# APPENDIX A: Estimate of Food Value of Beluga to Pangnirtung Inuit

## 1.0 INTRODUCTION

This appendix explains the assumptions, methods, and data used to estimate the economic value, using a replacement cost approach, of an average beluga harvested by Pangnirtung Inuit from the Cumberland Sound beluga population.

## 2.0 QUANTITY AND USE OF FOOD AVAILABLE FROM BELUGA

To determine the average quantity (volume) and use of food available from the average beluga harvested, the following information is required:

(1) average live weight of belugas;

(2) information about what parts of beluga are used by Pangnirtung Inuit and for what purposes;

(3) detailed information about the proportion of live weight that is used for food and other purposes (known as "edible weight"); and,

(4) information about what portions of edible weight are used for human consumption, dog food, and other purposes.

### 2.1 Average Live Weight of Belugas Harvested

An estimate of the average live weight of belugas harvested by Pangnirtung Inuit should be based upon a combination of baseline data regarding:

(1) the numbers of animals harvested per year by sex and age; and
(2) documented live weights for beluga of different age and gender classes.

The numbers of beluga harvested (shot and retrieved) by Pangnirtung Inuit for food purposes has been documented since at least 1970.[23] However, these hunt statistics do not include information regarding the composition (numbers or percentages of animals by age and sex) of the annual harvest. According to the Pangnirtung HTO, hunters harvest beluga on an opportunistic basis,

[23] The food harvest is reported by Pangnirtung hunters to DFO's Iqaluit Area office annually. For harvest data for the period 1948-1987 see Strong, J.T. 1989, Reported Harvests of Narwhal, Beluga and Walrus in the Northwest Territories, 1948-1987. Canadian Data Report of Fisheries and Aquatic Sciences No. 734, Fisheries and Oceans Canada. As well, harvest data was recorded in the Nunavut Harvest Study for the period June 1996/May 1997 through June 2000/May 2001.

taking adults, juveniles and young of both sexes. There is no definite pattern on a year to year basis.[24]

A review of the literature reveals two studies which have documented beluga food harvest composition. Usher (2000) reported that the Inuvialuit Inuit beluga harvest is predominantly adult animals (95%) with a male-female ratio of 70:30. DFO (2009) reported that the Nunavik Inuit beluga harvest for the period 1993-2008 has been comprised of 52-59% older adults (whites), 34-50% young beluga (grey/light grey), and 5-8% juveniles (dark greys). For the period 1993 to 2004 the harvest included equal numbers of male and female beluga, however during the period 2005-2008, the proportion of females harvested increased to 58.4%.

Based upon information from the Pangnirtung HTA indicating there is no specific age or gender pattern or hunting preference, the Nunavik Inuit harvest composition is used as a proxy to develop a picture of the age/sex composition of the Pangnirtung Inuit beluga harvest. Table A1 presents an estimate of the composition of the Pangnirtung Cumberland Sound beluga harvest (using the current harvest quota of 41 animals/year).

TABLE A1: Estimate of Pangnirtung Inuit Beluga Harvest Composition

| | DFO Range[25] | Rounded Total[26] | Male | Female | Male | Female | Total |
|---|---|---|---|---|---|---|---|
| Age Class | | % | % | % | # | # | # |
| Adult (Whites) | 52-59% | 53% | 27% | 27% | 11 | 11 | 22 |
| Young (Dark Grey) | 34-50% | 41% | 21% | 21% | 8 | 9 | 17 |
| Juvenile(Grey/LightGrey) | 5-8% | 6% | 3% | 3% | 1 | 1 | 2 |
| Total | | 100% | 50% | 50% | 20 | 21 | 41 |

In the case of the Cumberland Sound beluga, the only live weight data specific to this population is that adults (male and female combined) range from 800 to 1000 kgs. (DFO, 2002). There are no data regarding the live weights for young beluga (greys, light greys) or juveniles (dark greys) by gender or age class.[27]

A review of available literature indicates that live weight figures or ranges for adult beluga have been reported for some Canadian beluga populations, however, live weight data specifically for older adults (whites) young (grey/light grey) and juvenile (dark grey) beluga do not appear to be reported. Therefore, in the absence of live weight data for different age/gender classes specific to the Cumberland Sound population, more generalized information about beluga in Canada has been utilized to model live weights for different age/gender classes.

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[24] Personal Communication with Jevua Maniapik, Pangnirtung HTA, November 17, 2009.

[25] Ranges provided by DFO (2005) concerning the Nunavik Inuit beluga harvest composition.

[26] Mid range of DFO data for each age class totaled 104, therefore figures for each age class adjusted and rounded to equal 100%.

[27] Beluga change color as they age. Juvenile beluga appear black/dark grey in their first year and gradually lighten as they age, turning white by the time they are 4 to 5 years of age (Banfield, 1974).

DFO[28] generally reports that adult beluga males across Canada range from 450-1000 kgs. and adult females range from 250-700 kgs. For purposes of modeling it is assumed that these ranges include all beluga aged 2 years and older, i.e. those that are grey/light grey to white. An average live weight for older white beluga is assumed to be the mid-point in the upper half of the overall range and the average live weight for young beluga is assumed to be the mid range in the lower half of the overall range. For example, in the case of white male beluga, this mid point is calculated as 863 kgs. (1000+450/2=725 mid-point in range > 1000+725/2=863 kgs. mid point in upper half of range) and for young male beluga, the mid-point is calculated as 588 kgs. (1000+450/2=725 mid-point in range > 725+450/2=588 mid-point in lower half of the lower range).

As noted, the literature review did not identify any live weight information for juvenile beluga. DFO[29] reports that by the time juvenile beluga reach the age of two years they are approximately 70% of the length of adults. For purposes of modeling, it has been assumed that there is a direct correlation between length and weight, i.e. if juveniles are 70% the length of an adult then they are also 70% of the weight of an adult. Since there is such a broad range in the reported weights of adults, it has been assumed that juveniles are 70% of the weight calculated for young adults. Table A2 below presents the estimated live weights for the different age/gender classes based upon the data and assumptions described above.

TABLE A2: Estimated Live Weight of Cumberland Belugas by Age and Gender Class

| | Belugas in General | | Estimated Live Weights for Cumberland Sound Belugas |
|---|---|---|---|
| Older Adults (Whites aged 4-5 years +): assumed they are the mid-point in the upper half of the total range. | | | |
| Males | Range 450-1000 kgs. | 863 kgs. avg. | 863 kgs. |
| Females | Range 250-700 kgs. | 588 kgs. avg. | 588 kgs. |
| Young (Dark Greys aged 2 years): assumed they are the mid-point in the lower half of the total range. | | | |
| Males | Range 450-1000 kgs. | 588 kgs.avg | 588 kgs. |
| Females | Range 250-700 kgs. | 363 kgs. avg. | 363 kgs. |
| Juveniles (Light Greys/Greys aged 2-4/5 years): assumed they are 70% of the weight of the young age class. | | | |
| Males | 588 kgs x 70% =412 kgs. | | 412 kgs. |
| Females | 363 kgs x70%=254 kgs. | | 254 kgs. |

Based upon the estimates of the Pangnirtung harvest composition (Table A1) and the modeled live weights (Table A2), the average live weight of beluga harvested in the Cumberland Sound population by Pangnirtung hunters is estimated at 600 kgs. as illustrated in Table A3 below.

[28] http://www.dfo-mpo.gc.ca/zone/underwater_sous-marin/beluga/beluga-eng.htm
[29] http://www.dfo-mpo.gc.ca/zone/underwater_sous-marin/beluga/beluga-eng.htm

TABLE A3:
Estimated Unit Live Weight of Beluga Harvested from Cumberland Sound Population

| Age/Gender Class | # Harvested/Year (from Table A1) | Avg. Live Weight (kgs.) (from Table A2) | Total Live Weight (kgs.) | Average Live Weight per Beluga (kgs.) |
|---|---|---|---|---|
| Older Adults (Whites) | | | | |
| Male | 11 | 863 | 9,493 | |
| Female | 11 | 588 | 6,468 | |
| Young (Dark Grey) | | | | |
| Male | 8 | 588 | 4,704 | |
| Female | 9 | 363 | 3,267 | |
| Juveniles (Grey/Light Grey) | | | | |
| Male | 1 | 412 | 412 | [24,598 kgs/41 animals] = 600 |
| Female | 1 | 254 | 254 | |
| TOTAL | 41 | | 24,598 | |

## 2.2 Parts of Beluga Utilized by Pangnirtung Inuit

Historically, most parts of beluga, except the head were used for food and equipment purposes. The outer layers (outer dermis, skin and blubber) of the animal, known as muktuk (also muktag) when eaten, as well as choice parts of the meat provided food for people. Blubber and organ meats were fed to dogs. In the past, the stomach and skin were used to make equipment such as whip handles and ropes, the blubber was used extensively to fuel the "Qulik" (stove), and finally the bones were used in the winter as fox bait or eaten when no other meat was available (Kilabuk, 1988).

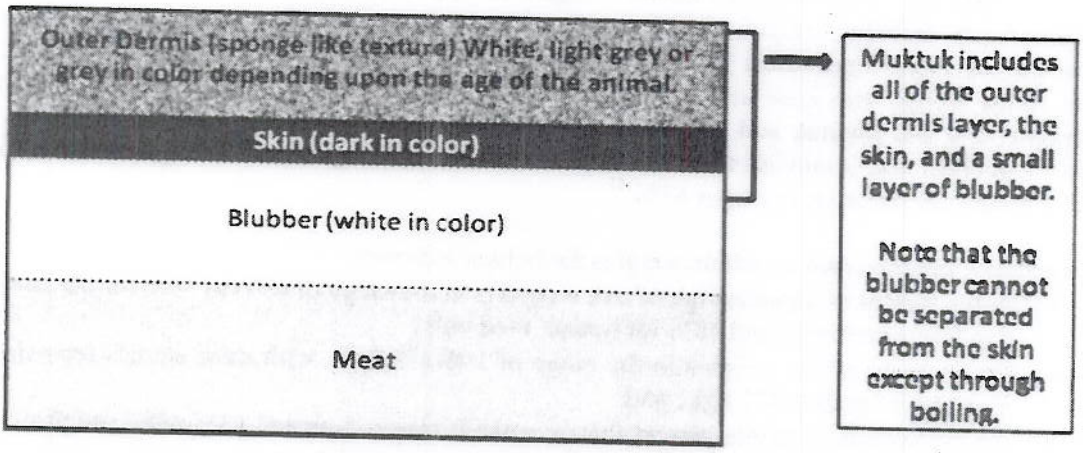
In contemporary times, it is mostly the two outer layers, which combined are called muktuk, the flippers, and choice meats that are utilized for human consumption. According to the Pangnirtung HTA, about 50% of Pangnirtung families still eat the meat. The organs, meat and some blubber are used to feed dogs.[30] This appears to be the norm amongst Nunavut Inuit, where "older" people are said to continue to eat dried beluga meat and those who still have dog teams use the meat, including organs, and bones for feed.[31]

### 2.2.1 Muktuk

The edible parts of a beluga whale are illustrated below. The portion that is known as Muktuk when eaten includes all of the two outermost layers (outer dermis and skin) and a small strip

[30] Personal Communication with Jevua Maniapik, Pangnirtung HTA, November 17, 2009.
[31] Personal Communication with John Hicks, NTI Negotiator on November 3rd and 18th, 2009.

from the blubber layer. The depth of the outer dermis and blubber layer varies according to the age of the animal and the season.




## 2.3 Edible Weight of Average Beluga Harvested

There are no data reported about the actual volume (kgs.) of food derived by Pangnirtung Inuit from the beluga they harvest, nor are there data about the proportion (ratio, percentage) of edible products to live weight. A number of studies concerning beluga edible weights were reviewed and are summarized below.

Cameron and Weis (1993) in their study of contaminants in country foods consumed by the Belcher Island Inuit community of Sanikiluaq utilized an average edible weight per beluga of 372 kgs. The report does not present data on the live weight of the animals harvested or indicate a ratio of live weight to edible weight.

Friesen and Arnold (1995) utilized an edible weight to live weight ratio of 70% and estimated the edible weight of the average beluga harvested from the Beaufort Sea by Inuit for food purposes was 280 kgs. The authors relied upon live weight data collected for adult males (1,075 kgs) and females (675 kgs.) and made adjustments to account for juvenile or immature belugas also harvested for food purposes. The authors used a conservative estimate of 400 kgs. live weight per animal multiplied by 70% for an average edible weight of 280 kgs. (edible tissue excluding skin, bone and other non-edible parts).

Usher (2000) recommended an edible weight of 335 kgs. This estimate was developed based upon known information about the sex and age composition of the Inuvialuit harvest (90% adults and male:female ratio of 70:30), knowledge of the portions of beluga that are typically utilized for human consumption only by Inuvialuit families (muktuk, flippers, flukes and selected cuts of meat) and data on live weights for adults and juveniles. Usher's analysis suggests that edible weight for human consumption purposes only is 40% of live weight.

Ashley (2002) investigated the literature concerning edible weight values for beluga. Based upon a review of eleven studies, the author reported an edible weight range of between 106 and 481 kgs. per animal, with most of the studies reporting between 200 and 372 kgs. The author indicates that the large range in edible weights is due to the fact that some of the studies reviewed only included muktuk and oil, while other studies include the meat as well, or just the meat portion. This report cites two studies which provided a breakdown on the percentage of total edible weight into meat and muktuk products. Berger (1977) indicated that beluga meat averages 32% and muktuk and oil averages 68% of total edible weight.[32] A second study by Ewan Cotterhill and Associates Inc. (1986) indicated that beluga meat averages 37% of total edible weight and muktuk averages 63%.[33]

In summary, the literature on edible weights for beluga indicates:

- Edible weight as a percentage of live weight is in the range of 63% to 70% for human and dog food combined, and 40% for human food only;
- Beluga yield edible weights in the range of 106-372 kgs., with most studies reporting a range between 200-372 kgs.; and,
- The proportion of edible weight that is muktuk ranges between 63%-68% and the meat portion ranges between 32% and 37%. The accuracy of these proportions is difficult to discern due to the varying interpretations of what muktuk actually is. Most studies appear to include the entire layer of blubber in their calculations. However, Nunavut Inuit generally only eat the outer dermis, skin and ¾ to 1 inch of the blubber.[34]

According to John Hicks, a Nunavut Inuit, the outer dermis, skin and blubber make up about 40-45% of the live weight of a beluga, 20% of live weight is organs, 20% is loin meat, and the balance (~20%) is bones and flippers. Of the portion of live weight that is dermis, skin and blubber (i.e. 40-45%), about 30-35% of this is eaten as muktuk and some of the blubber is fed to dogs.[35] This would suggest that the edible weight (food for human and dog consumption) is about 57% of live weight [muktuk (14%)[36] + loin meat (20%) + organs (20%) + flippers (~3%)]. This estimate falls in the lower end of the range of edible weight to live weight ratios indicated in the literature (63%-70%), however it is thought that some of the estimates in the literature include all or a large portion of the blubber as muktuk.

For this SE analysis, it is assumed that the edible weight portion of an average beluga harvested by Pangnirtung hunters from the Cumberland Sound population is 63% of live weight, i.e. the low end of the range reported in the literature. Therefore, the average edible weight of beluga

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[32] Berger, Thomas, R., Mr. Justice. 1977. *Northern homeland northern frontier: the report of the Mackenzie Valley Pipeline Inquiry: volume 2*. Supply and Services Canada, Ottawa. Cited in Ashley, 2002.

[33] Ewan Cotterhill & Associates Inc. 1986. Arctic compensation study. Prepared for Department of Indian Affairs and Northern Development. June 1986. Cited in Ashley, 2002.

[34] Personal communications with John Hicks, November 18, 2009 and Jevua Maniapik, Pangnirtung HTA, November 17, 2009.

[35] Personal communication with John Hicks, November 18, 2009.

[36] Based on Mr. Hicks information that muktuk comprises 30-35% of the reported 40-45% live weight for the outer dermis, skin and blubber combined, muktuk as a percentage of live weight, is estimated at 14% of total live weight (40+45/2=43 x 30%=13% and 40+45/2=43 x 35%=15% ).

harvested by Pangnirtung hunters from the Cumberland Sound population is estimated at 378 kgs. (600 kgs. average animal live weight x 63%).

## 2.4 Edible Weights for Human and Dog Food Purposes

Based upon the literature and information provided by Nunavut Inuit contacted in the research, the allocation of the average/animal edible weight value (378 kgs.) to human and dog consumption is estimated at 170 kgs. and 208 kgs., respectively (see Table A4 below). The edible weight estimate value of 170 kgs/animal for human consumption indicates that 44% of the live weight is used for human consumption, a figure that is consistent with the work by Usher (2000). His work determined that edible weight for human food consumption was about 40% of total live weight.

TABLE A4: EDIBLE WEIGHT OF AVERAGE BELUGA

| | Edible Weight Proportions by part of animal | Edible Weight (kgs.) based upon a Total Live Weight/Animal 600 kgs. * 63% | Human Consumption | | Dog Food | |
|---|---|---|---|---|---|---|
| | | | % of Edible Weight Consumed | Kgs. Edible Weight | % of Edible Weight consumed | Kgs. Edible Weight |
| | A | B=A*378 kgs. | C | D=B*C | E | F=B*E |
| Outer Dermis & Skin -Muktuk | 14%/25% | 378*25%=95 kgs. | 100% | 95 | 0% | 0 |
| Loin Meat & Flippers | 23%/40% | 378*40%=151 kgs. | 50% | 75 | 50% | 76 |
| Organs, some blubber | 20%/35% | 378*35%=132 kgs. | 0% | 0 | 100% | 132 |
| TOTALS | 57%/100% | 378 kgs. | | 170 | | 208 |

Column A: Edible weight to live weight portions shown on left, and adjusted edible weight portions shown on right.

Column B: Live weight (600 kgs.) x 63% = 378 kgs./animal edible weight multiplied by percentages of different "cuts" of edible weight.

Columns C & E: 35% of outer dermis, skin and blubber is eaten as muktuk and balance (65%) is blubber fed to dogs (shown in Column E). Model estimates that choice meats and flippers make up 50% of total edible weight of loin meat+flippers+organs and balance (50%) comprised or organs, less choice meats are fed to dogs (Column E).

The annual quantity of food available from the Pangnirtung Inuit harvest of the Cumberland Sound beluga population, based upon an annual quota of 41 animals, is estimated at 15,498 kgs. of which 6,970 kgs. is estimated to be used for human consumption and 8,528 kgs. for dog feed. The total volume of beluga muktuk and meat available for human consumption annually equates to approximately 5 kgs/capita/year or just less than 0.1 kgs/capita/week.[37] There are currently

[37] According to the 2006 Census, the Pangnirtung Hamlet population was 1,325, of which 94% (1,240) self-identified as Aboriginal persons. http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/92-591/details/Page.cfm?Lang=E&Geo1=CSD&Code1=6204009&Geo2=PR&Code2=62&Data=Count&SearchText=p

about five individuals who have dog teams in the community.[38] Assuming each dog team owner has an average of 10 dogs, it is estimated there are about 50 sled dogs. The total volume of organs and meat available for dog feed equates to approximately186 kgs/dog/ year or about 0.47 kgs/dog/day.[39] Both cross-checks indicate that the estimates of food product available are reasonable.

## 3.0 VALUE OF BELUGA

Beluga muktuk, meat and blubber products are not available in the general wholesale or retail market in Canada, nor are they formally marketed within the Hamlet of Pangnirtung. That is to say, there is no established market or market value for beluga which can be drawn upon to impute a monetary value of beluga as a food source. There is limited inter-community trade of belugas in Pangnirtung, however it is very informal and prices asked are generally based upon individual hunters attempting to cover some of their hunting costs.

The following discussion and analysis is based upon the use of a replacement cost approach for assessing the economic value of beluga as a source of country food for Pangnirtung Inuit.

### 3.1 Substitute Products for Beluga Human Consumption

The replacement or substitution cost approach involves using the monetary value of a "like" commodity that is available in the market as a proxy for the value of the commodity (in this case beluga) that is not in the market. As Usher (1976) points out, identifying appropriate substitute market commodities is complex and involves considering taste preferences, nutritional equivalency, and the availability and local price of substitute commodities.

Apart from muktuk from other whale species (e.g. Narwhal), which also are not available in the market place, a "like" equivalent for beluga muktuk in terms of cultural preference likely does not exist amongst domestically grown and marketed food products. Therefore this analysis focuses exclusively on nutritional equivalency as a means of identifying appropriate substitute products for beluga muktuk and meat.

As illustrated in Table A5, raw muktuk (as it is commonly eaten) has slightly higher protein and slightly lower fat content than the comparison meat and fish products. The energy content (kCalories) of raw muktuk is similar to the meat and fish products. Muktuk contains extremely high levels of Retinol (Vitamin A) which are not found in beef or pork, and in much lower levels

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angnirtung&SearchType=Begins&SearchPR=62&B1=All&Custom= Per capita/year calculation determined as 6,970 kgs/year divided into 1,240 people. Per capita/week calculation determined as 6,970 kgs/1,240 population/52 weeks.

[38] Personal Communication with Jevua Maniapik, Pangnirtung HTA, November 17, 2009.

[39] 8,528 kgs./50 dogs = 170 kgs./dog/year divided by 365 days = .47 kgs/dog/day. The amount of blubber fed to dogs is unknown.

TABLE A5: Nutrient Values of Beluga and Other Comparable Food Products (Values per 100 g of edible portion)

| Nutrient name | Unit | Boiled Muktuk | Raw Muktuk | Dried Beluga Meat | Raw Beluga Meat | Beef, composite cuts, steak, lean and fat | Pork, fresh loin, sirloin roast, boneless, lean and fat, raw | Chicken, breast, meat only raw | Arctic Char, skin off, raw | Atlantic Salmon, Wild, Raw | Raw Florida Orange | Raw Carrot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Food Code #** | | 5767 | 5766 | 5769 | (1) | 6170 | 1921 | 891 | 3230 | 3049 | 1617 | 2380 |
| **Proximates** | | | | | | | | | | | | |
| Moisture | g | 61.000 | 68.500 | 22.000 | 72.500 | 67.800 | 59.120 | 75.240 | 77.000 | 68.500 | 87.140 | 88.290 |
| Protein | g | 24.000 | 24.500 | 72.000 | 26.500 | 20.710 | 33.020 | 22.340 | 19.500 | 19.840 | 0.700 | 0.930 |
| Total Fat | g | 10.000 | 5.500 | 5.200 | 0.500 | 10.430 | 6.850 | 1.650 | 2.650 | 6.340 | 0.210 | 0.240 |
| Energy (kcal) | kCal | 203.000 | 154.000 | 356.000 | 111.000 | 185.000 | 208.000 | 110.000 | 103.000 | 142.000 | 46.000 | 41.000 |
| **Minerals** | | | | | | | | | | | | |
| Calcium, Ca | mg | 14.000 | 6.000 | 7.000 | 7.000 | 8.000 | 5.000 | 11.000 | 9.000 | 12.000 | 43.000 | 33.000 |
| Iron, Fe | mg | 1.200 | 0.450 | 57.000 | 25.900 | 1.970 | 3.550 | 0.890 | 0.500 | 0.800 | 0.090 | 0.300 |
| Magnesium, Mg | mg | 23.000 | 20.000 | 68.000 | 22.000 | 22.000 | 26.000 | 25.000 | 30.000 | 29.000 | 10.000 | 12.000 |
| Phosphorus, P | mg | 145.000 | 166.000 | 582.000 | 239.000 | 176.000 | 202.000 | 223.000 | 266.000 | 200.000 | 12.000 | 35.000 |
| Potassium, K | mg | 371.000 | 325.000 | | 283.000 | 308.000 | 324.000 | 252.000 | 309.000 | 490.000 | 169.000 | 320.000 |
| Sodium, Na | mg | 90.000 | 110.000 | 91.000 | 78.000 | 63.000 | 59.000 | 51.000 | 61.000 | 44.000 | 0.000 | 69.000 |
| Zinc, Zn | mg | 8.000 | 7.200 | 8.900 | 2.760 | 5.500 | 8.420 | 0.660 | 0.500 | 0.640 | 0.080 | 0.240 |
| Copper, Cu | mg | 0.060 | 0.100 | 0.200 | 0.113 | 0.070 | 0.100 | 0.038 | 0.085 | 0.250 | 0.039 | 0.045 |
| Manganese, Mn | mg | 0.010 | 0.006 | 0.050 | 0.046 | 0.013 | 0.016 | 0.017 | 0.010 | 0.016 | 0.024 | 0.143 |
| Selenium, Se | µg | 650.000 | 200.000 | | 36.500 | 18.800 | 26.500 | - | 10.000 | 36.500 | 0.500 | 0.600 |
| **Vitamins** | | | | | | | | | | | | |
| Retinol activity equivalents, RAE | µg | 649.000 | 649.000 | 307.000 | 102.000 | 0.000 | 0.000 | 8.000 | 17.000 | 12.000 | 6.000 | 602.000 |
| Vitamin C | mg | 23.600 | 36.000 | 1.100 | 0.000 | 0.000 | 0.000 | 1.200 | 1.200 | 0.000 | 45.000 | 5.900 |

**(1) Source United States Department of Agriculture, National Nutrient Database for Standard Reference http://www.nal.usda.gov/fnic/foodcomp/search**
**Source for all other data: Canadian Nutrient File (CNF) http://webprod.hc-sc.gc.ca/cnf-fce/index-eng.jsp**

in chicken and fish. Muktuk contains slightly more Retinol than found in a medium sized carrot. Muktuk also contains a high level of Vitamin C which is not found at all in domestically raised livestock and in low quantities in fish. One hundred grams of muktuk has about 80% of the Vitamin C found in a fresh orange (100 grams). Thus, from a nutritional perspective, muktuk is a high protein, low fat food source similar to beef, pork, chicken and fish, but with the additional benefit of high sources of Retinol and Vitamin C. A meal of muktuk provides the nutritional equivalent of a meal of meat/fish, a small orange and a medium sized carrot, so to speak.

For purposes of this analysis, it is proposed that a nutritional substitute for muktuk would include a food basket of boneless, fat trimmed beef, pork and chicken cuts (similar protein and fat content), and oranges and carrots (to account for Retinol and Vitamin C) as follows:

| 1 kg. raw muktuk | Nutrient Substitution Basket | |
|---|---|---|
| | .33 kgs. beef | Similar protein, fat and calories |
| | .33 kgs. pork | |
| | .33 kgs. chicken | |
| | 1.0 kg. carrots (similar Retinol values) | |
| | .80 kgs. oranges (1 kg. Muktuk has 80% of Vitamin C content as 1 kg. of oranges | |

Beluga meat has similar protein characteristics as beef, pork and chicken and slightly higher protein content than fish. Due to the much lower levels of fat in beluga meat, caloric content is lower than beef, pork, salmon and char. As shown in Table A5, raw beluga meat is most similar to chicken (breast, meat only) in terms of nutrient composition, with the exception that it also contains significant levels of Retinol. For purposes of this analysis, it is proposed that a nutritional substitute for beluga meat is chicken (breast, skin/bones removed).[40]

### 3.2 Substitute Products for Beluga Used for Dog Feed

As discussed above, the beluga harvest provides Pangnirtung Inuit with a ready supply of dog food. It was noted that portions of the blubber, organ meat and some of the less desirable cuts of the meat are fed to dogs. It was also noted that they are an estimated 50 sled dogs (5 teams of an average of 10 dogs each) which are fed beluga products.[41] For purposes of this analysis, it will be assumed that commercial dry dog feed is a suitable substitute for beluga blubber and meat.

Table A5 above indicates that raw beluga meat has 1110 kCal/kg (111 Kcal/100 grams) comprised of approximately 1,060 kCal of protein (4 kCal/gram x 26.5 grams protein/100 grams x 10) and 45 kCal of fat (9 kCal/gram x 0.50 grams fat/100 grams x 10). Data concerning the nutrient content of beluga blubber is not available, therefore animal lard nutritional content is

[40] Iams Dog Food. http://www.iams.com/iams/premium-pet-food/large-breed-dog-food.jsp#nutritionInformation

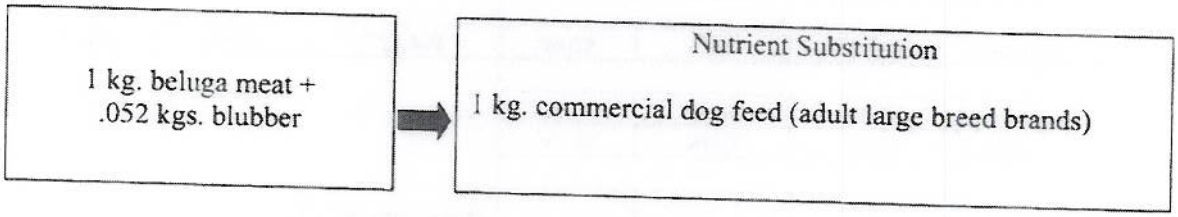
[41] There are likely many more dogs in Pangnirtung which are household pets. For the purposes of this analysis, it has been assumed that beluga is largely used as feed by individuals who have dog teams.

used as a proxy. Animal lard has about 9 kCal/gram and therefore a kg. of blubber is estimated to contain 9,000 kCal in fat (9 kCal/gram x 1000).[42]

A quick internet search for the nutrient content of commercial dog feed yielded the following information from the Aimes website. Iams ProActive Health Large Breed dog food contains 3,588 kCal per kg. of which 1,345 kCal comes from protein and fat (825 Kcal are from protein and 520 kCal are from fat, balance comes from carbohydrates).[43]

The above information suggests that about 1 kg. of beluga meat and .0528 kgs. of blubber contains the same caloric content of protein and fat found in commercial dog feed. To meet the same fat caloric content as commercial dog feed/kg., approximately 0.0528 kgs. of beluga blubber (yields 475 kCal) would have to be added to the beluga meat, i.e. 1 kgs. beluga meat + .0528 kgs. beluga blubber provides a total of 1,585 kCal/kg (1 kgs. beluga meat = 1110 kCal and .0528 kgs. beluga blubber provides 475 kCal).

For purposes of this analysis, it is proposed that a nutritional substitute for beluga meat and blubber used as dog food is commercial dog as follows.




### 3.3 Monetary Values of Substitute Products

For this analysis, average Canadian reported prices for human food products identified as substitutes for beluga, adjusted for higher prices in Pangnirtung, are employed. Statistics Canada reports on average retail prices for an extensive list of food items on a monthly basis, with the most recent data reported for September, 2009.[44] Based upon these prices, the substitute values for beluga muktuk and beluga meat, for human consumption, are shown in Table A6.

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[42] Canadian Nutrient File. http://webprod.hc-sc.gc.ca/cnf-fce/serving-portion.do?lang=eng&id=464 Pork Lard, Food Code 464.

[43] Iams Dog Food. http://www.iams.com/iams/premium-pet-food/large-breed-dog-food.jsp#nutritionInformation

[44] Statistics Canada, Catalogue 62-001-XIE, "Food and Other Selected Items, Average Retail Prices."

TABLE A6: Average Retail Prices of Substitute Products for Beluga Consumed by Humans

| Substitute Food Items | MUKTUK REPLACEMENT VALUES | | | BELUGA MEAT REPLACEMENT VALUES | | |
|---|---|---|---|---|---|---|
| | Average Retail Price $/Kg. | Basket Adjustments | Adjusted Price/Kg. | Average Retail Price $/Kg. | Basket Adjustments | Adjusted Price/Kg. |
| Beef: | | | | | | |
| Round Steak | $12.56 | | | | | |
| Sirloin Steak | $16.55 | | | | | |
| Prime Rib Roast | $21.82 | | | | | |
| Blade Roast | $13.34 | | | | | |
| Stewing Beef | $9.83 | | | | | |
| Average Beef | $14.82 | 33% | $4.89 | | | |
| Pork: Pork Chops | $9.60 | 33% | $3.17 | | | |
| Chicken | $6.34 | 33% | $2.09 | $14.82[45] | 100% | $14.82 |
| Oranges | $2.76 | 80% | $2.21 | | | |
| Carrots | $1.54 | 100% | $1.54 | | | |
| Proxy Value of 1 Kg. Muktuk= | | | $13.90 | Proxy Value of 1 Kg. Beluga Meat= | | $14.82 |
| Substitution Value of 1 kg. Muktuk in Pangnirtung ($ price x 2) | | | $27.80 | Substitution Value of 1 kg. Beluga Meat in Pangnirtung | | $27.80 |

The substitute values in Table A6 above are inflated by a factor of two to reflect higher retail prices in Pangnirtung. According to Indian and Northern Affairs Canada, the average cost of a basket of perishable foods in Pangnirtung is twice the cost of the same basket in Ottawa.[46]

The final step in estimating net replacement values is to convert gross values to net values to account for production costs associated with beluga harvesting activities. GSGislason and Associates Ltd. (2003) assessed the gross monetary value of the edible portion of beluga

[45] Statistics Canada only reports a single blended price for all chicken prices. Since there is no price specific to chicken breasts (chosen nutrient equivalent for beluga meat), the basket price for muktuk is used as a price for chicken breast.

[46] Weekly cost of the Revised Northern Food Basket for a Family of Four, Baffin Region, 2008. www.ainc-inac.gc.ca/nth/fon/fc/rgrs-eng.asp A number of other sources indicate that food prices in Nunavut are approximately twice the average price across Canada. For example, Rogan (2003) reports the average cost of food in Nunavut is double the cost in southern Canada and suggests that the purchasing power of a dollar in southern Canada costs $2.01 in Pangnirtung. Statistics Canada (2007) reported that the average food expenditure by household in Canada during 2007 was $7,305 and for Nunavut it was almost twice at $14,057.

harvested by Inuvialuit Inuit using the replacement cost method and then adjusted this figure to a net value by deducting 25% to account for the costs associated with harvesting (based upon the work of Usher, 1976).[47] For purposes of this SE analysis, net values are calculated as 75% of gross replacement values.

The estimated gross and net replacement values of beluga used for human consumption for an average beluga total $4,726 and $3,545, respectively, as shown in Table A7.

TABLE A7: Estimated Value of Single Beluga as Food for Human Consumption

| | Kgs. Edible Meat/Beluga (from Table A4) | Substitute Price/Kg. (from Table A6) | Gross Value ($) Per Beluga | Net Value ($) Per Beluga |
|---|---|---|---|---|
| | A | B | C=A*B | D=C*75% |
| Muktuk | 95 | $27.80 | $2,641 | $1,981 |
| Meat | 75 | $27.80 | $ 2,085 | $1,564 |
| TOTAL | 170 | | $4,726 | $3,545 |

For this analysis, average reported internet prices for Iams dog food are used as a proxy for the value of the beluga meat and blubber used as dog food, adjusted by a factor of two for higher prices in Pangnirtung. The average retail price for Iams Proactive Health Large Breed Dogs is the range of $34.99-$38.99/40 lbs. bag (U.S. dollars).[48] This equates to about $37.44 to $41.72/40 lbs. bag in Canadian dollars (using exchange rate of $1.07), or an average of $2.18/kg. [37.44+41.72/2=$39.58/18.143 kgs/40 lbs=$2.18/kg]. Doubling this price to $4.36/kg. provides an estimate of the cost of this brand of dog food in Pangnirtung as shown in Table A8. Production costs are not deducted as they are largely accounted for in Table A7 above.

TABLE A8: Estimated Value of Dog Food Component of a Single Beluga

| | Kgs. Edible Meat/Beluga | Substitute Price/Kg. | Value ($) Per Beluga |
|---|---|---|---|
| Meat | 208[1] | $4.36 | $907 |
| Blubber | 3.4[2] | | |

[1] From Table A4
[2] 0.052 kgs/kg blubber to meet fat content of commercial dog feed.

[47] Usher, Peter J. "Evaluating Country Food in the Northern Native Economy", *Arctic* Vol. 29 No 2: 106-120, 1976.
[48] www.PetSmart.com; www.sortprice.com

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# APPENDIX B: Literature Findings on Non-Use/Passive Values

## Analysis of Factors Influencing Non-Use/Passive Values

At the Scoping Stage, it was proposed that the work of Rudd (2007) would be relied upon to provide a perspective on what the range of non-use/passive values could be for Cumberland Sound belugas under baseline and listing circumstances and to gain a better understanding of how these values may impact the determination of net present value in a cost-benefit analysis.

Additionally, it was proposed that Rudd's work would assist in assessing the accuracy of the assumptions presented at the Scoping Stage. To gain a better understanding of some basic characteristics of non-use/passive values in the context of a *SARA* listing and recovery initiatives setting, it was indicated that Rudd's work would be reviewed with a number of questions in mind. Since the Scoping Stage a second relevant study done by Olar et.al. (2007) has been identified which pertains specifically to marine mammals. Where relevant, the findings of this study are included in the discussion below.

Rudd (2007) conducted an internet-based survey in 2006 specifically designed to assess non-use values and factors that influence WTP in context of *SARA* listing and recovery circumstances. Specifically he set out to determine: (1) does WTP for aquatic species at risk vary amongst different segments of Canadian society?; (2) What program attributes influence Canadian citizens' WTP for *SARA* conservation initiatives?; and (3) What is the proper geographic scope of analysis for assessing passive use benefits of conservation for select regional aquatic species at risk? He employed a stated-preference valuation method to quantify WTP using a "choice experiment" survey instrument.[49] The survey involved Canadians from all parts of the country however individuals from Atlantic Canada were deliberately over-sampled. A total of 3,983 individuals visited the survey website and 2,761 valid and complete surveys were assembled. Rudd's study focused on six aquatic species that were either already listed under *SARA* or were proposed at the time to be listed. Four of the species are found only on the Atlantic coast (Atlantic salmon, Atlantic whitefish, North Atlantic right whale, and porbeagle shark), one on both the Atlantic and Pacific coasts (leatherback turtle), and one only on the Pacific coast (white sturgeon).

Rudd's study also examined how WTP was influenced by various factors, including:

- Whether the listing status of species in question would change as a consequence of the listing and recovery program initiative, e.g. the species would retain an endangered designation despite the listing, the species would be improved to threatened status;
- Whether the listing of the species was predicted to increase the population of the species in question during the recovery period (e.g. by 50%, 100%, 200% );

[49] "Choice experiment" refers to survey questions being designed in a way that requires the survey participant select a preferred choice from among supplied options.

- The probability that the recovery of the species would be successful (i.e. 50%, 75% or 100% successful).

Olar et.al. (2007) conducted a study similar to that of Rudd, which focused exclusively on three marine species in the St. Lawrence Estuary (beluga, harbour seal and blue whale). The study was designed to identify the tradeoffs that Canadians make between different conservation program options including costs, with their choices implicitly revealing estimates of the economic value Canadians place on marine mammal recovery in the St Lawrence Estuary and as such provide measures of the economic benefits of species at risk recovery plans. This study involved a survey sample of 2,006 Canadians; however, in order to examine regional differences, the province of Quebec was over-sampled by 400 respondents. With the exception of reporting on regional differences, the findings are reported for a data set representative of all Canadians (comprised of 1,606 respondents, including a representative sample of 367 respondents from Quebec).

Question #1: Are there differences in WTP among different segments (geographic, age, gender, income, etc.) of the population?

Rudd[50] organized the survey respondents in his study into seven segments or groups based upon their responses. That is, the groups do not specifically reflect homogeneous traits such as age, gender, geographic location, income, etc. Apart from two groups which had clusters of younger people, the demographic characteristics of all the remaining groups are not evident. What the Rudd report does indicate is that there are differences in WTP values among different segments of society as illustrated below.

| Ranking (Lowest to Highest WTP Values) | Group # | Segment/Group Name | Proportion of Total Sample | Characterization of Group |
|---|---|---|---|---|
| Lowest | 1 | Young and Frugal | 16.5% | A group of younger than average respondents willing to pay for conservation of any species, irrespective of anticipated recovery performance. |
| Slightly higher than Group 1, but with similar WTP values. | 2 | Conditional Supporters | 18.0% | a group characterized as being open to all forms of species conservation but needing to know that the conservation effort would result in more than trivial results before they are willing to support and pay for the initiatives. |
| | 3 | SARA Skeptics | 6.3% | a group including respondents somewhat older than average who are WTP only for specific programs. |

[50] Unless otherwise referenced, the reference to Rudd's study pertaining to the discussion in Questions 1-8 is "Valuation of the Social and Economic Benefits of Marine Resources." http://www.swgc.mun.ca/research/evpl/Documents/Canadian_Parks_Council_(Ma_%2027_2007).pdf. It is noted that this report collapsed the 9 respondent categories to 7 categories.

| Ranking (Lowest to Highest WTP Values) | Group # | Segment/Group Name | Proportion of Total Sample | Characterization of Group |
|---|---|---|---|---|
| WTP values about 4x greater than Group 1 and 3x greater than Groups 2 & 3. | 4 | Young and Free Spending | 23.9% | a group with respondents younger than average, with a slightly higher proportion of Quebec residents and French speakers |
| WTP values slightly higher than Group 4. | 5 | No New Tax Advocates | 6.3% | a group of respondents with significantly higher incomes, who support conservation efforts so long as it is done through reallocation of existing tax dollars. |
| WTP values 10x greater than Group 1 and about 45% higher than Group 5. | 6 | Unconditional Supporters | 20.8% | a group most likely to include people from Atlantic Canada and least likely from the Prairies, and including people who are older, with higher incomes. |
| WTP values similar to Group 6, but highest values placed on fish species. | 7 | Atlantic Salmon Fishers | 8.3% | a group which included individuals who indicated they had or were planning to fish for salmon, and which were significantly older than the sample average, yielded the highest WTP values for the three fish species addressed in the study, but lower values for the other species. |

Olar et.al. (2007) reported "Older people tend to vote more favourably towards species recovery programs relative to younger people and people with college and university diplomas are also more likely to choose the proposed programs. Income also has a positive impact up to a certain threshold (around $55,000/year/household) but once the threshold is passed it becomes insignificant, suggesting that willingness to pay does not increase with income once households earn more than $55,000/year." They also reported that "... active participation in environmental organizations does not have a significant impact on the willingness to recover marine species at risk" and ".... Quebec respondents voted less favourably toward recovery of the St. Lawrence Estuary marine mammals than Canadians from other provinces..." Finally, their study indicated that women have a lower propensity to vote for species recovery programs than men.

Question #2: Is there a relationship between WTP and the species subject to recovery efforts, i.e. are people WTP more/less depending upon the species being listed?

Rudd's study found that the most significant factor influencing WTP values is the species under consideration. All of the seven respondent groups in his study demonstrated they would be WTP higher amounts for their preferred species than for their less preferred species. Among the six species included in the survey, the total survey indicated the highest mean WPT value for Atlantic salmon and the second highest WTP was for Atlantic Right whale (72% of mean WPT for salmon). The remaining four species had WTP values that were less than 50% of the mean WPT for salmon.

Importantly, WTP values differ among species, even when the species is identified as a preferred species. For example, the respondent categories that identified leatherback turtle or Right whale

as their preferred species yielded mean WTP values lower than the respondent categories that identified salmon as their preferred species.

Species preference and WTP values were also found to be influenced by the values of different segments of society. For example, the respondent group that included salmon fishers yielded the highest WTP value for salmon, indicating their WTP is higher for species that have some recreational value. The respondent group identified as "unconditional supporters" yielded high WTP values for all species, whereas the groups identified as "SARA skeptics" and "Young and Frugal" yielded low WTP value for all species.

Rudd concluded that the economic value of benefits of conservation will run in the tens of millions of dollars annually for relatively low profile aquatic species and into the range of hundreds of millions of dollars annually for high profile aquatic species.

The Olar et.al. (2007) study found that Canadians were WTP a mean value 23% higher ($107/household/year) to support a recovery program that only addressed beluga than a program that only addressed habour seal recovery ($82/household/year). The authors' Canada-wide estimate of WTP for programs that would increase the St. Lawrence Estuary beluga population to a point where it was downgraded from threatened to species of concern was in the order of $123.7 million/year.

Question #3: Is there a relationship between WTP and the probability of a successful recovery program?

Rudd's research found that WTP was influenced positively if the recovery program for the listed species was predicted to have a high probability of success, regardless of the species in question. All seven respondent groups indicated higher WTP for recovery programs that would have the highest levels of success. Of all of the conservation program attributes, the probability of program success was the most important factor influencing WTP. Probability of a successful recovery program was the second highest factor influencing WTP, next to species preference.

Question #4: Does WTP change as the abundance of the species improves over the recovery period?

Rudd's study looked at variations in WTP where the species population recovery was indicated at different levels (50% to 200% increase in population by end of recovery period). The degree of population increase under the recovery period was not identified as a major (statistically significant) influencing factor for WTP across the entire sample, although the mean WTP for increases in population abundance was higher if the population would increase by 200% than the lowest range (50%). Olar et.al. (2007) reported that people are WTP more for programs that contribute to greater increases in marine mammal populations.

Question #5: Is there a relationship between WTP and the listing category (endangered, threatened, special concern), e.g. are people WTP more/less for recovery programs for species listed as endangered versus threatened?

Rudd's study only considered species that were listed or proposed to be listed as endangered. He did however look at variations in WTP where as a consequence of the listing and recovery program the status of the target species would remain the same or would be upgraded to a less serious designation (e.g. improved to threatened status). A change in listing status was not identified as a major (statistically significant) influencing factor for WTP across the entire sample, although WTP for an upgrade in listing status was higher if the species improved from threatened to endangered. This suggests that the status of the species at the time of listing may not be a significant factor in WTP.

Olar et.al. (2007:34) found that WTP is highest for improvements that result in a species risk status being downgraded (e.g. from threatened to special concern), but WTP extra for additional improvements that result in delisting to "not at risk" are not significant. The report concludes that "Canadians want to make sure that species are not "threatened", but they are not willing to pay a great deal more to move them beyond that level to the "not at risk" status."

Question #6: Is there a relationship between WTP and recovery time, i.e. are people WTP more annually for a program that results in recovery of the species in fewer years?

This issue was not addressed in either the Rudd or Olar et.al. studies, although in the latter study the survey respondents were aware that the recovery period for the various recovery programs was 50 years.

Question #7: Are there differences in WTP if a recovery program is directed at a species that is designated as threatened in several geographic regions, but the recovery effort is targeted to one region only?

Neither the Rudd nor Olar et.al. studies specifically addressed this question. Olar et.al. reported that about 78% of respondents were concerned about the marine mammals at risk in the St. Lawrence Estuary, while the percentage was almost the same (76.5%) for those concerned about marine mammals at risk elsewhere in Canada.

Question #8: Are there differences in WTP if the funds to cover recovery programs are derived from a reallocation of existing tax revenue versus introduction of additional taxes?

Rudd's study examined differences in WTP depending upon whether recovery costs were based upon a reallocation of existing tax dollars or through the institution of new taxes. He found that only one respondent group (SARA skeptics) was indifferent about the funding mechanism and the balance of the survey participants expressed higher WTP values if the recovery of the species was funded through reallocation of existing tax dollars.