An Assessment of the Availability of Country Foods to Feed Ranch-raised Foxes in the Keewatin Region, Northwest Territories

by

Doris Eggers

A Practicum submitted in partial fulfillment of the requirements for the degree of Master of Natural Resources Management

Natural Resources Institute
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ABSTRACT

This study was undertaken to identify viable, local food sources to feed ranch-raised domestic foxes in the Keewatin. The study was conducted in Eskimo Point since it is the first Keewatin community to establish a fox farm. Yet the findings can be applied to any Keewatin community pending available food sources.

Marine mammal meat, fat, and viscera, and caribou viscera were found to constitute the bulk of unused by-products. These excess foods appear to be available in such quantities and regularity to deem them a reliable food source for fox farms throughout most of the year. Moreover, country foods can fill the fox's requirement for a high percentage of animal protein.

Feasibility of harvesting lake trout and whitefish for use as fox food was also investigated. Fishing lakes 115 km (70 miles) or further from the fox farm was found to be economically unfeasible. Commercial fishing the local lakes on a small scale may be acceptable if quotas are implemented and domestic harvest is not affected.

Use of country foods for fox food should be restricted to animal by-products and underused food sources, so as not to increase harvest levels.

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Chapter I

INTRODUCTION

1.1 PREAMBLE

This report was generated in response to the need for locating a commercially viable food source for proposed fox farming operations in the Keewatin Region, Northwest Territories (N.W.T.). This report deals with assessing the local (country) foods for which a surplus exists, as in excess and waste foods, and determining their nutritional adequacy. While the basic principles of feeding foxes covered herein may be applied to fox farms in any Keewatin community, the actual content of the diet will be restricted to available food sources, specific to each community. Eskimo Point was chosen for an indepth assessment of country foods because it is the site of the first fox farm to be established for the production of furs in the Keewatin.

The first 12 standard silver foxes arrived in Eskimo Point, N.W.T. from Charlottetown, Prince Edward Island, in December 1985.[1] Demand of silver domestic foxes is high in comparison with wild arctic foxes (Alopex lagopus).

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[1] Silver is a colour phase of the red fox (Vulpes vulpes). Standard refers to one variation of this breed.

1.2 PROBLEM

Importing southern goods to northern regions is very costly. The viability of fox farming may be tied to the use of country foods as feed. Initial investigation indicated the availability of marine mammal meat in coastal regions of the Keewatin. Unused parts of the harvest create a surplus of marine mammal meat in Eskimo Point. Therefore the possibility of utilizing the unused parts for fox food was investigated. At least one workshop in the First International Symposium on Renewable Resources and the Economy of the North proposed increased utilization of marine mammal meat (Mair, 1981). The existence of excess meat in the region suggests the availability of an economical, local food source for foxes in captivity.

Because of the availability of excess meat in the Keewatin, the problem of formulating a fox food diet takes on an interesting reversal from the norm in the south. In southern Canada fox foods are formulated to maximize the level of cereal, the principle source of carbohydrates, in the diet. While carbohydrates may constitute as little as 13.7% of the total metabolizable energy in the diet, the levels are frequently higher than this for economic reasons, since cereal is generally cheaper than protein sources such as meat. Assuming that it is less expensive to utilize country food by-products than to import commercial products from the south, this report looks at maximizing levels of country foods in the fox diet.

1.3 OBJECTIVES

The purpose of this study was to assess availability and adequacy of food sources for fox farms in the Keewatin. Specific objectives were:

1. To determine the nutrient requirements of captive foxes.
2. To identify the country food sources that can be used to feed captive foxes in Eskimo Point. The food sources were assessed for availability, quantity, costs involved, nutrient composition, and seasonal availability.
3. To develop a fox food formula based principally on country foods or some combination with commercial feeds.

This study was conducted in agreement with the terms of a contract with the Northwest Territories Departments of Economic Development & Tourism and Renewable Resources, Rankin Inlet, N.W.T. This report was produced on the University of Manitoba Mantes Text Editing System and submitted to the N.W.T. Government.

1.4 DELIMITATIONS

The nutritional content of the foods was investigated through the North American literature alone. While a large body of literature on fox nutrition exists in the Russian and Scandinavian literature, much of this was inaccessible because of the language barrier. No nutrient analysis was conducted by the researcher. The nutrient requirements of foxes was investigated through the literature and fox food specialists.

Chapter II

METHODS

The study was conducted in three phases: literature review; interviews and discussions; and data compilation.

Phase I

The first phase of the study was an information gathering phase and involved a review of the literature. First, the nutrient requirements of captive foxes and feed types were investigated through the literature. Second, harvest studies provided data pertaining to potential food sources in the Keewatin Region and seasonal availability. Nutrient composition of country foods was also investigated through the literature.

Phase II

Informal discussions and interviews with individuals knowledgeable about fox nutrition, country foods, or Keewatin harvest constituted the second phase of research. Informal discussions were held with representatives of:

- the federal Department of Fisheries and Oceans, Rankin Inlet and Winnipeg;
- the Northwest Territories Department of Economic Development and Tourism, Rankin Inlet;

- the Northwest Territories Department of Renewable Resources, Rankin Inlet;
- the Keewatin Wildlife Federation, Rankin Inlet;
- the Hunter and Trappers Association, Eskimo Point;
- Victor Fox Foods, Winnipeg; and
- the Newfoundland and Labrador Department of Rural Agricultural and Northern Development, Harbour Grace, Newfoundland.

Standardized interviews were conducted with hunters in Eskimo Point. The primary objectives of the discussions and interviews were to identify country foods that may be used for fox food, to assess their availability throughout the year, and to gain practical advice on the feeding of captive foxes. Interviews also addressed the collection, transportation, handling, and storage of foods. Emphasis was given to the attitudes and concerns of native people with respect to food distribution in that region.

Phase III

The third phase involved the compilation of data and development of guidelines for feeding captive foxes. Sample fox diets based principally on country foods and supplemented with fortified cereals were formulated.

2.1 DEVELOPING THE INTERVIEW QUESTIONNAIRE

An interview questionnaire to be addressed to hunters of Eskimo Point was designed to identify country food sources and to gain the hunters' perspective on use of excess country foods as fox food. The scope of the interview and the interview questions are outlined in Appendices B and C respectively. The interview questionnaire was used as a guide when interviewing hunters. While each hunter was asked the questions listed in Appendix C, the actual method of questioning was flexible enough to allow hunters to add relevant information that was not specifically called for in the interview questions.

2.2 SELECTION OF INTERVIEWEES

Interviewees were selected on the basis of:

- experience in hunting;
- referral to me by my interpreter; and
- availability and willingness to be interviewed.

There was no effort made in any way to limit the number of hunters interviewed. It was desired to interview as many hunters as was possible in the duration of my stay in Eskimo Point. The names of experienced hunters were acquired through an interpreter. This method of selection, informal as it may be, proved to be adequate for this situation. The interpreter, a permanent resident of Eskimo Point and

employee of the Hamlet Office, was acquainted with virtually all the hunters in the small community (1,022 people, as of 1984 {NWT Data Book}).

2.3 INTERVIEW TECHNIQUES

Hunters were first contacted by phone or in person and informed of the project. Their participation in the interview was requested and a time and location for the interview was established. Interviews took place either in the home of the interviewee or at the Inuit Cultural Institute in Eskimo Point. Non-english speaking hunters were contacted by an interpreter and English speaking hunters were contacted by me personally. Needless to say, interviews with non-english speaking hunters were conducted in Inuktitut through an interpreter.

Interviews were recorded by writing the responses on the questionnaire form.

Chapter III

NUTRIENT REQUIREMENTS OF FOXES

Recommendations concerning the dietary needs of foxes are based on recommendations made in the National Research Council (1982) publication, "Nutrient Requirements of Mink and Foxes", unless otherwise indicated.

3.1 ENERGY REQUIREMENTS

While energy can be expressed in a number of ways, energy is expressed here primarily in kilocalories (kcal) of metabolizable energy (ME) to maintain consistency. Metabolizable energy is defined as that portion of the total combustible energy that is utilized by the animal for maintenance, production, and energy storage and is not lost in either feces or urine (N.R.C., 1982). This form of expressing energy is useful because it refers to that portion of energy that is actually used by the fox. However, fox fox farmers frequently refer to nutrients in terms of the percent of dry matter in the diet. The distinction lies in the fact that the former expresses nutrient content in terms of the proportion of energy it comprises, while the latter expresses nutrient content in terms of the relative proportion of dry matter that is

comprised by that nutrient. In some cases the latter manner of expressing energy is also given since it is more familiar to many fox farmers and nutritionists. The total energy intake of the fox is provided by three types of nutrients: fats, proteins, and carbohydrates. Since each nutrient is an essential component of the diet it is important that part of the energy is provided by each of them.

N.R.C. (1982) has recommended that the fox diet contains 3,227 kcal of energy per kilogram (kg) of dry matter. It is important that foxes receive an adequate supply of energy. Energy requirements vary depending on season, body weight, age, and condition of fox, e.g., growing, pregnant, or lactating. N.R.C. (1982) suggests that the energy requirement for adult maintenance peaks at its highest level in the summer (August) and hits its lowest level in the winter (January). Perel'dik et al. (1972, cited in N.R.C., 1982) provides the following guideline for energy requirements for adult maintenance:[2]

June to August	- 93 kcal of ME per kg live weight
September to October	- 81 kcal of ME per kg live weight
November	- 72 kcal of ME per kg live weight
December	- 65 kcal of ME per kg live weight

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[2] It is of interest to note that elsewhere in the report (Table 16) N.R.C. provides other data from Perel'dik (1972) that is inconsistent with the energy requirements reported here. Energy requirements are given for silver adult female foxes that are roughly 11-23% higher than those cited here, although the preference for reduced food intake in the winter months is consistent.

However, this timing of energy level shifts is not supported by all sources. Agriculture Canada (1979) recommends increasing the ration for males and females about mid November, then decreasing the ration after December, so that the animals will be lean and trim for breeding. The energy level will have to be adjusted to the Keewatin climate. The fox farmer may consider the above guidelines while taking into account that energy requirements are higher in the Keewatin because of lower temperatures. Foxes should be observed closely to see that their energy requirements are being met. However, neither female nor male foxes will perform well during breeding and whelping time if they are overweight.

The fox's energy requirement changes for different stages in its life cycle. There is some dispute about whether pregnant foxes require increased levels of energy intake or not. The fox farmer may use his or her own discretion to determine the best level of energy increase for pregnant females. It is important to keep pregnant females from getting too fat, or difficulties will arise when giving birth. The energy requirements of the vixen increases during lactation since she must supply nutrition to the pups as well as herself.

Energy requirements for lactating dams are greater the larger the number of pups in the litter and the older the litter is. Accepted levels of energy intake for lactating

females can be easily calculated with the help of Table 1. Lactating females require an allowance of about 450 kcal of ME per day for maintenance plus variable increases for successive 10-day periods of lactation.

TABLE 1

Additional Energy Requirements for Lactating Females

10-day periods of lactation[1]	Additional energy per pup daily (kcal of ME)[1]	Additional quantity of food as a percent of 450
1st period	52	12
2nd period	123	27
3rd period	195	43
4th period	292	65
5th period	392	87
6th period	450	100

[1]These columns adopted from N.R.C. (1982, p. 24).

Thus, for example, during the first 10 day period of lactation, a vixen with 1 pup receives 502 kcal of ME (450 + 52) and a vixen with 2 pups receives 554 kcal of ME (450 + 52 + 52) per day, and so on. The vixen with 1 pup receives 12% more food than the vixen with no pups and the vixen with 2 pups receives 24% more food than the vixen with no pups.

Once the pups are weaned, their energy requirements for maintenance and growth must be supplied in the formulated

diet. As they grow, the pups' energy requirements increase until they reach about 7 months. About that time, energy requirements begin to decline. Energy allowances for growing silver fox pups are provided in Table 2.

TABLE 2

Energy Requirements of Growing Silver Fox Pups

Age of pups (months)	Live Weight at Beginning of Month (kg)	Total ME Allowance (kcal/day)
2-3	1.80	450
3-4	3.00	590
4-5	4.10	630
5-6	5.00	666
6-7	5.75	560
7-8	6.00	490

Table from N.R.C., 1982.

The importance of keeping up the energy levels cannot be overstressed. Insufficient energy allowances will adversely affect the health of the animal and the condition of the fur. Deficiency in energy intake may result in reduced milk yield in lactating females and stunted growth and dull fur in all animals.

3.2 FAT

The most concentrated supply of energy to a diet is fat. Energy density of a diet is readily adjusted by the addition or reduction of fats or oils. Foxes can tolerate high levels of fat in their diet. Up to 44% of fresh fat has been used in the fox diet without ill effect (Bassett, 1951, cited in N.R.C., 1982). The contribution of fat to energy may range from 23-49% of ME in the diet. Blake Cryderman, fur specialist has recommended the following fat rations (on a dry matter basis) as a guide for feeding foxes:[3] 7% fat in the maintenance diet; 9-10% of the diet from breeding to whelping; 15% of the lactation ration; and 15-20% fat from weaning to pelting (pers. comm., 1985).

Fat concentrations may be raised somewhat in anticipation of freezing temperatures. Unless extremely cold temperatures persist, the fat level can be reduced so as not to affect optimum fur colour (H.B.C., date unknown). The energy contribution of fat should not exceed 49% of ME.

The main problem with high levels of fat in the diet is the possibility of rancidity. Ingestion of rancid fat results in oxidation in cells. With excessive levels of rancid fat, vitamin E, which counters this process to a point, is itself oxidized and vitamin E deficiency occurs (Campbell, pers. comm., 1985). This problem can be averted

[3] Note that these are expressed as percentages as opposed to energy levels of fat.

by the addition of antioxidants to the fat prior to storing. For suggested types and doses of antioxidants refer to Section 3.8.1 on antioxidants. Rancidity may also be countered with the addition of vitamin E to the diet (Johnson, 1983).

3.3 PROTEIN

Another important factor in the fox's diet is protein. Of prime importance are the individual building blocks, or amino acids that make up the protein molecule. To ensure that the foxes are getting all the required amino acids, quality proteins such as marine mammal meat or fish should be used. Excessive heating may reduce the quality of the feed. This must be kept in mind when cooking fish to destroy the enzyme thiaminase for instance.[4] Dehydration processes may also cause the destruction of the amino acid lysine, thus creating the need for lysine supplementation. In a high protein diet this problem is apt to be less severe. Good sources of protein are muscle meats, organ meats, fish, and eggs.

The National Research Council (1982) recommends the following minimum protein contributions to energy: 22% of ME from digestible protein for a maintenance diet; 30-35% of ME during gestation and lactation; 28-30% of ME for fox pups between the ages of 7 and 23 weeks; and 25% of ME for pups

[4] See Section 3.6.7 on thiamin.

ages 23 weeks to maturity.

Blake Cryderman suggests the following guides for protein rations (dry matter basis):[5] 24% protein in the ration for a maintenance diet; 30% protein or more from breeding to whelping; 32% protein from whelping to weaning; and 34% or more protein for pups from weaning to pelting (pers. comm., 1985).

It should be emphasized that these figures represent the minimum protein requirements of foxes. To provide a margin of safety, it is recommended that higher concentrations of protein than those cited in N.R.C. (1982) are present in the fox diet. In fact, since country food sources such as whale and seal meat are rich in protein, over-feeding of protein may be more of a potential hazard than under-feeding protein. There is considerable flexibility as to the protein and fat content of the fox diet. However, it is important to maintain a good balance of these components. Improper proportions of proteins and fats will have undesired effects on the fox's health and pelt.

Protein levels should not exceed 42% of the diet on a dry matter basis (Langtry, pers. comm., 1985). Diets containing too much protein place extra stress on the kidneys, with the result of producing kidney stones. Foxes with diarrhea may be suffering from too much protein in the diet. Development

[5] Note again that these are expressed as percentages as opposed to energy levels (ME) of protein.

of long bodies and limited hair growth has been attributed to too much protein in the diet (Langtry, pers. comm., 1985). This may be the result of an amino acid imbalance. For instance, an insufficient amount of sulfur amino acids may result in poor fur growth (Campbell, pers. comm., 1986). Further research in amino acid quality is needed to clarify the effect on fox growth and fur development. Clipping of the fur (chewing off the tips of the hairs) has also been reported for foxes receiving too much protein in their diet (Cryderman, pers. comm., 1985), though this is not supported by all sources (Langtry, pers. comm., 1985). Alternately, if foxes are fed diets with high levels of fat relative to protein, stunted growth and poor fur may result (Langtry, pers. comm., 1985). Exceedingly high levels of fat have also been known to reduce the desired contrast in fur colour. For instance, if the fat level is too high in late October and early November, the coat of the silver fox will be brown instead of a clear black (H.B.C., date unknown). Therefore, while allowing some fluctuations in protein and fat levels, the fox farmer should attempt to keep protein and fat levels within reasonable limits. More details of utilizing country foods to fill these requirements will be covered in Section 4.5 on deriving a fox food formula.

3.4 CARBOHYDRATES

The recommended proportion of pure carbohydrates (containing no protein) in the silver fox's diet is between 13.7 and 33.5% of ME. Carbohydrates are usually added as a filler to provide the remainder of the energy requirement not filled by fat and protein. That is, when protein and fat sources are limited, greater proportions of ingredients high in carbohydrates (such as cereal) will be added to the diet. As was noted earlier there is much benefit to this in southern Canada where cereal is cheap relative to protein sources. In the Keewatin however, where protein-rich country foods are more accessible than cereals, carbohydrate levels should be kept at the minimum levels for purely economic reasons. Thus the higher the level of fats and proteins, the lower the carbohydrate requirement, to a point below which the carbohydrate requirement is not being met.[6] Fortified cereals are formulated to contain the essential vitamins and minerals required by foxes. While such supplements could be added to the diet independently of cereal, the cereal content is necessary to provide the required carbohydrate level.

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[6] In the wild, red foxes will attain their carbohydrate requirements through the consumption of berries, roots, and other plants, though there is some dispute about the extent of this food source in the red fox diet (Hockman and Chapman, 1983; and Langtry, pers. comm., 1986).

3.5 FAT-SOLUBLE VITAMINS

3.5.1 Vitamin A

The recommended dose of vitamin A for growing foxes from 7 weeks to maturity is 66 IU of vitamin A per 100 kcal of ME. Recommended doses for maintenance, gestation, or lactation have not yet been determined, though a dietary need has been demonstrated. Foxes can tolerate relatively large doses of vitamin A, but diets in excess of 132,000 IU per 100 kcal of ME have resulted in hypervitaminosis A in pups (extrapolated from data cited in N.R.C., 1982, p. 26). Liver is a good source of vitamin A in the fox diet. However, the liver of sea mammals contain poisonous levels of vitamin A (Rodahl and Moore, 1943; Friend and Crampton, 1961). In a study comparing the effects of feeding diets of 5 and 10% whale liver to mink, it was found that hypervitaminosis was provoked by the diet containing 10% whale liver, and not by the diet with 5% whale liver. Vitamin A toxicity was manifested in lower reproductive ability (Friend and Crampton, 1961). For this reason, sea mammal liver content will have to be kept down to 5% of the diet. Though it is unwise to extrapolate the effect of feeding marine mammal liver on mink (family Mustelidae) to foxes (family Canidae), one should be aware of these potential hazzards.

Signs of excess vitamin A include a wide array of symptoms: anorexia, bone deterioration, abnormal

protrusions of the eyeball (exophthalmia), cramps, and extreme sensitiveness (hyperesthesia) of the skin.

Vitamin A deficiency, on the other hand is manifested in a series of progressively worse nervous derangements from trembling to running in circles and even passing into a coma. Vitamin A deficiency has also been related to sterility in both males and females, and can cause the development of large fetuses resulting in difficulties at birth (Johnson, 1983).

3.5.2 Vitamin D

The requirement of vitamin D is 22 IU per 100 kcal of ME for growing foxes. Sufficient levels of vitamin D are generally provided in a diet of natural food stuffs. Vitamin D deficiency can result in rickets in foxes if a corresponding improper calcium to phosphorus ratio exists.

3.5.3 Vitamin E

Vitamin E is important because it helps to prevent rancidity of the feed and slows the breakdown of vitamin A (Johnson, 1983). Sufficient levels of vitamin E are generally provided in fortified cereal. However, when feeding feedstuffs that are prone to rancidity, such as meats of seal, whale, polar bear, and whole fish, a supplement may be used. See Section 3.8.1 on antioxidants.

The cause of vitamin E deficiency has already been described in Section 3.2.

3.6 WATER-SOLUBLE VITAMINS

3.6.1 Biotin

No required minimums have been established for biotin in foxes. However, it has been clearly determined that feeding foxes a diet high in raw egg will produce signs of biotin deficiency, namely greying and and loss of fur over the body and tail, and deformation of legs. Thus eggs, fresh and powdered, must be cooked if they are to be used in the fox diet.

3.6.2 Folic Acid

The accepted requirement for folic acid in foxes is 5.2 micrograms per 100 kcal of ME.[7] Folic acid deficiency results in anorexia, weight loss, and a decrease in hemoglobin and in red and white blood cells.

3.6.3 Niacin

A satisfactory level of niacin for foxes is 0.26 mg per 100 kcal of ME.[8] Niacin deficiency is typified by signs of anorexia, weight loss and a severe inflamation of the gums

[7] The requirement of folic acid is based on limited data and should be accepted as tentative.

[8] Same as above.

and lips, known as black tongue.

3.6.4 Pantothenic Acid

Pantothenic acid requirements are around 0.21 mg per 100 kcal of ME.[9]

3.6.5 Pyridoxine (Vitamin B_6)

The fox diet should contain 50 micrograms per 100 kcal of ME of pyridoxine.[10] Signs of pyridoxine deficiency are similar to those of folic acid: anorexia, cessation of growth, and a decrease in hemoglobin.

3.6.6 Riboflavin

Riboflavin appears to be one of the most important of B-complex vitamins. The minimum requirement of riboflavin per 100 kcal of ME is 0.1 mg for half grown pups and 0.15 mg for pregnant and lactating dams. Foxes deficient in riboflavin may show signs of muscular weakness, chronic spasms, coma, and paling of the eye lenses and fur.

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[9] The requirement of pantothenic acid is based on limited data and should be accepted as tentative.

[10] Same as above.

3.6.7 Thiamin

Foxes require at least 27 micrograms of thiamin per 100 kcal of ME. Thiamin deficiency in foxes results in anorexia, weakness, convulsions and paralysis. Foxes become thiamin deficient by eating certain raw fish containing the enzyme thiaminase. This enzyme destroys the thiamin in the diet and results in the disease known as Chastek paralysis. Keewatin fish known to contain significant concentrations of thiaminase are whitefish (Coregonus clupeaformis), burbot (Lota lota), and suckers (Catostomus catostomus) to name a few. Safe species, namely those not containing thiaminase, are trout (Salvelinus namaycush) and northern pike (Esox lucius). Thiaminase can be destroyed by cooking the fish at 83°C (181°F) for at least 5 minutes (N.R.C., 1982). Another source suggests cooking the fish for 15 minutes (Langtry, pers. comm., 1985). Presumably, cooking time required to destroy thiaminase is related to size of the chunks of fish. Thiamin deficiency can be cured by feeding the affected foxes thiamin hydrochloride or by subcutaneously injecting foxes with thiamin hydrochloride diluted with sterile distilled water. Chastek paralysis can be prevented by mixing thiamin hydrochloride with the food, although this suggestion is under dispute (Langtry, pers. comm., 1985).

3.7 MINERALS

3.7.1 Calcium and Phosphorus

The most important minerals are calcium and phosphorus, which along with vitamin D, aid in bone development. Calcium and phosphorus levels were experimentally varied in the diets of 128 foxes from the time of weaning (50 days) to pelting (254 days old). The minimum calcium and phosphorus requirements were found to be 0.5-0.6% and 0.4-0.6% respectively in the dry matter of the diet. The acceptable range in practice is 0.6-1.0% calcium and 0.6-0.8% phosphorus in the dry diet. Of primary importance is to maintain the appropriate calcium to phosphorus ratio (Harris et al., 1951). The acceptable range of calcium to phosphorus ratios is 1:1 to 1.7:1, though is is advisable to keep the ratio closer to 1:1 (Langtry, pers. comm., 1985). Improper balance of these minerals results in rickets. Diets lacking in bone content will probably be low in calcium, unless calcium supplements are added.

A good source of calcium is ground bone. Soft bones such as fish bones are advisable, since harder bones such as from seal, whale, or caribou will splinter and could puncture the mouth of the fox, causing boils. Normally, a diet containing 5 to 10% fish heads provides sufficient calcium to prevent rickets (Langtry, pers. comm., 1985). However, the limited data that exists concerning calcium and phosphorus levels in marine mammals suggests these elements

are in lower concentration than in beef or horse muscle meats or organ meats. Thus, it may be necessary to include 10-15% fish heads or skeletons to the diet.

Calcium and phosphorus deficiency results in varying degrees of bone malformations, such as lameness, bent and crooked leg bones, recurrent spasms, enlarged joints, cranial enlargement, and malformed body bones (Harris et al., 1951). Calcium deficiency may also cause enlargement of the muzzle and swollen gums. Phosphorus deficiency occasionally causes foxes to develop an undershot jaw.

3.7.2 Iron

The minimum requirement of iron has not been determined. The iron needs of foxes can usually be filled by the inclusion of liver in the diet. However, it is of interest to note that feeding certain uncooked fish from the cod family to mink and rats results in interference of iron absorption. It is not known if foxes are so affected or if such a reaction results from the consumption of arctic cod. Signs of iron deficiency in foxes include anemia and depigmentation of underfur.

The nutrient requirements are summarized on Table 3. Nutritional disorders, their symptoms, causes, and remedies are summarized on Table 4.

TABLE 3

Nutrient Requirements of Captive Foxes

Nutrient	Recommended Daily Dietary Allowance
Total Energy Requirement	68-135 kcal of ME/kg live weight
Fats (linoleic and linolenic acids)	23-49% ME
Carbohydrates	13.7-33.5% ME
Protein[1]	
Maintenance	22% ME from digestible protein
Gestation and Lactation	30-35% ME
Early Growth (7-23 weeks)	28-30% ME
Late Growth (23 weeks-maturity)	25% ME
Maximum	42%
Fat-Soluble Vitamins	
Vitamin A (Retinol)	
Growing Foxes	66 IU per 100 kcal ME
Vitamin D	
Growing foxes	22 IU per 100 kcal ME
Vitamin E	not determined; no supplements needed
Vitamin K	not determined
Water-Soluble Vitamins	
Absorbic Acid (Vitamin C)	no supplements needed
Biotin	no supplements needed[2]
Folic Acid	0.2 mg/kg dry diet or 5.2 microgram/100 kcal ME
Niacin	10 mg/kg dry diet or 0.26 mg/100 kcal ME
Pantothenic Acid	8.0 mg/kg dry diet or .21 mg/ 100 kcal ME
Riboflavin	
Half grown pups	>1.6 and <4.0 mg/kg of diet
	0.1 mg/100 kcal ME
Pregnancy and Lactation	0.15 mg/100 kcal ME
Thiamin	1.0 mg/kg dry diet or 27 micrograms/100 kcal ME
Vitamin B_6 (Pyridoxine)	2.0 mg/kg dry diet or 50 micrograms/100 kcal ME
Vitamin B_{12}	not determined
Minerals	
Calcium and Phosphorus	
Calcium	
7-37 weeks	0.5-0.6% dry diet
Phosphorus	
7-37 weeks	0.5-0.6% dry diet or slightly less[3]
Sodium and chlorine	
Sodium chloride (salt)	0.5% dry diet
Iron	not determined[4]
Cobalt, Copper, Iodine, Manganese, and Zinc	not determined[5]

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[1] All ME percentages given represent the minimum requirements. To allow a margin of safety, greater proportions of protein may be allotted.

[2] Biotin deficiencies occurred when foxes were fed diets containing raw egg. Symptoms can be relieved by adding 5% yeast to diet or pressure cooking the egg.

[3] It is important that the calcium-to-phosphorus ratio is between 1:1 and 1.7:1.0 for proper bone development.

[4] Iron supplements were required for silver and blue foxes fed air-dried cod.

[5] Manipulation of the concentration of these minerals in fox diets have been observed to affect litter sizes.

TABLE 4

Nutritional Disorders

Disorder or Disease	Symptoms	Cause	Remedy	Page
Vitamin A toxicity	anorexia bone deterioration abnormal protrusions of the eyeball extreme sensitiveness of the skin	excess of vitamin A in diet too much marine mammal liver	reduce levels of vitamin A reduce liver in diet	11-12
Vitamin A deficiency	nervous derangements -trembling -running in circles sterility in males and females development of large fetuses resulting in difficult birth	inadequate levels of vitamin A in the diet	increase vitamin A levels increase liver in diet	12
Vitamin D deficiency	rickets	inadequate levels of vitamin D andimproper calcium to phosphorus ratio in the diet	add vitamin D supplement correct calcium to phosphorus ratio (by adjusting rations of bone or meat)	12
Vitamin E deficiency Yellow fat disease	wet belly dribbling on self due to blockage of urinary tract	consumption of rancid meat or fat	add antioxidants or vitamin E supplement to prevent rancidity	9, 12-13 21
Biotin deficiency	graying of the pelt deformation of legs	raw powdered or fresh egg in the diet	cook eggs before feeding to foxes	13
Folic acid deficiency	anorexia weight loss decrease in blood count	inadequate levels of folic acid in the diet	increase levels of folic acid	13
Niacin deficiency Black tongue	anorexia weight loss inflammation of the gums and lips	inadequate levels of niacin in the diet inadequate levels of niacin in the diet	increase levels of niacin increase levels of niacin	14
Pyridoxine deficiency	anorexia cessation of growth decrease in hemoglobin	inadequate levels of pyridoxine in the diet	increase levels of	14
Riboflavin deficiency	muscular weakness chronic spasms coma paling of eye lenses paling of the fur	inadequate levels of riboflavin in the diet	increase levels of riboflavin	14-15
Thiamin deficiency	anorexia weakness convulsions paralysis	consumption of fish containing thiaminase	add thiamin hydrochloride to feed or inject subcutaneously thiamin hydrochloride diluted with sterile water to prevent thiamin deficiency, cook fish that contain thiaminase	15
Calcium deficiency	bone malformations enlargement of muzzle swollen gums	inadequate levels of bone in diet	addition of ground soft bone (eg. fish racks)	16
Phosphorus deficiency	bone malformations undershot jaw	inadequate portions of meat in diet	increase levels of meat in diet	16
Iron deficiency	anemia depigmentation of underfur	inadequate levels of iron in the diet	increase liver ration	16-17
Excess protein	big , long body limited hair growth	too much protein in diet	balance protein and fat rations	11
Excess fat	short, stubby body poor fur production	too much fat in diet	balance protein and fat rations	11

3.8 FEED ADDITIVES

3.8.1 Antioxidants

Antioxidants are added to food to prevent oxidation of meats which leads to vitamin E deficiency. Marine mammal meat, fish, and fat are prone to become rancid if improperly stored, or stored for prolonged periods of time. A variety of antioxidants have been successfully used in mink diets containing high levels of fish waste and sea mammal meat at a concentration of 123 mg per kg of wet diet (Leekley et al, 1962). Among these are hydroxytoluene (BHT), 2,4,5-trihydroxy butyrophenone (THBT) and dehydroethoxy trimethylquinoline (ethoxyquin). Vitamin E can also be added as an antioxidant. One pound of stabilized vitamin E concentrate is required for 1 ton of mixed wet feed (Johnson, 1983).[11]

3.9 USING A WET OR DRY DIET

The fox diet can be either wet or dry. The traditional fox diet is a wet diet and consists mostly of a combination of raw meat and cereal. In more recent years, dry fox food pellets or cubes have been formulated for growing, furring, or breeding seasons. When using a wet diet these changes must be made by the farmer (Johnson, 1983). The more uniform the diet, the fewer problems that will be

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[11] The metric equivalent is 0.5 kg of stabilized vitamin E concentrate for 1 tonne of mixed wet feed.

encountered (Agriculture Canada, 1979). Dry diets have been promoted because they are easy to use, no refrigeration or mixing equipment is required and foxes receive a uniform diet (Agriculture Canada, 1979).

Wet diets also have their advantages. In the Keewatin, where large quantities of high quality protein meats are available, their use is more economical than shipping dry foods from the south. A wet diet fills the fox's requirement for a high percentage of animal protein. Use of a dry diet demands a constant supply of fresh, clean water, while a wet diet supplies a large percentage of the fox's water requirement. Particularly in the winter, a wet diet is more practical because cold temperatures make it difficult to maintain a fresh water supply. Foxes will not eat enough snow to provide sufficient moisture intake when on a dry diet (Agriculture Canada, 1979).

According to Agriculture Canada (1979) the ideal diet will contain about 2/3 meat and 1/3 cereal. However, fortified cereals are available that can be fed at 15% of the diet on an as fed basis.[12] Therefore, when protein sources are readily available and economical to use, the 'ideal' diet would contain substantially less than 33% cereal. The fortified cereal provides all the vitamins and minerals needed for a balanced diet. The fat and protein is

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[12] Superblend fortified cereal, manufactured by Victor Fox Food.

provided mainly by the fat and meat portions of the diet. The types of suitable meats are muscle meat, viscera, and other waste products. Supplements of bone are also required to fill the calcium and phosphorus needs.

3.9.1 Food Preparation

There are basically 2 methods of wet food preparation. One is to serve the meat portion in chunks and the cereal mixed with water to form a paste. The other method is to mix the meat and cereal and water in a grinder to produce a mixture the consistency of hamburger. While feeding foxes a chunk diet is easier for the farmer, the second option is recommended because it produces "better and more uniform development of the pups" (Agriculture Canada, 1979, p. 9). Uniformity of fox pups will aid later, in selection of foxes to be pelted.

Chapter IV

RESULTS

It was the purpose of the study to identify local food sources for future fox farming operations in the Keewatin. So as not to put added pressure on the existing domestic harvest, the emphasis was on animals and animal parts that are underused by the Inuit. The main source of this information was interviews with 23 Eskimo Point hunters. First, hunters were asked to identify those animals which they felt had potential as fox food and could be used without putting pressure on the domestic harvest. Then, they were asked to identify specific parts of the animal that would be available as fox food.

It should be pointed out that the responses to the questionnaires have been assessed separately from other data concerning the potential of these foods as fox food. First the analyses of questions 3 and 4 are given, then other considerations about country foods and their suitability as fox food.

4.1 ANALYSIS OF 2 QUESTIONNAIRE QUESTIONS

4.1.1 Analysis of Question 3

"What food sources are available near Eskimo Point that could be fed to foxes in captivity but would not put added pressure on food sources used by Inuit people?"

Animals suggested as potential food sources included terrestrial and marine mammals, birds, and fish. While the total list of animals mentioned at least once, covered a vast array of species, the list of animals that were mentioned frequently, and those that could effectively be utilized as fox food is much smaller.

4.1.1.1 Fish

Ten types of fish were indicated at least once as being suitable for fox food, namely: arctic char (Salvelinus alpinus), arctic cod (Boreogadus saida), arctic grayling (Thymallus arcticus), burbot, catfish (Ictaluridae spp.),[13] northern pike, lake trout, sucker, sculpin (Myoxocephalus quadricornis), and whitefish. Lake trout was by far the most recommended species of fish as it was suggested by 13 of the 23 hunters interviewed. Arctic grayling, sucker, and whitefish were each suggested 7 times. Arctic cod, burbot and sculpin were each mentioned 6 times.

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[13] As far as is known, there are no Ictaluridae as far north as the Northwest Territories (Scott and Crossman, 1973).

4.1.1.2 Marine Mammals

Marine mammals were the most strongly recommended fox food source, undoubtedly because these are frequently not used in their entirety. Among these were polar bear (Ursus maritimus), seal (Phoca spp.), and beluga whale (Delphinapterus leucas). Seal and whale were each suggested by 20 hunters. Polar bear was indicated 3 times.

4.1.1.3 Terrestrial Mammals

A total of 6 species of terrestrial mammals were indicated as potential sources of fox food, namely, caribou (Rangifer tarandus), lemmings (Dicrostonyx torquatus) and Lemmus sibiricus), siksik (Spermophilus parryii), rabbit (arctic hare) (Lepus arcticus), weasel (Mustela spp.), and wolf (Canis lupus). The most strongly recommended were caribou, by 17 hunters, lemmings by 13 hunters and siksik by 9 hunters. Wolf was indicated 4 times and weasel and rabbit were each suggested 1 time.

4.1.1.4 Game Birds

Birds were far less enthusiastically proposed as fox food. All in all there were only 6 references to game birds of any type or their eggs.

4.1.2 Analysis of Question 4

"What parts of those animals mentioned in question 3 could be used as fox food?"

Given that all parts of the animals harvested are not utilized by the people, the hunters were asked to identify those unused parts that could potentially be used as fox food. Some animals mentioned in question 3 are not usually harvested by the people of Eskimo Point. These species, if used, would have to be harvested specifically for use as fox food. Among the parts of animals available for fox food, waste was frequently cited. The definition of the term 'waste' as used in the context of this report is given in the glossary. See Appendix A.

4.1.2.1 Fish

All fish species mentioned, except for char, were said to be little used by the Inuit people. Thus, with the exception of char, fish would have to be harvested exclusively for fox food. The two hunters who suggested the use of char for fox food, recommended using the waste of the fish, namely the head and guts. In one case that trout and whitefish were suggested, the hunter indicated only the scraps of these fish should be used as fox food. The flesh could be used by people.

4.1.2.2 Marine Mammals

My observations of the harvest of sea mammals suggested that considerable portions were left over after the hunters took all the parts they wanted. This observation was supported by the answers given to question 4 with respect to marine mammals. Whale and seal meat and viscera were the parts most frequently suggested as potential fox foods. Of the 23 hunters interviewed, 13 recommended the use of whale meat and 13 recommended seal viscera. Seal meat was indicated 11 times as a potential food source and whale viscera 9 times. Ten hunters gave reference to the availability of whale fat and 4 to seal fat. Seal waste was recommended by 5 hunters and whale waste was suggested by 3 hunters. Three hunters indicated the availability of seal bones and 2 hunters gave reference to whale bones. One hunter suggested the entire seal would be suitable for fox food. No hunters suggested that muktuk, the outer layer of skin on the whale, would be available as a food source for captive foxes. Use of polar bear meat was suggested by 3 hunters.

4.1.2.3 Terrestrial Mammals

Of the large terrestrial mammals harvested, caribou and wolf parts were suggested as possible food sources. Twelve hunters indicated that caribou viscera would be available as a food source for foxes. Ten hunters indicated caribou

waste, and 4 suggested the use of wolf meat. Caribou bones were suggested by 2 hunters and 1 hunter recommended the use of caribou meat. It is likely the latter hunter meant waste caribou meat that is left on the carcass, as he also spoke of caribou carcass. Finally, wolf guts were suggested by 1 hunter.

With respect to the smaller terrestrial mammals, notably lemmings and siksik, since Inuit people do not eat any parts of these animals it is obvious they would be available in their entirety. However, they would have to be caught specifically for fox food.

4.1.2.4 Game Birds

As with small terrestrial mammals, those few references to game birds and eggs were directed at the whole bird. In other words, these would have to be hunted specifically for use by the fox farm.

4.2 PRACTICAL CONSIDERATIONS

Following are some practical considerations in the use of country foods as fox food. Country foods are examined under the headings of fish, marine mammals, terrestrial mammals, and game birds.

4.2.1 Fish

There are several considerations in the use of fish as fox food. The first concerns obtaining a commercial fishing permit and quota for harvesting fish in local lakes or the Hudson Bay. Permits for specific lakes are obtained by applying to the Federal Department of Fisheries and Oceans (D.F.O.) in Rankin Inlet, N.W.T. If a permit is granted, a test fishery is set up on a lake for 1 to 4 years to establish permanent yearly quotas.

The second consideration is the accessibility of the lake to be fished and the costs associated with establishing a commercial fishery there and transporting the fish to the community. In communities, such as Baker Lake, where large lakes with plentiful fish supply exist nearby this may not be a problem.

4.2.1.1 Commercial Fishing

In Eskimo Point, commercial fishing on a large scale does not seem to be feasible. While some hunters indicated the presence of fish in several of the small lakes within a 100 km radius of Eskimo Point, none of these appear in the D.F.O. listing of Keewatin lakes with potential quotas (Schedule V, N.W.T. Fishery Regulations). That is not to say that the smaller lakes, not listed on Schedule V (N.W.T. Fishery Regulations) could not support a test fishery

(Larocque, pers. comm., 1985). However, it stands to reason that the carrying capacity of these lakes for fish would be much smaller than the larger lakes that do appear on Schedule V (N.W.T. Fishery Regulations), such as Kaminak, Kaminuriak, O'Neil and Carr Lakes. Furthermore, the small lakes close to Eskimo Point (within 100 km) are used for domestic fishing. The three year average of estimated harvest of lake trout and whitefish for the years 1981-1984, were 1,456 and 183 fish respectively, based on data collected by Gamble (averages calculated from Table 8, Gamble, 1984 and Gamble, in print). See Table 7. While several of the hunters interviewed indicated that there was an abundance of trout and whitefish and there would be no objection from local people if these species were fished for fox food, at least two individuals were very adamant that none of the small lakes near Eskimo Point could support commercial fishing of lake trout and whitefish for more than 1 year (anonymous, pers. comm., 1985).

These small lakes may be able to support fishing on a small scale, however. A test fishery would be required to determine how many fish can be taken without harming the fish population. Naturally, the domestic harvest would have to be taken into account in determining quotas for the fox farm. Thus lines of communication with local fishermen should be kept open on this matter.

The larger lakes near Eskimo Point with potential quotas between 500 and 45,500 kg round weight per year are at least 115 km from Eskimo Point. Table 5 shows some lakes, distance from Eskimo Point, and approximate quotas for whitefish and trout.

TABLE 5

Potential Quotas of Lakes near Eskimo Point

Lake[1]	Nearest distance from Eskimo Point in kilometers	Approximate quota (in kilograms round weight)[1]
Kaminak Lake	115	22,700
Carr Lake	130	1,000
O'Neil Lake	160	500
Kaminuriak Lake	200	45,500

[1] From Schedule V (N.W.T. Fishery Regulations), Department of Fisheries and Oceans, 1981.

The costs of fishing, particularly transportation gets extremely high when fishermen must travel such distances. Since the ruggedness of the terrain that must be travelled to arrive at these distant lakes would make the trip very difficult in the summer by ATC three-wheeler, and the lakes are inaccessible by canoe, fishing trips must be made in the winter by snowmobile or bombardier. Calculations were made to determine the cost of 2 people fishing on Kaminak Lake for 5 days travelling by skidoo with komatiks or bombardier. The cost of 2 fishermen making a trip to Kaminak Lake, a

distance of about 100 miles (160 km), (to get there and find a suitable fishing spot), was calculated based on the following expenses:

Distance:	100 miles (160 km) 1 way 200 miles (320 km) round trip
Cost of gas:	$3/gallon ($.65/litre)
Mileage:	200 miles @ 12 miles/gallon = 17 gallons (320 km @ 4.2 km/litre = 76 litres)

Expense Item	Calculation of Cost	Cost ($)
Gas:	17 gallons/snowmobile/trip x 2 @ $3/gallon (77 litres/snowmobile/trip x 2 @ $.65/litre)	102
Food:	2 people/5 days @ $25/person/day	250
Wages:	2 fishermen/5 days @ $60/fisherman/day	600
Naptha:	0.44 gallon @ $31.80/gallon (2 litres @ $7/litre)	14
Spare Parts:	$67/snowmobile/trip	134
Total Cost:		1,100

Based on these calculations, it would cost $1,100 for 2 fishermen to fish Kaminak Lake for 5 days no matter how many fish were caught. Assuming that 2 fishermen can catch 1,250 lb (568 kg) in 5 days using their own equipment,[14] and that this quantity of fish can be carried on 2 komatiks, the price of 1,250 lb of fish would be $1,100. This is the equivalent to about $.88 /lb ($1.94/kg) (wet weight basis). In order to put this price into perspective, compare it to the price of an alternative, fish meal cereal. Since fish meal is a dry food the fish has to be converted to a dry

[14] Discussions with experienced fishermen suggested that the assumption that 250 lb of fish may be caught by 2 fishermen in one day in such a lake as Kaminak Lake is not unrealistic.

weight basis. Given that lake trout and whitefish contain about 65% moisture, dry weight is calculated by multiplying weight by 0.35. By multiplying 1250 lb by 0.35, we find this equivalent to 438 lb (198 kg) dry weight. Thus the price of the concentrated fish (no moisture) is the cost divided by the dry weight ($1,100/438 lb), which is $2.51/lb ($5.53/kg).

When compared to the price of the equivalent amount of fish meal cereal imported from Winnipeg, this method seems unreasonably expensive. Table 6 shows that landed price of fish meal in Eskimo Point is about $.55/lb ($1.21/kg).

TABLE 6

Cost of Fish Meal

	$/lb	$/kg
Price of fish meal FOB Winnipeg (Victor Fox Foods: $420/tonne)	.19	.42
Price of CN freight Winnipeg to Churchill (based on rate 5,000 lb minimum)	.11	.24
Price of Calm Air Churchill to Eskimo Point (back haul basis)	.25	.55
Total cost of fish meal cereal	.55	1.21

Thus, based on prior calculations, fresh fish costs $1.96/lb ($2.51 - $.55) more than fish meal cereal.[15]

[15] The price of fish meal alone can be expected to be more expensive than fish meal cereal because of the higher protein content.

The cost of making the same trip with a bombardier can be determined similarly. Since the load capacity of a bombardier is greater than 2 snowmobiles, it will be assumed that it takes 20 days for the fishermen to make their catch. Assume that 1 bombardier has a load capacity of 5,000 lb (2,268 kg) and gets 8 miles to the gallon (2.83 km/litre), (Brooks Equipment Ltd., pers. comm., 1985). The cost of gas and the distance is the same as above:

Mileage: 200 miles @ 8 miles/gallon = 25 gallons
(320 km @ 2.8 km/litre = 114 litres)

Expense Item	Calculation of Cost	Cost ($)
Gas:	25 gallons/bombardier/trip @ $3/gallon (114 litres) ($.65/litre)	75
Food:	2 people/20 days @ $25/person/day	1,000
Wages:	2 fishermen/20 days @ $60/fisherman/day	2,400
Naptha:	1.8 gallons @ $31.80/gallon (8 litres @ $7/litre)	56
Spare Parts:	$200/bombardier/trip	200
Bombardier Rental:	$469/bombardier/10 days	469
Total Cost:		4,200

Assuming 2 fishermen catch 5,000 lb (2,268 kg) in 20 days, the price of the fresh fish is $4,200. This equals $.84/lb ($1.85/kg) wet weight, or $2.40/lb ($4,200/1750lb = $2.40) on a dry matter basis. While this is a slight improvement over using snowmobiles as transportation, it is obvious that it is cheaper to import the fish meal cereal from Winnipeg.

Furthermore, the cost of fish given here is based on favourable conditions and excludes the added cost of storage and preparation. Thus the cost of fresh fish is significantly greater than the cost of fish meal.

4.2.1.2 Thiaminase

Another consideration in using fish for fox food is the fact that several of the available fish species contain the thiamin-destroying enzyme, thiaminase. See Section 3.6.7 on thiamin. Northern fish species that contain thiaminase are whitefish, suckers, and burbot. Northern species that have been reported **not** to contain thiaminase are lake trout and northern pike. The presence of thiaminase in the fish necessitates that the fish be cooked to render them safe for fox consumption, as described in Section 3.6.7. Therefore, energy costs of cooking fish to destroy thiaminase would also deserve some consideration.

4.2.1.3 Conclusion

In conclusion then, it does not appear to be economically practical to fish the large lakes, over 100 miles (160 km) from Eskimo Point solely for the acquisition of fox food. Judging by the above calculations, the only way to make fishing the large, distant lakes worthwhile, would be to cater to a market that is willing to pay more for the fish. Perhaps, if fish were being caught as a country food for local consumption by the people of Eskimo Point, a higher price would be brought in. In this situation the by-products of the fish would provide a suitable food source for foxes.

Initiating a commercial fishery on the smaller, less distant lakes may be opposed by local fishermen who use such species as lake trout and whitefish for domestic purposes. Harvesting of fish for fox food may be accepted by local fishermen if done on a small scale and within limits of a quota determined by the D.F.O.

An alternative to setting up a commercial fishery per se on a lake, would be for fishermen to supply fish whenever they have an excess supply. Thus a fisherman who goes char fishing in the spring and catches trout, whitefish, or burbot, etc. may wish to sell the undesired fish for use by the fox farm. If the trip were made for the acquisition of fish for personal use, any money that could be made on any

undesired catch would be a bonus. This way the owner of the fox farm could buy fish at less cost than importing fish meal from Winnipeg and some fishermen could benefit from selling undesired fish. The quantity of fish that may be taken for commercial use may be determined by the D.F.O. But, see the section on hunter concerns. This issue may also be raised with the local Hunter and Trapper Association (HTA).

Another source of fish could be supplied by the fish plant at Rankin Inlet. The purchase of fish scrap that would otherwise be disposed of by the plant could provide a cheap source of fish bone if transported to Eskimo Point on a back haul basis by boat or plane. Fresh fish scraps would have to be sent regularly to prevent bacterial infection that could afflict the fox colony.

Those fish species mentioned that contain thiaminase will need to be cooked before feeding to foxes. Those species reported not to contain thiaminase need not be cooked. As for the other available fish species not yet mentioned, namely arctic grayling, sculpin,[16] arctic cod, and arctic char, no report was found on presence or absence of thiaminase in these species. Species of fish where it is

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[16] The sculpin species, Myxocephalus octodecimspinosus, (sic) was found not to contain thiaminase by Neilands (1947) using a chemical analysis. It is not known however if this species occurs in the west coast of the Hudson Bay, or if a generalization can be made to other sculpin species.

unknown if they contain thiaminase may be cooked as a safety precaution if being used in large quantities. If they are not being used in large proportions of the diet the fur farmer may wish to experiment by feeding these fish raw and making close observations, watching for signs of thiamin deficiency. At the first sign of anorexia or weakness, these species should be removed from the diet or else cooked before feeding. Recommended cures for thiamin deficiency in foxes are given in Section 3.6.7.

Sufficient calcium to prevent rickets can be provided by a diet containing 5 to 10% fish heads. Fish heads or fish viscera may make up to 40% of the diet (Langtry, pers. comm., 1985).[17] Any fish flesh that can be provided will make an excellent source of protein and in combination with other protein sources may constitute up to 30% of the diet.

4.2.2 Marine Mammals

Marine mammals appear to be the most available food source near Eskimo Point and all coastal communities. Because such a substantial part of the whale and seal is a by-product, not normally used, these parts constitute a practical, economical food source for foxes. The interviews suggested that parts of the whale and seal for consideration as fox food are the blubber, meat, viscera and bones. Polar

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[17] However, it is better if no single product exceeds 30% of the diet.

bear meat and organs are also by-products since polar bears are primarily harvested for their fur. However, it was suggested by one hunter that polar bear meat is all used for dog food.

It has already been mentioned that whale and seal bones are too hard to use in the fox diet since they splinter when ground, and may damage a fox's mouth. Seal, whale, and polar bear liver may provide a good source of iron but must be kept down to 5% of the diet because of the high vitamin A content (Friend and Crampton, 1961). Rations of marine mammal liver in excess of 5% are considered toxic and should not be used.

Whale and seal blubber may provide the required fat content for the diet. Up to 5% should provide a sufficient amount, although this quantity may be increased to raise the energy content, particularly during the cold winter months (Williams, pers. comm., 1985). Caution must be taken to prevent rancidity in fat, as this may result in vitamin E deficiency. See Section 3.2 on fat requirement. Addition of antioxidants before storing is recommended. Meat of marine mammals will constitute the most substantial portion of country foods. Several of those people interviewed indicated that whale and seal are sometimes used for human consumption and whale, seal, and bear meat are frequently fed to the dogs. Nevertheless, it is apparent that there is an abundance of these meats that is unused.

Whale, seal, and polar bear are very high in protein content and have a muscle value about equal to horsemeat, which is frequently used for fox food in southern localities (Finley, pers. comm., 1985). In combination with fish, the other major source of protein, these meats may constitute up to 30% of the fox's diet to fill the protein requirements. As with fish and fat, rancidity leading to vitamin E deficiency may be a problem. Antioxidants must be added before storing to prevent rancidity.

There is some suggestion that mercury levels may be abnormally high in marine mammals from the Keewatin. See Appendix D. Though there is not enough evidence to merit not using marine mammal meat at this time, this subject deserves further study. Such information would be particularly useful here since it questions the viability of using the major country food source. Signs of mercury poisoning in foxes is slippage of the fur. N.R.C. (1982) reports that signs of mercury poisoning in mink are incoordination, anorexia, weight loss, tremors, ataxia, paralysis, paroxysmal convulsions, and high-pitched vocalizations. Furthermore, when mercury poisoned mink are suspended by the tail, their limbs cross. This is typical of mercury poisoning in several other species. The fox rancher should be aware of these symptoms and discontinue use of marine mammal meat as feed should they persist. If symptoms disappear with discontinued use of marine mammal

meat, it would appear that Keewatin marine mammals do indeed contain toxic levels of mercury.

4.2.3 Terrestrial Mammals

Of all the terrestrial mammals said to be available for fox food in the interviews, only caribou parts are suitable. Other terrestrial mammals, such as lemming, siksik, rabbit, weasel, and wolf, will increase the bacterial levels and increase the risk of rabies infection. Moreover, with the exception of wolf, their capture would entail large expenditures of effort for a relatively small return in terms of volume. Therefore, use of these animals is not recommended.

Caribou meat is a major source of food for the Inuit and will therefore not be considered as a food source for foxes. Caribou waste was frequently promoted as a potential fox food. There has been much concern expressed in the past, over the wastage of caribou meat. (See Gordon, 1985). Some of those hunters interviewed, reasoned that since there is some caribou meat that is unused anyways, it might as well be fed to foxes. I do not advise using even undesired caribou meat as fox food for the following reasons. Caribou meat is important in the northern diet. Therefore, it is not worth risking increased harvest of caribou and subsequent reduction of the caribou herd because it is being

sold for fox food. If hunters are paid, even a small amount, for caribou meat that they cannot or will not use, there is a possibility that increased harvest of caribou will result. This possibility was stated in some of the interview responses. Secondly, there would be some legal barriers to overcome. Specifically, there is no commercial quota on caribou in the Keewatin. Moreover, section 58(2) of the Wildlife Ordinance Act prohibits the feeding of caribou meat to domestic animals for commercial or domestic purposes. The final concern pertains to the quality of caribou 'waste' meat. If the meat has started to decay, it would not be suitable for fox food.

Caribou viscera, on the other hand may provide a good source of protein to the fox diet. It has a nutrient value similar to tripe and lungs (Finley, pers. comm., 1985). Intestines, gall bladder, spleen, and heart may constitute 10 to 20% of the fox diet. Caribou liver, not used in combination with marine mammal livers, could constitute as much as 10% of the diet and would provide a good source of iron. In conjunction with marine mammal livers, however, it is advised to keep this proportion down to 5%, because of the high vitamin A content.

The danger in using caribou viscera is in the rapidness that these start to deteriorate. Organ meats should be used only if they can be frozen right away (Finley, pers. comm., 1985). Unless caribou viscera can be brought in very

quickly after the animal has been killed, use of organ meats may be restricted to the winter months, when they will be promptly frozen.

4.2.4 Game Birds

It is not recommended that game birds be used for fox food since these are consumed by the Inuit. Demand for fox food may compete with human demand. If a fresh, inexpensive source of game bird carcass was available, this could be used in the same capacity as fish bones, or poultry by-products. Nutrient composition would be similar to that of poultry by-products. If available, game bird by-products would provide a good source of filler, low in protein and relatively higher in fat and ash than the quality protein sources.

4.3 SEASONAL VARIATION

With the exception of beluga whale and polar bear, most animal species are available year-round. The most active times of year for hunting and fishing, according to the hunters interviewed, is spring through fall. This will probably be the most productive season for the acquisition of country foods. In the spring, when the weather starts getting warmer, many people celebrate by going hunting and fishing. Starting at this time, seals are plentiful. Though seals are hunted actively right through the summer to

about October, the seal hunt intensifies in the spring and fall. Towards the end of June, or the beginning of July, when the ice breaks up in Hudson Bay, beluga whales appear near Eskimo Point. For 4 to 8 weeks, belugas are hunted intensively. During this time a plentiful supply of whale meat may be accumulated.

Polar bear season lasts from October 1 to May 31 in the Keewatin. Polar bears are hunted on a quota system. Each community receives a yearly quota for polar bears, which is usually filled in a short time. An additional quota is sometimes granted later in the season. Most of the polar bear meat will be available in the fall. Caribou and fish are harvested year-round, except perhaps during the coldest months of the year.

Seasonal availability may present some restrictions on use of country foods in the fox diet. Food is most plentiful during the spring to fall months. Fortunately, this also coincides with the early growth stage of young foxes when protein sources are most needed. Hunting is substantially reduced in the winter months, so a shortage of fresh meat may be expected at this time. The foods that are accumulated throughout the spring, summer and fall seasons may be stored for some time but will not keep the entire winter through.

The most substantial source of meat could be provided by beluga whales. See Table 8. Yet belugas are hunted for only 4 to 8 weeks of the year. The meat may be stored for up to 2 months but risk of spoilage is heightened thereafter. If killed in September, beluga meat will keep till November. This corresponds neatly with time of pelting, when the demand for country foods will drop dramatically. As for the breeding herd that must be fed over the winter, unless a steady supply of seal meat is provided, their diet will have to be supplemented with imported commercial pellet feed.

4.4 QUANTITY OF FOOD

The quantity of country foods available in Eskimo Point was estimated from harvest data provided by Gamble (1984 and in press). Annual harvest of relevant species in specific Keewatin communities from October 1981 thru September 1984 are summarized on Table 7. For comparison see Appendix E, which provides data on beluga whale landings in Eskimo Point, Rankin Inlet and Whale Cove, N.W.T., collected by the Department of Fisheries and Oceans from 1973 to 1984.

Estimated quantities of country foods available in Eskimo Point are given in Table 8. Availability was estimated on the basis of available species, average animal weights, relative proportions of meat, organs and blubber, and estimated harvest levels. Information concerning body

TABLE 7

Annual Keewatin Harvest

Community Species	Estimated Number of Animals Harvested Annually[1] 1981/1982	1982/1983	1983/1984	3 Year Average[2]
Baker Lake				
Seal (ringed)	n.a.[3]	1	6	4
Arctic Char	128	n.a.	203	166
Lake Trout	11,678[4]	3,236	3,745	6,220
Whitefish	n.a.	276	637	457
Other Freshwater Fish	142	n.a.	50	96
Caribou adult	3,605	4,937	6,320	4,954
calf	5	5	n.a.	3
unknown	108	3	112	74
total	3,718	4,945	6,432	5,031
Chesterfield Inlet				
Polar Bear	3	10	9	10
Beluga Whale	8	7	12	10
Seal (all spp.)	48	137	47	92
Walrus	n.a.	11	7	9
Arctic Char	76	152	480	316
Lake Trout	220	333	129	231
Caribou adult	150	601	366	484
calf	n.a.	1	n.a.	1
unknown	n.a.	10	15	13
total	150	612	381	497
Coral Harbour[5]				
Beluga Whale	124	n.a.	116	120
Polar Bear	15	n.a.	34	24
Seal (all spp.)	977	n.a.	921	949
Walrus	73	n.a.	44	59
Arctic Char	4,180	n.a.	3,038	3,609
Arctic Cod	18	n.a.	170	94
Lake Trout	419	n.a.	n.a.	419
Other freshwater fish	n.a.	n.a.	19	19
Caribou adult	88	n.a.	486	287
unknown	1	n.a.	151	76
total	89	n.a.	637	363
Eskimo Point				
Beluga Whale	85	58	50	64
Polar Bear	14	15	21	17
Seal (all spp.)	448	278	572	433
Arctic Char	2,480	2,048	2,499	2,343
Lake Trout	2,473	926	970	1,456
Whitefish	395	n.a.	154	183
Other Freshwater Fish	315	100	475	297
Caribou adult	3,248	1,990	2,510	2,583
calf	194	105	89	129
unknown	317	249	180	249
total	3,759	2,344	2,779	2,961
Rankin Inlet				
Beluga Whale	35	29	69	44
Polar Bear	9	19	9	12
Seal (all spp.)	465	469	438	457
Arctic Char	11,068	5,508	5,114	7,230
Lake Trout	185	354	458	332
Whitefish	n.a.	n.a.	8	8
Other Freshwater Fish	157	104	n.a.	131
Caribou adult	1,997	1,379	1,378	1,585
calf	55	19	9	28
unknown	24	85	111	73
total	2,076	1,483	1,498	1,686
Repulse Bay				
Beluga and Narwhal	48	46	56	50
Polar Bear	16	19	14	16
Seal (all spp.)	836	360	584	593
Walrus	21	13	5	13
Arctic Char	1,764	1,225	2,199	1,729
Lake Trout	1,395	69	62	509
Other Freshwater Fish	13	n.a.	216	115
Caribou adult	1,248	830	1,106	1,061
calf	53	13	7	24
unknown	58	6	166	77
total	1,359	849	1,279	1,162
Whale Cove				
Beluga and Narwhal	8	n.a.	24	16
Polar Bear	7	5	8	7
Seal (all spp.)	134	57	122	104
Walrus	7	n.a.	n.a.	7
Arctic Char	8,183	145	962	3,097
Lake Trout	561	183	314	353
Whitefish	11	n.a.	n.a.	11
Other Freshwater Fish	4	75	n.a.	40
Caribou adult	1,018	343	536	632
calf	50	2	n.a.	26
unknown	29	30	9	23
total	1,097	376	545	673

[1] Harvest figures adapted from 'Estimated Harvest' figures from Tables 2,4,6,8,10,12, and 14 in Gamble (1984) and Gamble (in print).
[2] Where harvest data for 1 or 2 years is not available, the average is based on available figures.
[3] Not available.
[4] Harvest from a commercial fishery which took place in the Baker Lake area in 1984 are included. This has caused an overestimation of usual trout harvest.
[5] Data Collection for Coral Harbour was reportedly inconsistent, so estimated harvest figures may not be representative of harvest in this community.

TABLE 8

Estimated Quantity of Country Foods Available in Eskimo Point

Muscle Meats

Species	Average Animal Weight Adult (kg)[1]	% Muscle Meat[2]	Average Muscle Weight (kg)	Estimated No. of Animals Harvested/Year in Eskimo Point[3]	Available Meat/Year (kg)
Beluga Whale	620	21	130	64	8,320
Ringed seal	43	43	18	433	7,794
Polar Bear	363	44	160	17	2,720
Total					18,834

Organ Meats

		% Viscera	Average Viscera Weight (kg)		Available Organ Meat Per Year (kg)
Beluga Whale	620	10	62	64	3,968
Ringed Seal	43	10	4	433	1,862
Polar Bear	363	10	36	17	612
Caribou (Adult)	93	20	19	2,583	49,077
Total					55,519

Blubber[4]

		% Blubber	Average Blubber Weight (kg)		Available Blubber Per Year (kg)
Beluga Whale	620	21	130	64	8,320
Ringed Seal	43	21	9	433	3,987
Total					12,217

[1] The figures presented here represent maximum quantities of available food sources estimated from previous harvest levels. These figures do not take into account other factors that affect availability. See Section 4.4.

[2] The average percentage of muscle meat and viscera for beluga whale was estimated from data provided by Walker (pers. comm., 1985) based on a sample of 3 beluga whales. The percentage of muscle meat for ringed seal and polar bear were based on the percent of usable weight from these animals (McEachern, 1978).

[3] Based on average harvest of last 3 years. See Table 7.

[4] Proportions of whale and seal blubber were estimated to be half the weight of skin and the layer of fat that is considered 'edible' (McEachern, 1978). The proportion of seal blubber was estimated to be the same as for whale.

weights and proportionate weights of body parts of Keewatin wildlife is scanty in the literature. Where information was lacking, it was necessary to extrapolate from what was available. Thus, of necessity these estimations are speculative. The estimations given in Table 8 represent the maximum quantity of food based on current harvest levels. Harvest data from other Keewatin communities will be useful for determining available country foods for particular communities being considered for development of a fox farm.

In order to put this into perspective as regards the quantity of country foods required by foxes, see Appendix F. Appendix F provides calculations of the quantity of foods needed to feed 10 foxes for 1 year. The food requirements of foxes were calculated on the basis of daily energy requirements for each stage of cycle and energy content of the respective diets. Table F.7 provides a synopsis of the estimated quantities of food required to feed 1 male, 2 females, and 7 silver fox pups. The accumulated weight of the entire food base required to feed 10 foxes for 1 year is 455 kg.

The actual quantity of country foods available to the fox farm depends on a number of factors. The interviews with hunters suggested that the leftover portions of animals varies from one harvest to another, and from one individual to another. The quantity of potential fox food left over depends on the size of the animal, what portion is taken for

human consumption, how much is taken for dog food, and whether the hunter decides to bring the leftovers back to the community to sell for fox food. Consider whale for example. The muktuk is virtually always taken for human consumption, the quantity of fat left over depends on how much is removed with the muktuk, and then some people eat the meat, while others don't. Some people feed the whale meat to their dogs, other people don't have dogs so they leave the meat or they may choose to give or sell it to someone who does have dogs.

The quantity of food delivered for fox food will certainly depend on the price that is offered. Of the 23 hunters interviewed, it was unanimously agreed that hunters would bring in country foods for fox food if they were paid for it (interview question 9). It is probably safe to assume that the better informed the hunters are and the higher the price they receive for the meats they deliver, the higher the participation rate of the hunters in contributing food to the fox farm.

4.5 DERIVING A FOX FOOD FORMULA

The first step in deriving a fox food formula is to determine what feedstuffs are available and in what proportions they may be fed. Ranges of composition of feedstuffs are shown in Table 9. Components of the fox diet are varied according to availability of food types and stage

TABLE 9

Potential Range of Composition of Diets for Foxes

Ingredients	Percent[1]
Fortified cereal[2]	15-50
Quality proteins[3]	
fish, whale meat, seal meat, polar bear meat	5-30
Fish scrap	
head, bones, viscera	0-40[4]
Liver	
whale, seal, polar bear, caribou	0-10[5]
Organ meats	
caribou and marine mammal intestine, gall bladder, spleen, heart, lung, kidney	10-20
Fat supplementation[6]	
whale blubber, seal blubber	0-10

[1] Adapted from Table 11, N.R.C. (1982). Country foods were substituted for commercial foods where possible.

[2] While N.R.C. (1982) recommends that 25-50% of the fox diet may be provided by a fortified cereal, Victor Fox Food Catalogue (no date) recommends the following rations for their products: Superblend: 15-25% of ration; Victor Triple XXX: 20-30% of ration F-35: 35% of ration. While it is recommended that for best results these products should be fed at the recommended rations, it is possible to increase the rations if desired to raise carbohydrate levels. It is advised to practice caution and keep careful watch over the health of the foxes if rations of cereals go beyond what it recommended (Langtry, pers. comm., 1985).

[3] Foxes require higher levels of protein during critical fur development and reproduction-lactation phases. Therefore, quality protein can be increased at this time so long as overall protein levels don't go higher than about 42%.

[4] N.R.C. (1982) suggests up to 50% fish scrap in the diet, but another source does not advise including more than 30-40% of any single ingredient in the diet (Langtry, pers. comm., 1985). When feeding high levels of fish scrap, the level of bone in the diet is needed to provide calcium and phosphorus, these levels should not exceed 1.0 and 0.8% dry matter respectively in the diet.

[5] No more than 5% if substantial portion comes from marine mammals.

[6] Increase fat to meet proper protein/energy balance for each stage of life cycle.

of life cycle. While the requirements are not inflexible, so long as minimum requirements of nutrients are met. Best results are produced when changes made in the diet are gradual.

The respective proportions of protein, fat, and carbohydrates as well as the respective levels of energy from each ingredient are shown in Table 10. Protein, fat and carbohydrate levels were derived from the literature. Where more than one source was available averages were used.[18] The original sources of this information are listed in Appendix G. Digestive coefficients, deduced from Table 9, N.R.C. (1982) were used to arrive at metabolizable energy (ME) levels for each nutrient in a given food source. Since there is no energy in ash content, no digestive coefficient corresponds to it.

Throughout this report energy has been expressed in terms of ME. However, many fur specialists talk about fox food nutrients in terms of percentage. Therefore fox food formulations have been calculated in terms of ME and percent

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[18] It should be pointed out that available data on nutrient composition is limited and samples tend to be small. However, nutrient composition of foods cited here may serve as approximate guidelines.

TABLE 10

Nutrient Composition and Energy Content of Foods

Food Item	Wet Matter: Moisture %	Wet Matter: Protein %	Wet Matter: Fat %	Wet Matter: Carb. %	Wet Matter: Ash %	Wet Matter: Dry Matter %	Dry Matter: (1) Protein % (p)	Dry Matter: (1) Fat % (f)	Dry Matter: (1) Carb. % (c)	Dry Matter: (1) Ash %	(2) Total %	ME (3) Protein P=p(38.25) (kcal/kg)	ME (3) Fat F=f(85.5) (kcal/kg)	ME (3) Carb. C=c(30) (kcal/kg)	ME Total P + F + C (kcal/kg)
Cereal															
Superblend	7	14	3	74	1.5	93	14	3	80	2	100	536	257	2,430	3,223
Triple XXX	7	18	3	71	1.5	93	18	3	76	2	100	689	257	2,310	3,256
F-35	7	25	3	63	1.5	93	25	3	68	2	100	956	257	2,100	3,313
Marine Mammals															
Meat															
Seal	69	28	2	0	1	31	90	6	0	3	99	3,443	513	0	3,956
Whale	75	24	1	0	1	25	96	4	0	4	104	3,672	342	0	4,014
Polar Bear	70	26	3	0	1	30	87	10	0	3	100	3,328	855	0	4,183
Marine Mammal Avg.	71	26	2	0	1	29	90	7	0	3	100	3,481	570	0	4,042
Blubber															
Seal	1	0	99	0	0	99	0	100	0	0	100	0	8,550	0	8,550
Whale (muktuk + fat)	10	3	85	2	1	90	3	94	2	1	100	115	8,037	60	8,212
Fish															
Fresh Meat															
Whitefish	71	26	1	0	2	29	90	3	0	7	100	3,443	257	0	3,700
Trout	73	25	1	0	1	27	93	4	0	4	101	3,557	342	0	3,899
Grayling	70	22	4	0	5	30	73	13	0	17	103	2,792	1,112	0	3,904
Fish Average	71	24	2	0	3	29	83	7	0	10	100	3,264	570	0	3,774
Fish By-products	77	15	3	1	5	23	65	12	3	20	100	2,486	1,026	90	3,602
Liver	72	22	4	1 (4)	1 (4)	28	79	14	2 (4)	5 (4)	100	3,022	1,197	60	4,279
Organ Meats	74	16	7	1 (4)	2 (4)	26	62	27	5 (4)	6 (4)	100	2,372	2,309	150	4,831
Poultry By-products	66	21	16	2 (4)	5 (4)	44	48	36	5 (4)	11 (4)	100	1,832	3,069	150	5,051

(1) Food values were determined by averaging data from the literature. See Appendix B.
(2) Figures that do not total 100 are the result of errors caused by averaging.
(3) Multipliers derived by multiplying digestible coefficients (NRC, 1982) by metabolizable energy (ME) per kg for each of protein, fat and carbohydrates.
(4) Estimates.

of nutrient components.[19] Sample fox food formulations comprised of combinations of country foods and commercial cereals were derived for various dietary needs: maintenance, gestation and lactation, early growth and late growth to maturity diets. See Appendix H. In deriving a diet, the most important factors to regulate are levels of protein, fat, and carbohydrate and the ratio of calcium to phosphorus. Levels of other nutrients are generally regulated by the cereal ration.

While protein levels are recommended in the range of 24% to 34%+ dry matter, depending on stage of life cycle, somewhat higher levels are acceptable. Since country food sources are protein-rich, it may be desirable to increase protein levels above the minimum. It is not recommended that protein levels go beyond 42% dry matter for reasons given in Section 3.3. Therefore, some of the early growth diets contain protein levels up to 39% of ME (42% of dry matter). Although the sample diets in Appendix H correspond to different stages of the life cycle, the diets need not be

[19] When diets were formulated to achieve desired energy levels of respective nutrients, there were some minor discrepancies between meeting the ME requirements and the recommended proportions of a given nutrient on a dry matter basis. For example, during gestation and lactation the protein requirement is 30-35% of ME, whereas in terms of percentage of protein, 30-32% of dry matter has been recommended. However, the sample diet in Table H.5 (Appendix H) contains a protein level of 30% of ME or 34% of dry matter in the diet. While this is at the lower end of the ME requirement, it exceeds the recommended level on a percent dry matter basis. The sample diets have therefore been derived such that the ME requirements of protein, fat and carbohydrates are met.

restricted to these periods. If protein sources are plentiful, it may well be desirable to increase the protein levels above the required minimums so long as the protein level does not exceed the upper limit of 42% dry matter.

Fat levels have been recommended in the range of 7% to 20% dry matter, depending on stage of life. Due to the low temperatures experienced in the Keewatin, energy requirements of foxes raised there will generally be higher than that of foxes raised in the south. Particularly during the coldest months of the year, foxes will require higher fat levels. See Section 3.2. Fat levels in the range of 23% to 49% of ME are acceptable.

When country foods are scarce, the relative proportion of fat and protein can be decreased by raising the level of cereal. For the maintenance diets it was necessary to include cereal levels at 39% (Triple XXX) or 50% (F-35), to bring protein levels down to the minimum required for maintenance. In actual practice, it is preferable to keep cereal portions within the recommended ranges and let protein levels go above the minimum. It has been advised that only the most experienced fox farmer include cereal at levels higher than 30-35% of the ration (Langtry, pers. comm., 1985). The fox feed becomes unpalatable for foxes when there is too much cereal in it and nutritional disorders may develop.

4.6 HANDLING AND STORAGE

Three options were considered for storage of fox food: drying, cold storage, and freezing. Before considering the advantages and disadvantages of various storage systems, let us consider the characteristics of a suitable storage facility.

First of all, we know that food availability is inconsistent throughout the year. Second, the time of year that meat is most important to the diet is the winter and early spring because of the water content in meat. This also coincides with the time of most limited food supply. Third, one of the most important food sources for the fox farm operation, namely beluga whale meat, is available in large quantities only for a short time in the year. Therefore, the storage facility must be able to keep meats fresh for relatively long periods of time. For storage of organ meats, i. e. caribou and marine mammal viscera, a freezer is needed since these foods are highly perishable unless frozen (Langtry, pers. comm., 1985).

The storage facility should be spacious enough to hold large quantities of meat. The facility must have easy access and preferably be located in close vicinity to a climate controlled area where feed preparation can take place. The feed preparation area should be equipped with hot and cold running water for cleaning the meat, and

general cleaning of the area, a grinder for mixing and grinding of foods, and a stove for cooking fish containing thiaminase. A scale will be required for the weighing of components of the feed. Materials for packaging need also be on hand.

Consideration was given to kiln-drying meats. While this system would be efficient in terms of energy saved, there are several disadvantages. Organ meats, which are highly perishable could not be dried (Langtry, pers. comm., 1985). There is a danger of marine mammal meats turning rancid, if not frozen shortly after harvest. Also, this process is highly labour intensive, because it involves cutting meat in thin strips. Finally, taking the moisture out of the meat, would require that a constant supply of fresh water is available. For the cold winter months a heated watering system would need to be installed.

Consideration was given to the construction of an insulated pit dug out of the ground. This facility would require access, and must be totally enclosed to keep out scavengers and maintain the temperature. If a pit is equipped with a self-contained refrigeration unit to prevent meats from perishing, this system should be functional for storing foods for a short period of time. Unless the refrigeration unit was able to keep temperatures below freezing, this facility would be unsuitable when foods must be frozen immediately.

Costs include rental fee on a back hoe to dig a pit, expense of building materials for cement or wooden lining, wooden posts, steps, and insulation, refrigeration unit and the energy costs to run it 4 to 6 months of the year.

This system has the advantage of the insulation properties of the earth to hold the cold and reduce energy costs. The main problems seen are difficulties associated with construction of the pit and gaining access to the storage area.

The problems of construction and access may be substantially reduced by constructing an above ground walk-in freezer similar in structure to the one used by "Nunavut Country Foods" in Eskimo Point. An above ground insulated building equipped with a refrigerator door allows access and can be attached to a climate controlled area which can be used for food preparation. Costs of the walk-in freezer can be substantially reduced by the construction of an insulated room as opposed to purchasing a complete metal refrigeration box. According to Nunavut Country Foods' manager, Ian Copland, this system works just as well as the more expensive walk-in freezers that can be purchased complete (Copland, pers. comm., 1985).

The costs of this facility include the expense of construction materials to build the box, an insulated refrigerator door, a compressor, and the energy costs to run it.

The main advantages seen with this facility are that it can be constructed with easy access to the food preparation quarters, and if the box is constructed with at least 3 walls and the roof exposed, and with a vent to the outside, the compressor can be turned off in the winter. Thus, for about 6 months this system will not require electricity for cooling. The main disadvantage of this system is the energy costs of running the freezer during the warm months of the year. Moreover, at the present herd size of 12 foxes the quantity of food required does not warrant such a large storage area. Consideration should be given to 1 or more 22 cubic foot floor freezers for storage. If kept in an insulated room, electricity can be cut off during the cold months of winter to reduce energy costs.

Some general recommendations on storage can be made at this point. Food materials must be well wrapped to prevent freezer burn. Foods should be packaged in separable units smaller than a requirement size. For example, the ground and mixed feed could be formed into 75 or 100 gm wiener-shaped chunks. If they could be easily separated, individual servings for foxes with varying diets should be facilitated.

4.7 HUNTER CONCERNS

The final question asked hunters during interviews was: "Is there anything that you would like to add about feeding foxes or the fox farm in general?" This question was included to give the hunters a chance to express their opinions and concerns about the fox farm that were not covered by the interview questions.

Some questions were raised about details of the farm, such as who made the proposal for a fox farm and where it would be located. Such inquiries I addressed to the best of my ability. As well as general questions about the fox farm, hunters expressed some concerns. Hunters' concerns included the danger of overkill and the necessity or effects of quotas; competition of the fox ranch with trappers; and attention by extremist animal rights groups.

Some hunters were concerned that if payment was made for contributing food for the fox farm, the harvest would increase, resulting in 'overkill'. Increased rates of harvest would reduce populations of animal species that are vital to the local people. Some people pointed out that it would not be wise to create employment for a few years if it were at the expense of another resource.

The possibility of overkill brings to bear 2 concerns. First, given an incentive, some hunters may increase their rate of harvest above their subsistence need. Second, the

hunt may be viewed as a commercial endeavor if by-products are sold for cash. Either, a reduction in the wildlife population, or the establishment of commercial harvest of caribou or marine mammals will induce the implementation of a quota system (Moshenko, pers. comm., 1986).

This is a sensitive issue in Eskimo Point. There are presently no limits on harvest of caribou, marine mammals (except narwhal (Monodon monoceros) and polar bear) and fish for domestic use. To implement a quota system would impose a limit where there presently is none. A general limit being placed on the take of game would most certainly not be well received in this or other Keewatin communities.

With this in mind, country foods used should be excess foods, as in whale and seal meat, or species that are not heavily used by the people, such as whitefish or trout. When hunters are informed of the possibility of selling by-products of their harvest, it should be emphasized that excess foods are desired. Also, the danger of overkill should be discussed among hunters in the community to ensure that everyone involved is aware of this risk.

Another concern was that the fox farm would come into competition with local trapping. Given the importance of trapping as part of the Inuit way of life and the economic returns from selling the pelts, this possibility should not be ignored. There are however, two factors that suggest

that ranch-raised pelts in the Keewatin will not come into conflict with wild furs. First, the ranch-raised furs will be from foxes other than arctic fox, which is the species normally trapped in the Keewatin region. Therefore, there will probably be different markets (buyers) for ranch-raised and trapped foxes. Second, if the ranch-raised foxes are sold directly to an auction, the Hudson Bay Fur Auction in Toronto, Ontario, for instance, trappers and ranchers will be selling furs through different outlets. Thus a sudden increase in the number of furs in a Keewatin community will not push down the price of furs there. Nevertheless, the trend to ranched furs in general has probably affected the demand for wild furs. Ranch-raised furs tend to be of higher quality since diets and time of pelting are regulated. Thus, while 1 or more fox farms in the Keewatin may have limited effect on the trapping end of the industry, fox farming does compete with trapping on a broader scale.

Another concern expressed was that the fox farm would draw attention from animal rights activists. The effect that the opposition by the animal rights movement to the Newfoundland harp seal (Pagophilus groenlandicus) hunt has had on the Inuit economy has been well documented (Foote, 1967; Wenzel, 1978). The protest against harp seals affected sale of ringed seals (Phoca hispida) as well because ringed seals are easily identified as seal, whereas other seal pelts can be dyed to disguise them. Therefore,

given the continuing controversy surrounding harvest of furs it is understandable that hunters would be concerned about attention from animal rights groups.

Chapter V

DISCUSSION AND RECOMMENDATIONS

The results of this study show that sufficient by-products are available in the Keewatin to make a substantial contribution to fox farms there. The benefits of utilizing excess country foods to feed ranch-raised foxes are that reduced wastage of marine mammal meat will result, and the shipping costs of feed will be profoundly reduced. Moreover, country foods can fill the fox's requirement for a high percentage of animal protein, and are easier to feed than dry foods in the winter when freezing temperatures complicate the task of providing a fresh, clean water supply.

Costs associated with use of country foods include cost of purchasing food from hunters, energy costs of storage and food preparation facilities, and cost of antioxidant additives to prevent rancidity of meats.

Primary sources of country food by-products in Eskimo Point are whale and seal meat, viscera and blubber, and caribou viscera. Polar bear meat and viscera may also be available, although it was suggested by 1 hunter that all polar bear meat in Eskimo Point is fed to the dogs. Freshwater fish species such as trout and whitefish may be

available in limited quantities. Fishing the large lakes 70 miles (115 km) or further from the site of the fox farm is economically unfeasible. Fishing the smaller, less distant lakes may conflict with domestic fishing. Commercial fishing on a small scale may be feasible if a quota is introduced so as not to affect current rate of domestic harvest. Fish by-products from the fish plant in Rankin Inlet may provide a good source of bone for the diet.

The quantity of meat, viscera and fat produced in the Keewatin at the present level of harvest is substantial. The amount of country foods that are actually supplied to the fox farm will vary, depending on the price offered, the degree to which hunters are informed, and their willingness to participate.

While such things as extent of advertising and the level of good will surrounding the fox farm will certainly affect the accumulation of by-products, great care must be taken so as not to encourage increased harvesting. At the present time quotas are in effect for polar bear and narwhal alone. If harvest levels of other animals increase to the point where population levels drop, quotas may be implemented. Hunters should be informed of this risk and encouraged to supply only the by-products of their current level of harvest.

While this study focused on Eskimo Point, the basic principles of feeding foxes is consistent in all Keewatin communities. The selection of country foods available in Eskimo Point resembles other coastal communities in the Keewatin, though quantities will vary. Moreover, consumption of marine mammal meat by Inuit may be higher in other coastal communities where people have resided longer on the coast. At Baker Lake, marine mammal meat may be substituted by whitefish and trout.

Seasonable availability may limit use of country foods in the winter since hunting activity is reduced at this time. Beluga whale is available for 4 to 8 weeks of the year between the end of June and the middle of September. Polar bear season lasts from October 1 to May 31, but most polar bears are harvested in the fall. Seal and caribou may be hunted year-round though the hunt intensifies in spring and fall. All told, food availability is greatest from spring through fall. This coincides with the growth stage of pups when the food requirement is greatest.

The dietary needs of foxes can be met by combining country foods with fortified cereals. Fortified cereals can be imported from Winnipeg. Fox diets are formulated by varying protein, carbohydrate and fat levels to meet the requirements of various stages. Best results are produced when these changes are made gradually. The stages requiring the highest protein levels are early growth, late growth,

gestation and lactation. The maintenance diet requires the least amount of protein. Protein levels cited herein represent minimum requirements. When protein sources are available, protein levels should be increased, but no higher than 42% of dry matter.

The use of country foods for feeding foxes introduces a unique situation in the realm of fox farming. In southern Canada, use of cereal products is maximized for economic reasons since protein sources are more expensive. In contrast, in the Keewatin, protein-rich foods are plentiful and do not entail shipping costs. Therefore use of country foods should be maximized. Further research on the effect of feeding high protein levels on fox health and pelts would be beneficial.

It is vital that the fox diet be prepared with care and precision to ensure the high quality of the ration. Since the nutrient composition of country foods is based on limited data, ingredients should be sent to a lab for analysis. Particularly, information concerning calcium and phosphorus levels are limited. When the nutrient composition is verified the fox farmer can prepare his or her feed with confidence.

The use of country foods to feed furbearers is a relatively novel enterprise. Apparently marine mammals have been used to feed mink and foxes in Canada's eastern

provinces. However, no published reports of these endeavors were found. Since the production of high quality pelts, the fox farmer's ultimate goal, is so closely tied to the fox diet, the fox farmer would greatly benefit from the guidance of an experienced fox farmer or fox nutritionist. The demand for professional assistance is amplified by the fact that little work has been done in Canada on raising foxes in this climate, and there is considerable reliance on the fox farmer to appraise the condition of the fox and to adjust to the Keewatin situation. While it has been the object of this report to present clearly and completely as possible, the details of feeding foxes, it cannot replace the expertise of a seasoned fox farmer. Therefore, it is advised that the farmer receive some professional training to learn the subtleties of fox behaviour and appearance that indicate the good health of the herd.

Ongoing assessment and evaluation of the feeding regime employed by Keewatin fox farms is strongly encouraged, both for future reference to benefit succeeding fox farms and as a way of monitering the success of the present fox farm.

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Appendix A

GLOSSARY OF TERMS

Animal Rights Groups:	Organizations opposed to the use of animals by humans. Not to be confused with animal welfare groups that are concerned with the well-being of animals, but are not opposed to their use for eating, harvest of furs, etc.
Country Foods:	Wild foods, harvested locally.
Dam:	The female with young in any animal species.
Dry weight:	The weight of a mass with no moisture in it.
Hunter:	Inuit man who hunts.
Viscera:	This term is used interchangeably with 'organ meats' and refers to kidney, heart, spleen, etc.
Vixen:	A female fox.
Waste:	During the interviews, specifically in the question dealing with parts of the animals that are available as fox food, reference was frequently given to the 'waste' of an animal. The waste does not refer to any specific part of an animal, but rather includes anything that is left over after the desired portions are removed. The use of the term waste here is <u>not</u> meant to infer wastefulness, rather it simply refers to the undesired portions of an animal. Thus for fish, waste usually includes the head, skeleton and viscera. For other animals the stripped carcass would usually include the head, skeleton, and viscera and in the case of sea mammals, frequently the meat and fat as well. Waste could also include those edible portions that have rotted and are not fit for human consumption.

Appendix B

SCOPE OF THE INTERVIEW

The scope of the interview is as follows:

1. Type of animals hunted in Eskimo Point.
2. What parts are not used by the Inuit?
3. Response to feeding excess meat to foxes.
4. Are there certain meats that should not be used?
5. Are there other foods in Eskimo Point that are not meat that might be fed to foxes?
6. How much food could be used to feed foxes?
7. Is there enough food year-round, or is there seasonal variability in food supply?
8. Where are the food sources located?
9. What are the monetary costs involved with bringing the food to Eskimo Point, where they can be processed?
10. Is the manpower to conduct this task available?
11. Are there other things such as handling and storing that should be considered?

Appendix C

INTERVIEW QUESTIONNAIRE

1. How long have you been hunting and fishing?

2. How often do you go hunting or fishing?
   a) every week
   b) once every month
   c) once every two months
   d) twice a year
   e) at least once a year
   f) less than once a year

3. What food sources are available near Eskimo Point that could be fed to foxes in captivity but would not put added pressure on food sources used by Inuit people?

4. What parts of those animals mentioned in question 3 could be used as fox food?

5. If I recommend the use of whale meat for fox food, I'll need to know how much there is. The quantity of whale meat available will depend on the maturity and size of the whales hunted here. What proportion of whales caught near Eskimo Point are white (mature) as opposed to grey?

6. What proportion of seals caught near Eskimo Point are mature?

7. Where specifically are the food sources found?

8. What is the duration of the season of harvest for each of the animals mentioned previously? When is the season?

9. Would some hunters be interested in bringing these foods in to Eskimo Point if they were paid money?

10. How would each of the animals mentioned before be transported in?

11. What expenses would there be in bringing these foods in?

12. Do you have any suggestions for storing the foods?

13. Is there anything that you would like to add about feeding foxes or the fox farm in general?

Appendix D

MERCURY LEVELS IN KEEWATIN MARINE MAMMALS

In the literature and discussions with Northerners there were some obscure references made with regard to toxic levels of mercury in marine mammals. McEachern (1978) reports that, "the use of beluga for meat has recently been discontinued (in Eskimo Point) because of its toxic level of mercury, although muktuk is still prized" (p. 45). Unfortunately no reference is given for these striking findings. Nor is any explanation given for why muktuk is still prized when levels of mercury in the meat are considered toxic.

It is possible that the muktuk would be edible, while the meat contains toxic levels of mercury, as toxic metals are accumulated unequally in different body tissues (Wagemann and Muir, 1984). Since it is not known what 'normal' levels of mercury in marine mammals are, nor what the allowable level of mercury consumption by foxes (or humans for that matter) is, determining the risk of mercury poisoning from eating marine mammal meat is not clear cut (Wagemann, pers. comm., 1986). Data collected by Wagemann and Muir (1984) do however shed some light on the situation. Weighted averages of mercury content in beluga whale and ringed seal tissues

from the Eastern Arctic and from other places were calculated from Tables 1 and 5 (Wagemann and Muir, 1984). These calculations are summarized in Table D.1.

Mercury levels in Eastern Arctic beluga whale livers, muscle and kidney were 8.87, 0.54 and 2.44 micrograms per gram respectively. Average levels of mercury content were substantially lower (less than half as much) in the beluga whale liver and muscle collected in the Eastern arctic than the average of liver and muscle of whales from all others places examined. Corresponding data for kidney in whales from places other than the Eastern Arctic were not available.

Mercury levels in Eastern Artic ringed seal liver, muscle and kidney were 12.11, 0.31 and 2.31 micrograms per gram respectively. Mercury levels in all tissues of Eastern Arctic ringed seal were substantially less than the corresponding tissues in seals from places other than the Eastern Arctic. In the case of liver and muscle, mercury levels in Eastern Arctic seals was less than half of the average from all other places.

While these data do not bring one any closer to determining what levels of mercury are normal or what levels of consumption are toxic, they do indicate that mercury levels in the tissue of beluga whales and ringed seal from the Eastern Arctic are not high compared to the

Table D.1

Mercury Levels in Marine Mammals

Tissue type from the Eastern Arctic or Other Regions	Average Mercury micrograms/gram (weighted average)	N=
Beluga Whale		
Eastern Arctic		
liver	8.87	1
muscle	0.54	1
kidney	2.44	1
Other		
liver	18.32	16
muscle	1.57	19
blubber	0.01	1
Ringed Seal		
Eastern Arctic		
liver	12.11	189
muscle	0.31	193
kidney	2.31	1
Other		
liver	25.36	303
muscle	1.94	186
kidney	4.10	24

Note: Data was originally collected between 1967 and 1977.

corresponding levels in whales and seals from other localities.

Furthermore, it is clear that mercury is accumulated to a far greater degree by liver tissue than by muscle tissue in both beluga whales and ringed seal. Mercury accumulation in kidney is substantially less than in liver but more than in muscle. Therefore, one would expect greater risk of mercury poisoning from liver than muscle if both were consumed in equal quantities.

Appendix E

BELUGA WHALE LANDINGS
SOUTH KEEWATIN

Year	Community		
	Eskimo Point	Whale Cove	Rankin Inlet
1973	32	3	?
1974	?	?	?
1975	41	20	21
1976	20	5	25
1977	39	30	12
1978	18	37	30
1979	10	?	?
1980	22	8	14
1981	55	21	32
1982	45	6	37
1983	61	8	33
1984	60	24	69
Total	403	162	343
Average	37	16	38
Average 82-84	55	13	46

Data provided by Moshenko (pers. comm., 1986)

Appendix F

FOOD REQUIREMENTS OF 10 FOXES FOR 1 YEAR

Table F.1

Feeding Schedule

Date	Week(s)	Diet
Pup Cycle		
April 1	1	Birth-nursing
May 20	7	Weaning starts
May 20-Sept 2	7-22	Early Growth Diet
Sept 9 to Dec 2	23-35	Late Growth to Maturity Diet
Dec 9	36	Pelting
Female Cycle		
Feb 5-May 20	15	Gestation and Lactation Diet
May 21-Feb 5	37	Maintenance Diet
Male Cycle		
Year-round	52	Maintenance Diet

Note: This feeding schedule is based on average timing of cycles. Since time of breeding is dependent on daylight hours, breeding may start later in the year in the Keewatin.

Table F.2

Total Food Requirement of 1 Pup
(Weaning to Pelting)

Early Growth Diet
Weeks 7-23
(1,831 kcal/kg)

Ingredients	% of Ration	ME Kcal/kg	Required Food Intake (kg of food) (A) Weeks 7-10 (267 kcal ME/day/ 21 days)	(B) Weeks 11-14 (432 kcal ME/day/ 28 days)	(C) Weeks 15-18 (518 kcal ME/day/ 21 days)	(D) Weeks 19-22 (585 kcal ME/day/ 28 days)	Total A+B+C+D
Cereal	20	599	0.613	1.322	1.189	1.786	4.910
Marine Mammal Meat	20	235	0.613	1.322	1.189	1.786	4.910
Fish	5	56	0.153	0.330	0.297	0.447	1.227
Blubber	5	423	0.153	0.330	0.297	0.447	1.227
Fish By-Products	25	207	0.767	1.652	1.486	2.233	6.138
Liver	5	60	0.153	0.330	0.297	0.447	1.227
Organ Meats	20	251	0.613	1.322	1.189	1.786	4.910
Total	100	1,831	3.066	6.608	5.943	8.932	24.549

Late Growth Diet
Weeks 24-maturity
(2,278 kcal/kg)

Ingredients	% of Ration	ME Kcal/kg	Required Food Intake (kg of food) (E) Weeks 23-26 (607 kcal ME/day/ 21 days)	(F) Weeks 27-30 (543 kcal ME/day/ 28 days)	(G) Weeks 31-34 (466 kcal ME/day/ 28 days)	(H) Week 35 (451 kcal ME/day/ 7 days)	Total E+F+G+H	Total Food Early Growth plus Late Growth 35 weeks
Cereal	35	1,060	1.955	2.332	2.009	0.485	6.781	11.691
Marine Mammal Meat	5	59	0.279	0.333	0.287	0.069	0.968	5.878
Fish	0	0	0.000	0.000	0.000	0.000	0.000	1.227
Blubber	8	677	0.447	0.533	0.459	0.111	1.550	2.777
Fish By-Products	40	332	2.230	2.666	2.296	0.554	7.746	13.884
Liver	0	0	0.000	0.000	0.000	0.000	0.000	1.227
Organ Meats	12	151	0.670	0.800	0.689	0.166	2.325	7.235
Total	100	2,278	5.586	6.664	5.740	1.386	19.376	43.925

Table F.3

Energy Requirements of Lactating Females

10 Day Periods (days)	Initial Energy Requirement Plus Additional Energy/pup(1) (kcal ME)	3 Pups Per Day (kcal)	3 Pups Per 10 Day (kcal)	4 Pups Per Day (kcal)	4 Pups Per 10 Day (kcal)
0-10	450 + 52	606	6,060	658	6,580
10-20	450 + 123	819	8,190	942	9,420
20-30	450 + 195	1,035	10,350	1,230	12,300
30-40	450 + 292	1,326	13,260	1,618	16,180
40-50	450 + 392	1,626	16,260	2,018	20,180
			------		------
50 days	Total Energy Requirement		54,120		64,660
Quantity of Breeding and Lactation Diet (1,876 kcal/kg) required during lactation			28.849 kg		34.467 kg

(1) From Table 1.

Table F.4

Yearly Female Food Intake
(3 Pups)

Gestation and Lactation Diet
(1,876 kcal/kg)

Ingredients	% of Ration	ME kcal/kg	Required Food Intake (kg of food) (A) 7 Weeks Gestation (580 kcal ME/day)	(B) 7 Weeks Lactation	Total Gestation and Lactation (A+B)
Cereal	15	450	2.271	4.330	6.601
Marine Mammal Meat	20	235	3.028	5.770	8.798
Fish	5	56	0.757	1.442	2.199
Blubber	7	593	1.060	2.019	3.079
Fish By-Products	28	232	4.239	8.078	12.317
Liver	5	60	0.757	1.442	2.199
Organ Meats	20	251	3.028	5.770	8.798
Total	100	1,876	15.141	28.849	43.990

Maintenance Diet
(2,648 kcal/kg)

Ingredients	% of Ration	ME kcal/kg	Required Food Intake (kg of food) (C) 38 Weeks (532 kcal ME/day average)	Yearly Total (A+B+C)
Cereal	39	1,181	20.852	27.453
Marine Mammal Meat	5	59	2.673	11.471
Fish	0	0	0.000	2.199
Blubber	11	931	5.881	8.960
Fish By-Products	20	166	10.693	23.010
Liver	5	60	2.673	4.872
Organ Meats	20	251	10.693	19.491
Total	100	2,648	53.466	97.456

Table F.5

Yearly Female Food Requirement
(4 Pups)

Gestation and Lactation Diet
(1,876 kcal/kg)

Ingredients	% of Ration	ME kcal/kg	Required Food Intake (kg of food) (A) 7 Weeks Gestation (580 kcal ME/day)	(B) 7 Weeks Lactation	Total Gestation and Lactation (A+B)
Cereal	15	450	2.271	5.170	7.441
Marine Mammal Meat	20	235	3.028	6.893	9.921
Fish	5	56	0.757	1.723	2.480
Blubber	7	593	1.060	2.413	3.473
Fish By-Products	28	232	4.239	9.651	13.890
Liver	5	60	0.757	1.723	2.480
Organ Meats	20	251	3.028	6.893	9.921
Total	100	1,876	15.141	34.467	49.608

Maintenance Diet
(2,648 kcal/kg)

Ingredients	% of Ration	ME kcal/kg	Required Food Intake (kg of food) (C) 38 Weeks (532 kcal ME/day average)	Yearly Total (A+B+C)
Cereal	39	1,181	20.852	28.293
Marine Mammal Meat	5	59	2.673	12.594
Fish	0	0	0.000	2.480
Blubber	11	931	5.881	9.354
Fish By-Products	20	166	10.693	24.583
Liver	5	60	2.673	5.153
Organ Meats	20	251	10.693	20.614
Total	100	2,648	53.466	103.074

Table F.6

Yearly Male Food Requirement

Maintenance Diet
(1,876 kcal/kg)

Ingredients	% of Ration	ME kcal/kg	Required Food Intake (kg of food) (628 kcal ME/day/ 365 days)
Cereal	15	450	18.341
Marine Mammal Meat	20	235	24.455
Fish	5	56	6.114
Blubber	7	593	8.559
Fish By-Products	28	232	34.240
Liver	5	60	6.114
Organ Meats	20	251	24.455
Total	100	1,876	122.275

(1) Male energy requirement is estimated as 18% greater than female maintenance requirement.

Table F.7

Quantity of Food Needed to Feed
10 Silver Foxes for 1 Year

2 Females
1 Male
7 Pups

Ingredients	7 Pups Early Growth Plus Late Growth (1) (kg)	1 Female with 3 pups (2) (kg)	1 Female with 4 pups (3) (kg)	1 Male (4) (kg)	Total (kg)
Cereal	35.073	27.453	28.293	18.341	109.160
Marine Mammal Meat	17.634	11.471	12.594	24.455	66.154
Fish	3.681	2.199	2.480	6.114	14.474
Blubber	8.331	8.960	9.354	8.559	35.204
Fish By-Products	41.652	23.010	24.583	34.240	123.485
Liver	3.681	4.872	5.153	6.114	19.820
Organ Meat	21.705	19.491	20.614	24.455	86.265
Total	131.757	97.456	103.074	122.275	454.562

(1) Total food requirement from weaning to pelting (35 weeks). From Table F.2.
(2) Total yearly food requirement. From Table F.4.
(3) Total yearly food requirement. From Table F.5.
(4) Total yearly food requirement. From Table F.6.

Appendix G

NUTRIENT COMPOSITION OF COUNTRY FOODS

Food Item	Moisture %	Protein %	Fat %	Carbo-hydrate %	Ash %	Calcium %	Phos-phorus %	Source
Marine Mammals Fresh Meat Seal	67.5	26.1	4.7					Hoppner et al., 1978
Seal	72.9	23.8	1.3		1.40			Botta et al., 1982
Seal		32.0	1.8					Berkes and Farkas, 1978
Seal	66.6	31.0	1.1	0.15	1.15	0.023		Mann et al., 1958, average of 2 seals
Average	69.0	28.2	2.2	0.15	1.13	0.023		
Whale	75.0	23.6	0.7	0.00	0.90	0.017		Mann et al., 1958, 1 specimen
Polar Bear	70.3	25.6	3.1	0.00	1.10	0.017		Mann et al., 1958, 1 specimen
Average Sea Mammals	71.4	25.8	2.0	0.05	1.04	0.019		
Blubber Seal	1.0	0.4	98.7	0.00	0.00	0.011		Mann et al., 1958, 2 specimens
Whale (muk-tuk + fat)	9.5	2.8	85.2	1.70	1.90	0.015		Mann et al., 1958, 1 specimen
Freshwater Fish Fresh meat Whitefish	70.9	25.8	1.3	0.00	2.00	0.356		Mann et al., 1958, 1 specimen
Trout		25.0	1.1					Berkes and Farkas, 1978
Trout	72.9	25.8	1.3	0.00	1.20	0.054		Mann et al., 1958, 1 specimen
Grayling	70.2	21.3 23.4	5.7 1.6	0.00	4.80	0.532		Berkes and Farkas, 1978 Mann et al., 1958, 1 specimen
Average	71.3	24.0	2.2	0.00	2.67	0.314		
Fish By-products	76.8	14.7	2.8	0.69	6.90	0.240	0.290	Alberta Agriculture
Liver	71.5	22.3	4.2			0.350	0.300	Victor Fox Food Catalog (based on average of beef and horse liver)
Organ Meats	73.0	15.5	8.2			0.250	0.217	Victor Fox Food Catalog (based on average of heart, kidney, lungs, + tripe of beef + horse)
Chicken By-products	66.0	21.1	15.8					NRC, 1982

Appendix H

SAMPLE FOX FOOD FORMULATIONS

Table H.1

Maintenance Diet

Ingredients	Nutrient Composition of Ingredients As Fed Basis: % of ration min	% of ration max	% Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	Nutrient Composition of Fox Food Formula: % of Ration	% Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94	0.39	7.02	1.17	27.69	0.59	36.47
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.05	1.30	0.10	0.00	0.05	1.45
Fish			24	2	0	3	29	0.00	0.00	0.00	0.00	0.00	0.00
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.11	0.00	10.89	0.00	0.00	10.89
Fish By-products	5	40	15	3	1	5	24	0.20	3.00	0.60	0.20	1.00	4.80
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.20	3.20	1.40	0.20	0.40	5.20
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
							Total	1.00	16	14	28	2	60
							Percentage		0.26	0.24	0.47	0.03	1.00

Table H.1
cont.

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	641	239	2,148	0.39	249.99	93.21	837.72	1,180.92
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.05	50.45	8.25	0.00	58.70
Fish			947	165	0	0.00	0.00	0.00	0.00	0.00
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.11	0.00	931.15	0.00	931.15
Fish By-products	5	40	572	236	21	0.20	114.40	47.20	4.20	165.80
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.20	123.40	120.00	7.80	251.20
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	580.54	1,216.56	850.57	2,647.67
					Percentage		0.22	0.46	0.32	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.2

Maintenance Diet

Ingredients	% of Ration min	% of Ration max	Nutrient Composition of Ingredients As Fed Basis (1) ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	% of Ration (%)	Metabolizable Energy (ME) of Fox Food Formula ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	641	239	2,148	0.00	0.00	0.00	0.00	0.00
F-35	35		889	239	1,953	0.50	444.50	119.50	976.50	1,540.50
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.05	50.45	8.25	0.00	58.70
Fish			947	165	0	0.00	0.00	0.00	0.00	0.00
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.05	0.00	423.25	0.00	423.25
Fish By-products	5	40	572	236	21	0.25	143.00	59.00	5.25	207.25
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.10	61.70	60.00	3.90	125.60
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	741.95	686.75	986.50	2,415.20
					Percentage		0.31	0.28	0.41	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.2
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis: % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	Nutrient Composition of Fox Food Formula: % of Ration	% Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94	0.00	0.00	0.00	0.00	0.00	0.00
F-35	35		25	3	63	2	93	0.50	12.50	1.50	31.50	1.00	46.50
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.05	1.30	0.10	0.00	0.05	1.45
Fish			24	2	0	3	29	0.00	0.00	0.00	0.00	0.00	0.00
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.05	0.00	4.95	0.00	0.00	4.95
Fish By-products	5	40	15	3	1	5	24	0.25	3.75	0.75	0.25	1.25	6.00
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.10	1.60	0.70	0.10	0.20	2.60
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
							Total	1.00	20	8	32	3	63
							Percentage		0.32	0.13	0.51	0.04	1.00

Table H.3

Gestation and Lactation Diet

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.15	74.70	35.85	339.00	449.55
Triple XXX	20	30	641	239	2,148	0.00	0.00	0.00	0.00	0.00
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.20	201.80	33.00	0.00	234.80
Fish			947	165	0	0.05	47.35	8.25	0.00	55.60
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.07	0.00	592.55	0.00	592.55
Fish By-products	5	40	572	236	21	0.28	160.16	66.08	5.88	232.12
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.20	123.40	120.00	7.80	251.20
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	649.71	872.48	353.53	1,875.72
					Percentage		0.35	0.47	0.19	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.3
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis: % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	% of Ration	Nutrient Composition of Fox Food Formula: % Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.15	2.10	0.45	11.10	0.23	13.88
Triple XXX	20	30	18	3	71	2	94	0.00	0.00	0.00	0.00	0.00	0.00
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.05	1.20	0.10	0.00	0.15	1.45
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.07	0.00	6.93	0.00	0.00	6.93
Fish By-products	5	40	15	3	1	5	24	0.28	4.20	0.84	0.28	1.40	6.72
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.20	3.20	1.40	0.20	0.40	5.20
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
							Total	1.00	17	10	12	2	41
							Percentage		0.41	0.25	0.28	0.06	1.00

Table H.4

Gestation and Lactation Diet

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.20	99.60	47.80	452.00	599.40
Triple XXX	20	30	641	239	2,148	0.00	0.00	0.00	0.00	0.00
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.20	201.80	33.00	0.00	234.80
Fish			947	165	0	0.05	47.35	8.25	0.00	55.60
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.05	0.00	423.25	0.00	423.25
Fish By-products	5	40	572	236	21	0.25	143.00	59.00	5.25	207.25
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.20	123.40	120.00	7.80	251.20
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	657.45	708.05	465.90	1,831.40
					Percentage		0.36	0.39	0.25	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.4
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis: % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	Nutrient Composition of Fox Food Formula: % of Ration	% Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.20	2.80	0.60	14.80	0.30	18.50
Triple XXX	20	30	18	3	71	2	94	0.00	0.00	0.00	0.00	0.00	0.00
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.05	1.20	0.10	0.00	0.15	1.45
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.05	0.00	4.95	0.00	0.00	4.95
Fish By-products	5	40	15	3	1	5	24	0.25	3.75	0.75	0.25	1.25	6.00
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.20	3.20	1.40	0.20	0.40	5.20
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
							Total	1.00	17	8	15	2	43
							Percentage		0.40	0.19	0.35	0.05	1.00

Table H.5

Gestation and Lactation or Early Growth (7-23 weeks) Diet

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	641	239	2,148	0.30	192.30	71.70	644.40	908.40
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.15	151.35	24.75	0.00	176.10
Fish			947	165	0	0.05	47.35	8.25	0.00	55.60
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.07	0.00	592.55	0.00	592.55
Fish By-products	5	40	572	236	21	0.23	131.56	54.28	4.83	190.67
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.15	92.55	90.00	5.85	188.40
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	657.41	858.28	655.93	2,171.62
					Percentage		0.30	0.40	0.30	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.5
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis: % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	% of Ration	Nutrient Composition of Fox Food Formula: % Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94	0.30	5.40	0.90	21.30	0.45	28.05
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.15	3.90	0.30	0.00	0.15	4.35
Fish			24	2	0	3	29	0.05	1.20	0.10	0.00	0.15	1.45
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.07	0.00	6.93	0.00	0.00	6.93
Fish By-products	5	40	15	3	1	5	24	0.23	3.45	0.69	0.23	1.15	5.52
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.15	2.40	1.05	0.15	0.30	3.90
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
							Total	1.00	17	10	22	2	52
							Percentage		0.34	0.20	0.42	0.04	1.00

Table H.6

Early Growth Diet
(7-23 weeks)

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	641	239	2,148	0.30	192.30	71.70	644.40	908.40
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.20	201.80	33.00	0.00	234.80
Fish			947	165	0	0.10	94.70	16.50	0.00	111.20
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.10	0.00	846.50	0.00	846.50
Fish By-products	5	40	572	236	21	0.15	85.80	35.40	3.15	124.35
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.10	61.70	60.00	3.90	125.60
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	678.60	1,079.85	652.30	2,410.75
					Percentage		0.28	0.45	0.27	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.6
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	% of Ration	Nutrient Composition of Fox Food Formula % Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94	0.30	5.40	0.90	21.30	0.45	28.05
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.10	2.40	0.20	0.00	0.30	2.90
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.10	0.00	9.90	0.00	0.00	9.90
Fish By-products	5	40	15	3	1	5	24	0.15	2.25	0.45	0.15	0.75	3.60
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.10	1.60	0.70	0.10	0.20	2.60
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
							Total	1.00	18	13	22	2	54
							Percentage		0.33	0.24	0.40	0.04	1.00

Table H.7

Early Growth Diet
(7-23 weeks)

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.20	99.60	47.80	452.00	599.40
Triple XXX	20	30	641	239	2,148	0.00	0.00	0.00	0.00	0.00
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.20	201.80	33.00	0.00	234.80
Fish			947	165	0	0.05	47.35	8.25	0.00	55.60
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.05	0.00	423.25	0.00	423.25
Fish By-products	5	40	572	236	21	0.25	143.00	59.00	5.25	207.25
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.20	123.40	120.00	7.80	251.20
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	657.45	708.05	465.90	1,831.40
					Percentage		0.36	0.39	0.25	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.7
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	~Total	% of Ration	Nutrient Composition of Fox Food Formula % Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.20	2.80	0.60	14.80	0.30	18.50
Triple XXX	20	30	18	3	71	2	94	0.00	0.00	0.00	0.00	0.00	0.00
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.05	1.20	0.10	0.00	0.15	1.45
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.05	0.00	4.95	0.00	0.00	4.95
Fish By-products	5	40	15	3	1	5	24	0.25	3.75	0.75	0.25	1.25	6.00
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.20	3.20	1.40	0.20	0.40	5.20
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
								Total	1.00	17	8	15	2	43
								Percentage		0.40	0.19	0.35	0.05	1.00

Table H.8

Early Growth Diet
(7-23 weeks)

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal						0.00	0.00	0.00	0.00	0.00
Superblend	15	20	498	239	2,260	0.20	128.20	47.80	429.60	605.60
Triple XXX	20	30	641	239	2,148	0.00	0.00	0.00	0.00	0.00
F-35	35		889	239	1,953					
Quality Protein	5	30				0.20	201.80	33.00	0.00	234.80
Marine Mammal Meat			1,009	165	0	0.10	94.70	16.50	0.00	111.20
Fish			947	165	0					
Rendered Fat										
Based on composition										
of seal blubber	0	10	0	8,465	0	0.05	0.00	423.25	0.00	423.25
Fish By-products	5	40	572	236	21	0.30	171.60	70.80	6.30	248.70
Liver										
Based on beef and										
horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney,										
heart, and tripe (beef										
and horse)	10	20	617	600	39	0.10	61.70	60.00	3.90	125.60
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
						Total 1.00	700.30	668.10	440.65	1,809.05
						Percentage	0.39	0.37	0.24	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.8
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	% of Ration	Nutrient Composition of Fox Food Formula % Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94	0.20	3.60	0.60	14.20	0.30	18.70
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.10	2.40	0.20	0.00	0.30	2.90
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.05	0.00	4.95	0.00	0.00	4.95
Fish By-products	5	40	15	3	1	5	24	0.30	4.50	0.90	0.30	1.50	7.20
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.10	1.60	0.70	0.10	0.20	2.60
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
								Total	1.00	18	8	15	3	44
								Percentage		0.42	0.18	0.34	0.06	1.00

Table H.9

Early Growth Diet
(7-23 weeks)

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	641	239	2,148	0.20	128.20	47.80	429.60	605.60
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.20	201.80	33.00	0.00	234.80
Fish			947	165	0	0.10	94.70	16.50	0.00	111.20
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.10	0.00	846.50	0.00	846.50
Fish By-products	5	40	572	236	21	0.25	143.00	59.00	5.25	207.25
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.10	61.70	60.00	3.90	125.60
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	671.70	1,079.55	439.60	2,190.85
					Percentage		0.31	0.49	0.20	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.9
cont.

Ingredients	Nutrient Composition of Ingredients As Fed Basis: % of ration min	% of ration max	% Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	Nutrient Composition of Fox Food Formula: % of Ration	% Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94	0.20	3.60	0.60	14.20	0.30	18.70
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.10	2.40	0.20	0.00	0.30	2.90
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.10	0.00	9.90	0.00	0.00	9.90
Fish By-products	5	40	15	3	1	5	24	0.25	3.75	0.75	0.25	1.25	6.00
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.10	1.60	0.70	0.10	0.20	2.60
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
								Total	1.00	18	13	15	2	47
								Percentage		0.37	0.27	0.31	0.05	1.00

Table H.10

Early Growth Diet
(7-23 weeks)

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.20	99.60	47.80	452.00	599.40
Triple XXX	20	30	641	239	2,148	0.00	0.00	0.00	0.00	0.00
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.20	201.80	33.00	0.00	234.80
Fish			947	165	0	0.10	94.70	16.50	0.00	111.20
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.05	0.00	423.25	0.00	423.25
Fish By-products	5	40	572	236	21	0.25	143.00	59.00	5.25	207.25
Liver										
Based on beef and horse liver	0	10	846	335	17	0.05	42.30	16.75	0.85	59.90
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.15	92.55	90.00	5.85	188.40
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
						Total 1.00	673.95	686.30	463.95	1,824.20
						Percentage	0.37	0.38	0.25	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.10
cont.

Ingredients	% of ration min	% of ration max	Nutrient Composition of Ingredients As Fed Basis: % Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total	% of Ration	Nutrient Composition of Fox Food Formula: % Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal													
Superblend	15	20	14	3	74	2	93	0.20	2.80	0.60	14.80	0.30	18.50
Triple XXX	20	30	18	3	71	2	94	0.00	0.00	0.00	0.00	0.00	0.00
F-35	35		25	3	63	2	93	0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30											
Marine Mammal Meat			26	2	0	1	29	0.20	5.20	0.40	0.00	0.20	5.80
Fish			24	2	0	3	29	0.10	2.40	0.20	0.00	0.30	2.90
Rendered Fat													
Based on composition of seal blubber	0	10	0	99	0	0	99	0.05	0.00	4.95	0.00	0.00	4.95
Fish By-products	5	40	15	3	1	5	24	0.25	3.75	0.75	0.25	1.25	6.00
Liver													
Based on beef and horse liver	0	10	22	4	1	1	28	0.05	1.10	0.20	0.05	0.05	1.40
Organ Meats													
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26	0.15	2.40	1.05	0.15	0.30	3.90
Poultry By-products	0	40	21	16	2	5	44	0.00	0.00	0.00	0.00	0.00	0.00
								Total	1.00	18	8	15	2	43
								Percentage		0.41	0.19	0.35	0.06	1.00

Table H.11

Late Growth Diet
(23 weeks to maturity)

Ingredients	Nutrient Composition of Ingredients As Fed Basis (1) % of Ration min	max	ME Protien (kcal/kg) (P)	ME Fat (kcal/kg) (F)	ME Carb (kcal/kg) (C)	Metabolizable Energy (ME) of Fox Food Formula % of Ration (%)	ME Protein P x %	ME Fat F x %	ME Carb C x %	ME Total (kcal/kg)
Fortified Cereal										
Superblend	15	20	498	239	2,260	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	641	239	2,148	0.35	224.35	83.65	751.80	1,059.80
F-35	35		889	239	1,953	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30								
Marine Mammal Meat			1,009	165	0	0.05	50.45	8.25	0.00	58.70
Fish			947	165	0	0.00	0.00	0.00	0.00	0.00
Rendered Fat										
Based on composition of seal blubber	0	10	0	8,465	0	0.08	0.00	677.20	0.00	677.20
Fish By-products	5	40	572	236	21	0.40	228.80	94.40	8.40	331.60
Liver										
Based on beef and horse liver	0	10	846	335	17	0.00	0.00	0.00	0.00	0.00
Organ Meats										
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	617	600	39	0.12	74.04	72.00	4.68	150.72
Poultry By-products	0	40	806	1,350	66	0.00	0.00	0.00	0.00	0.00
					Total	1.00	577.64	935.50	764.88	2,278.02
					Percentage		0.25	0.41	0.34	1.00

(1) ME as fed basis is derived by multiplying ME dry matter basis by percent dry matter. See Table 10.

Table H.11
cont.

Ingredients	Nutrient Composition of Ingredients As Fed Basis: % of ration min	% of ration max	% Protein (P)	% Fat (F)	% Carb (C)	% Ash (A)	Total		Nutrient Composition of Fox Food Formula: % of Ration	% Protein P x %	% Fat F x %	% Carb C x %	% Ash A x %	Total
Fortified Cereal														
Superblend	15	20	14	3	74	2	93		0.00	0.00	0.00	0.00	0.00	0.00
Triple XXX	20	30	18	3	71	2	94		0.35	6.30	1.05	24.85	0.53	32.73
F-35	35		25	3	63	2	93		0.00	0.00	0.00	0.00	0.00	0.00
Quality Protein	5	30												
Marine Mammal Meat			26	2	0	1	29		0.05	1.30	0.10	0.00	0.05	1.45
Fish			24	2	0	3	29		0.00	0.00	0.00	0.00	0.00	0.00
Rendered Fat														
Based on composition of seal blubber	0	10	0	99	0	0	99		0.08	0.00	7.92	0.00	0.00	7.92
Fish By-products	5	40	15	3	1	5	24		0.40	6.00	1.20	0.40	2.00	9.60
Liver														
Based on beef and horse liver	0	10	22	4	1	1	28		0.00	0.00	0.00	0.00	0.00	0.00
Organ Meats														
Based on lungs, kidney, heart, and tripe (beef and horse)	10	20	16	7	1	2	26		0.12	1.92	0.84	0.12	0.24	3.12
Poultry By-products	0	40	21	16	2	5	44		0.00	0.00	0.00	0.00	0.00	0.00
								Total	1.00	16	11	25	3	55
								Percentage		0.28	0.20	0.46	0.05	1.00