

from a brown bear ancestry.^{7,9} Captive polar bears will readily consume plant matter. Consequently, a range of nutrient levels encompassing both feeding strategies may be appropriate for formulation of captive polar bear diets (see Table 1).

Recommendations

The goal of all diets throughout the seasons is good physical and psychological health and condition. Each institution should assess seasonal diet changes based on the body condition and appetite of their bears.

The diet items polar bears consume in the wild are not available for feeding in captivity. Thus, the nutrients, and not their packaging, should be considered. Various food items, such as nutritionally complete dry foods, raw nutritionally complete meat mix, nutritionally complete gel products, marine products, bones/prey, and produce, when fed in combination, should result in nutrient levels that meet the minimum dietary recommendations. Balanced polar bear diets including fats from marine sources (marine fish or fish fed marine sources) should fulfill omega-3 fatty acid needs without additional fatty acids supplements. Nutrients in items that are commercially available may vary depending on the location and time of the year. Consequently, regular analysis of diet ingredients and diet review are imperative to offering appropriate diets.

The order of feeding specific dietary items should be considered. After discussion among nutritionists and veterinarians, we recommend feeding food items that are soft or that could become soft first. For instance, the nutritionally complete hard foods could become soft and stick to the teeth. Food items such as bones, fish, or those with hair/skin should be offered last. This may improve oral health. Additionally, bears may need bones more than once a week for assistance in dental health. When considering food presentation for enrichment, variation of the food, different avenues to present food, placement of the food, and timing should be evaluated.

The feeding of road killed animals should be discouraged. If these animals are used they must be fresh, wholesome, in good condition (well fleshed, not bloated), free from obvious disease (no external lesions or wasted appearance), and fed as soon as possible. The carcass must be removed when spoilage begins, or 12 hours (USDA recommendation but may need to be modified according to environmental temperatures) after it has been placed into the enclosure, whichever comes first. Carcasses, whether fed out immediately or processed for freezing, should be opened (abdominally then up through the diaphragm) and organs inspected for internal lesions or abnormalities which might indicate presence of infectious disease (i.e. abscesses, parasites, etc). This inspection is best performed by a veterinarian/pathologist.

Sick animals, or animals that have died of illness or unknown causes, must not be used for food. Animals euthanized with chemical euthanizing agents must not be used for food because of danger of poisoning. When food animals have been euthanized by gunshot, the lead should be removed to prevent lead poisoning from ingestion of the slugs or shot. Downer animals exhibiting signs of central nervous system disorders,

including dairy and beef cows, horses, other livestock (particularly sheep), and wildlife, must not be used for food because of the risk of transmissible spongiform encephalopathies. This includes animals suffering from scrapie and any chronic wasting disease. If the downer animals were clearly harvested because of physical injuries only, they may be used for food when properly processed. In addition, animals known or suspected of being affected with Johne's disease should not be fed.

Plant materials introduced into, or growing in animal enclosures should be evaluated as if the exposed animals will ingest them. Plants should be screened for a number of criteria, including, but not limited to: known toxicities to comparable species (i.e. dogs, cats, humans); potential to cause obstruction of the gastrointestinal tract, physical irritation and exposure to pesticides, herbicides, and other noxious chemicals.

Care should be taken to ensure that the food for captive animals is of the highest quality. There are two publications that are available on the USDA website as well as links from the NAG website that outline fish, meat and prey handling.^{3,4}

The manner of presentation of the prescribed diet should be varied for behavioral enrichment purposes (i.e scattered, chopped vs. whole, frozen in blocks, presented in feeder balls or barrels, training sessions). Supplemental enrichment foods (i.e. raisins, peanut butter, honey etc.) may be offered but should vary and should not exceed (3% by weight) of the total diet offered. This is critical to providing a balanced diet. All edible food enrichment items should go through the institution's approval process, including review by nutritionists and veterinarians. All new items should be watched closely. Storage and handling of food enrichment items should follow the same standards as those for other diet ingredients.

Table 1. AAFCO and NRC cat and dog nutrient profile minimum for all stages compared to suggested dietary recommendations for polar bears on a dry matter basis

Nutrient	Unit	Minimum Nutrient Profile ^b		Minimum Dietary Recommendations ^c
		Cat	Dog	Polar Bear
Protein	%	26.0 (30.0)	18.0 (22.0)	25.0
Fat, min	%	9.0	5.0 (8.0)	5.0
Fat, max	%	-	8.0	20.0 ^d
Lysine	%	0.83 (1.2)	0.63 (0.77)	1.0
Methionine + Cystine	%	1.1	0.43 (0.53)	1.0
Methionine	%	0.62	-	0.55
Taurine	%	0.1	-	0.1
Linoleic Acid	%	0.5	1.0	1.0
Arachidonic	%	0.02	-	0.02
Vitamin A min	IU/g	5.0	5.0	5.0
Vitamin A max	IU/g	333 ^a	50 ^a	-
Vitamin D ₃	IU/g	0.5	0.5	1.8
Vitamin E	IU/kg	30	50	100
Vitamin K	mg/kg	0.1	-	-
Thiamin	mg/kg	5.0	1.0	5.0
Riboflavin	mg/kg	4.0	2.2	4.0
Niacin	mg/kg	60.0	11.4	40.0
Pyridoxine	mg/kg	4.0	1.0	4.0
Folacin	mg/kg	0.8	0.18	0.5
Biotin	mg/kg	0.07	-	0.07
Vitamin B ₁₂	mg/kg	0.02	0.022	0.02
Pantothenic acid	mg/kg	5.0	10.0	5.0
Choline	mg/kg	2400	1200	1200
Calcium	%	0.6 (1.0)	0.6 (1.0)	0.6
Phosphorus	%	0.5 (0.8)	0.5 (0.8)	0.5
Magnesium	%	0.04 (0.08)	0.04	0.04
Potassium	%	0.6	0.6	0.6
Sodium	%	0.2	0.06 (0.3)	0.2
Iron	mg/kg	80	80	80
Zinc	mg/kg	75	120	100
Copper	mg/kg	5.0 (15.0)	7.3	10
Manganese	mg/kg	7.5	5.0	7.5
Iodine	mg/kg	0.35	1.5	1.5
Selenium	mg/kg	0.1	0.11	0.1

^aAAFCO and NRC 2005

^b **bold = require for repro/growth**

^cValues should be adequate for growing cubs

^dA high level of dietary fat might result in less dry matter intake per day thus, daily intakes of other nutrients could be less as well.

LITERATURE CITED

1. Association of American Feed Control Officials (AAFCO). 2004. Dog and Cat Nutrient Profiles. Published by The Association of American Feed Control Officials. Oxford, IN. Pp:128-143.
2. Best, R.B. 1985. Digestibility of ringed seals by the polar bear. *Can. J. Zool.* V:63:1033-1036.
3. Crissey, S.D., K.A. Slifka, P. Shumway, and S.B. Spencer. 2001. Handling Frozen/Thawed Meat and Prey Items Fed to Captive Exotic Animals: A Manual of Standard Operating Procedures. U.S. Department of Agriculture, Agricultural Research Service, National Agriculture Library. Animal and Plant Health Inspection Service, Beltsville, MD. Pp:1-23.
4. Crissey, S.D. 1998. Handling Fish Fed to Fish-Eating Animals: A Manual of Standard Operating Procedures. United States Department of Agriculture, Agriculture Research Service, National Agricultural Library, Animal and Plant Health Inspection Service, Beltsville, MD. <http://www.nal.usda.gov/awic/pubs/fishhndl.htm>
5. Derocher, A.E., O. Wiig, and Magnus Andersen. 2002. Diet composition of polar bears in Svalbard and the western Barents Sea. *Polar Biol.* 25:448-452.
6. Derocher, A.E., O. Wiig, and G. Bangjord. 2000. Predation of Svalbard reindeer by polar bears. *Polar Biol.* 23:675-678.
7. Knudson, B. 1978. Time budgets of polar bears (*Urus maritimus*) on North Twin Island, James Bay, during summer. *Can J. Zool.* 56:1627-1628.
8. National Research Council. 2005. Nutrient Requirements of Cats and Dogs. National Academy Press, Washington, D.C.
9. Russell, R.H. 1975. The Food habits of Polar bears of James Bay and Southwest Hudson Bay in summer and autumn. *Artic.* 28:117-128.
10. Smith, T.G., Sjare, B. 1990. Predation of Belugas and Narwhals by Polar bears in Nearshore areas of the Canadian high Arctic. *Artic.* Vol 43, No 2, June, pp 99-102.
11. Stephens, C.E. and I.D. Hume. 1995. Comparative Physiology of the Vertebrate Digestive System. Second Ed. Cambridge University Press. New York, NY.
12. Stirling, I., and Archibald, W.R., 1977. Aspects of predation of seals by polar bears. *J.Fish.Res.Board Can.* Vol 34, pp 1126-1129.
13. Stirling, I., 1974. Midsummer observations on the behavior of wild polar bears (*Ursus*

maritimus). Can.J.Zool, Vol 52,pp1191-1197.