Heavy Metals in Soil and Edible Wild Mushrooms in the North Slave Region, Northwest Territories, Canada, and Assessment of the potential Human Health Risk from the Consumption of Edible Wild Mushrooms

Prepared by: Joachim Obst

For: Government of the Northwest Territories, Department of Industry, Tourism and Investment; Traditional Economy, Agriculture and Fisheries, Yellowknife

Revised Edition January 2014

Heavy Metals in Soil and Edible Wild Mushrooms in the

North Slave Region, Northwest Territories, Canada,

and Assessment of the potential Human Health Risk

from the Consumption of Edible Wild Mushrooms

The contents of this report are the sole responsibility of the author:

Joachim Obst, P. O. Box 1888, Yellowknife, NT, X1A 2P4, Canada;
obst100@gmail.com

Cover photograph: Red-capped Bolete (*Leccinum aurantiacum*)
growing in the City of Yellowknife; J.Obst.

EXECUTIVE SUMMARY

The analysis of potential contaminants in edible wild mushrooms is a requisite for the safe consumption of fungi by people in the Northwest Territories (NWT). From 1997 – 2009, 124 samples of wild fungi and 68 samples of soil in which they grew, as well as 16 wood samples, were collected in the North Slave region, NWT, and analyzed for 26 heavy metals. For comparison, 17 fungi- and 10 wood samples from other regions also were analyzed. The samples of fungi represent small populations of the observed most commonly consumed mushrooms. The report provides the results of the analyses and human health risk assessments on the intake of arsenic, lead, cadmium and mercury by residents, through the consumption of local wild fungi.

Mean levels of total arsenic in surface soil are 519.8 µg/g (range 9.9 – 7310 µg/g) within the city of Yellowknife and background values 4.5 µg/g (0.5 – 16.5 µg/g). Mean levels for total lead are 60.6 µg/g (3.2 – 296 µg/g) in Yellowknife and background values 3.6 µg/g (1.0 – 14 µg/g). Mean and background levels for total cadmium and mercury respectively are 0.7 µg/g Cd and 0.16 µg/g Cd, and 0.06 µg/g Hg and 0.014 µg/g Hg. Most soils in Yellowknife exceed the Canadian soil quality guidelines for arsenic but not for lead, cadmium and mercury. Levels of all four metals in soil gradually declined with increasing distances away from Yellowknife, mines and roads.

The background levels of arsenic and lead in five different types of bedrock range from very low (0 – 1 µg/g As; and <2 – 6 µg/g Pb) to extremely high (>10000 – 30000 µg/g As; and 302 – 494 µg/g Pb). The highest concentrations of arsenic and lead in bedrock occur in gold ore at the mines in the Yellowknife greenstone belt area located in the center of the study area.

The bio-accumulation of arsenic from the soil and environment to fungi is low for most families of mushrooms ranging from 0.004 – 0.5 times the levels in soil. The genus *Tricholoma* accumulates on average 7.6 (up to 202) times these levels. Mean levels of total arsenic in fungi are 89.6 µg/g dry weight (d.w.) (range 1 – 1370 µg/g) in Yellowknife, and 2.9 µg/g (0.5 – 20.3 µg/g) in backgrounds. Elevated levels of total arsenic up to 280 – 1370 µg/g are present in the genus *Tricholoma*, some *Agaricus*, *Lycoperdon*, and *Coprinus*. The levels in fungi of organic and inorganic arsenic range from 0.1 – 1.5 µg/g up to 178 and 456 µg/g DMA; 0.1 – 2.6 µg/g MMA; 0.2 – 4.7 µg/g up to 76.1 and 256 µg/g As (III); and <0.1 – 1.1 µg/g As (V). Total arsenic in fungi includes mean values of 61% organic arsenic, 22% inorganic arsenic, 17% unspecified total arsenic, and maximums of up to 89.8% inorganic arsenic and 89.5% of highly toxic arsenite (As III).

The bio-accumulation of lead from soil in many fungi comprising the sample population is low, ranging from 0.01 – 0.76 times the levels in soil, while the genus *Suillus*, *Morchella* and *Lycoperdon* accumulate lead respectively by factors of 67, 33 and 4

times these levels. Mean levels of total lead in fungi are 64.4 µg/g d.w. (0.1 – 1010 µg/g) in Yellowknife, 76.1 µg/g (0.1 – 993 µg/g) along road corridors, and 0.15 µg/g (0.1 – 0.3 µg/g) in backgrounds. Highly elevated lead levels of >100 µg/g up to 509 – 1010 µg/g are present in *Agaricus*, *Lycoperdon*, *Leccinum*, *Suillus*, and *Tricholoma* growing around Yellowknife, mines and roads. Some *Morchella* which grew near a road 65 km away from the city in 1999 also contained high lead levels ranging from 50.5 – 993 µg/g. In contrast, the levels of lead in all *Morchella* from other sites are very low with <0.1 – 0.5 µg/g. Cadmium and mercury levels were low in most fungi sampled except for elevated levels in *Agaricus*, *Amanita* and *Coprinus*.

Depending on the harvest location and species, an adult weighing 65 kg could only eat as little as 1.4 – 24.3 gram/day before exceeding the Canadian health standard for toxic inorganic arsenic; 2.3 – 35.2 g/day before exceeding the health standard for lead; and 45.6 – 92.8 g/day of meadow mushrooms (*Agaricus*) before exceeding the health standard for cadmium.

This study recommends that edible wild mushrooms growing within and around Yellowknife, mines, roads, infrastructure, and other impacted areas, should not be consumed at all even in small amounts because of their highly elevated levels of arsenic and lead.

It is also recommended to avoid the consumption of fungi growing within 30 km of Yellowknife and 1 km of roads, and to drastically limit the consumption of fungi within 30 – 50 km of Yellowknife. Edible wild mushrooms from areas further away from the city and roads are safe to consume. These findings, conclusions and recommendations are consistent with the scientific literature.

Three human health risk assessments conducted by health authorities on the intake of the four heavy metals through consumption of local fungi growing in and around Yellowknife are discussed in this paper. The final results of all samples presented here found unexpected high levels of inorganic arsenic and lead in fungi. Therefore, this paper recommends that health authorities should consider a reassessment of the potential health risks through the consumption of local fungi.

TABLE OF CONTENTS

EXECUTIVE SUMMARY………………………………………………………… iii

LIST OF FIGURES………………………………………………………………... vii
LIST OF TABLES…………………………………………………………………. viii

1. INTRODUCTION…………………………………………………………….. 1
2. OBJECTIVES………………………………………………………………… 1

3. STUDY AREA……………………………………………………………….. 2

4. METHODS…………………………………………………………………… 4
4.1. General……………………………………………………………………….. 4
4.2. Collection of Samples………………………………………………………. 4
4.2.1. Selection and Description of Samples……………………………………... 4
4.2.2. Collection Methods and Preparation of Samples before Analysis………… 6
4.2.3. Comparable Samples from Other Regions………………………………... 6

4.3. Laboratory Analysis………………………………………………………… 7

4.4. Calculation of Metal Intake through the Consumption of Fungi by Humans and Health Standards………………………………………… 9
4.4.1. Availability of Edible Wild Mushrooms for Consumption…………………… 9
4.4.2. Calculation of Metal Intake by Humans through Fungi…………………….. 9
4.4.3. Human Health Risk Assessment and Health Standards…………………… 11

5. RESULTS……………………………………………………………………... 12
5.1. Heavy Metals in Soil and Bedrock…………………………………………... 12
5.1.1. Arsenic in Soil…………………………………………………………………. 12
5.1.2. Lead in Soil……………………………………………………………………. 13
5.1.3. Cadmium in Soil………………………………………………………………. 14
5.1.4. Mercury in Soil………………………………………………………………… 15

5.2. Heavy Metals in Coniferous Trees………………………………………….. 16

5.3. Uptake of Heavy Metals from Soil by Fungi………………………………. 17

5.4. Heavy Metals in Fungi……………………………………………………… 18
5.4.1. Arsenic in Fungi……………………………………………………………… 18
5.4.2. Arsenic Speciation in Fungi………………………………………………… 19
5.4.3. Lead in Fungi………………………………………………………………….. 20
5.4.4. Cadmium in Fungi……………………………………………………………. 23

5.4.5. Mercury in Fungi…………………………………………………………… 22
5.4.6. Metal Concentrations in Age Classes and Washed Mushrooms………….. 25
5.4.7. Metal Concentrations in Poisonous Mushrooms……………………………. 26
5.4.8. Metal Concentrations in Mushrooms from Other Regions…………………. 27

5.5. Heavy Metal Intakes through the Consumption of Mushrooms and Human Health Risk Assessments……………………………………….... 28
5.5.1. Arsenic Intake through Mushrooms and Health Risk Assessment ……….. 28
5.5.2. Lead Intake through Mushrooms and Health Risk Assessment………….. 37
5.5.3. Cadmium Intake through Mushrooms and Health Risk Assessment ……. 45
5.5.4. Mercury Intake through Mushrooms and Health Risk Assessment………. 46

5.6. Other Metals……………………………………………………………….. 48

6. DISCUSSION………………………………………………………………. 49
6.1. Heavy Metals in Soil……………………………………………………… 49
6.1.1. Arsenic in Soil... 49
6.1.2. Lead in Soil... 51
6.1.3. Cadmium and Mercury in Soil.. 52

6.2. Bedrock Geology and Background Levels of Arsenic and Lead......... 53

6.3. Arsenic and Lead Levels in Plants and Organic Material..................... 57

6.4. Uptake of Heavy Metals from Soil by Mushrooms................................ 59
6.4.1. Bio-accumulation of Metals by Fungi……………………………………… 59
6.4.2. Biological Aspects of Metal Uptake by Fungi…………………………….. 60

6.5. Heavy Metals in Fungi…………………………………………………… 61

6.6. Metal Concentrations in Age Classes and Washed Mushrooms……... 65

6.7. Health Risk Assessments of Heavy Metal Intake through Mushrooms ……………………………………………………….. 65
6.7.1. Arsenic Intake through Fungi and Health Risk Assessment ……………… 65
6.7.2. Lead Intake through Fungi and Health Risk Assessment…………………. 69
6.7.3. Cadmium Intake through Fungi and Health Risk Assessment……………. 71
6.7.4. Mercury Intake through Fungi and Health Risk Assessment……………… 72
6.7.5. Health Concerns in other Countries……………………………………….. 73

6.8. Heavy Metal Toxicity……………………………………………………... 74
6.8.1. Arsenic…………………………………………………………………….. 74
6.8.2. Lead, Cadmium, and Mercury...75

6.9. Human Health Benefits from Edible Wild Mushrooms and Commerce………………………………………………………………….. 75

7. CONCLUSIONS……………………………………………………………… 77

8. RECOMMENDATIONS…………………………………………………… 81

9. PERSONAL COMMUNICATIONS………………………………………… 83

10. ACKNOWLEDGEMENTS………………………………………………….. 84

11. LITERATURE CITED……………………………………………………….. 86

APPENDICES………………………………………………………………………… 96

Appendix 1. Human Health Risk Assessments of Heavy Metal Intake through the Consumption of Edible Wild Mushrooms………… 96

Appendix 2... 100

Figures 1 – 12; Tables 1 – 5; and Tables A to J…………………………………101-178

LIST OF FIGURES

Figure 1. Sampling locations of Soil and Mushrooms in the North Slave Region, NWT……………………………………………………………… 101

Figure 2. Sampling locations of Soil and Mushrooms along the Ingraham road corridor, North Slave Region, NWT………………………………… 102

Figure 3. Sampling locations of Soil and Mushrooms within the City of Yellowknife, NWT…………………………………………………………… 103

Figure 4. Arsenic concentrations in Soil and Mushrooms, Great Slave Lake region, NWT………………………………………………………. . 104

Figure 5. Arsenic concentrations in Soil and Mushroom Families, Great Slave Lake region, NWT……………………………………………………… 105

Figure 6. Arsenic concentrations in Soil and Mushrooms near Roads,
Yellowknife region, NWT………………………………………………………………….. 106

Figure 7. Mean concentrations of Heavy Metals in Soil and Mushrooms,
Great Slave Lake region, NWT……………………………………………………………… 107

Figure 8. Lead concentrations in Soil and Mushrooms,
Great Slave Lake region, NWT……………………………………………………………… 108

Figure 9. Lead concentrations in Soil and Mushroom Families,
Great Slave Lake region, NWT……………………………………………………………… 109

Figure 10. Lead concentrations in Soil and Mushrooms near Roads,
Yellowknife region, NWT…………………………………………………………………. 110

Figure 11. Cadmium concentrations in Soil and Mushrooms,
Great Slave Lake region, NWT…………………………………………………………….. 111

Figure 12. Mercury concentrations in Soil and Mushrooms,
Great Slave Lake region, NWT…………………………………………………………….. 112

LIST OF TABLES

Table 1. Concentrations of Arsenic, Lead, Cadmium and Mercury in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 – 2009……………………...113-116

Table 1a. Concentrations of Arsenic, Lead, Cadmium and Mercury in Soil and Mushrooms from Popular Harvest Areas in the North Slave Region, Northwest Territories, 1997 – 2009……………...117-120

Table 1b. Arsenic and Lead concentrations in Mushrooms and Soil from Accessible and Popular Harvest Areas in and around Yellowknife, North Slave Region, Northwest Territories, 1997 – 2009...................................121-122

Table 1c. Arsenic and Lead concentrations in Mushrooms and Soil from Specific Popular Harvest Areas in and around Yellowknife, North Slave Region, Northwest Territories, 1997 – 2009...................................123-124

Table 2. Concentrations of Arsenic, Lead, Cadmium and Mercury in Mushrooms, Soil and Wood from Forest Fire Sites in the North Slave Region, Northwest Territories, 1998 – 2000.………………………….. 125
.

Table 3. Accumulations of four Heavy Metals from Soil to Mushrooms in the North Slave Region, Northwest Territories, 1997 – 2009…………………. 126

Table 4. Speciation of Arsenic in Mushrooms from Yellowknife, North Slave Region, Northwest Territories, 1997 – 2008…………………………. 127

Table 5. Estimated Annual Intake of four Heavy Metals through the consumption of Mushrooms by Harvesters and Residents of Yellowknife, Northwest Territories, 1998 – 1999………………………………………………. 128

Table A. Sampling Locations of Mushrooms, Soil and Wood from the North Slave Region, NWT, and from Other Regions, 1997 – 2009……………..129-132

Table A1. Concentrations of Arsenic in Soil, Wood, Fungi, Bedrock and Till in the North Slave Region, Northwest Territories, 1997 – 2009…………………133-136

Table A2. Concentrations of Lead in Soil, Wood and Fungi, and Bedrock Geology in the North Slave Region, Northwest Territories, 1997 – 2009………137-139

Table A3. Concentrations of Arsenic in Bedrock, Till and at Sampling Locations of Mushrooms, Soil and Wood Samples in the North Slave Region, Northwest Territories, 1997 – 2009………………………...140-143

Table A4. Concentrations of Arsenic and Lead in Bedrock, Till, Plants and Organic Materials in the Yellowknife Greenstone Belt Area and North Slave Region, Northwest Territories, 1997 – 2009…………………………. 144

Table B. Species List of Mushrooms collected for Heavy Metal Analyses in the North Slave Region, Northwest Territories, and comparable Mushroom Species obtained from Other Regions, 1997 – 2009………………... 145

Table C. Metal Detection Limits and Analytical Methods of Laboratory Analysis…………………………………………………………..146-147

Table D. Estimated Consumption of Mushrooms by Harvesters and Residents of Yellowknife, Northwest Territories, 1998 – 1999………………….. 148

Table E. Drying Ratios of Mushrooms from the North Slave Region, Northwest Territories, 1997 – 2008………………………………………………. 149

Table F: Metal Concentrations (Aluminum to Cesium) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in Mushrooms from Other Regions, 1997 – 2009……………………………………150-154

Table G: Metal Concentrations (Chromium to Manganese) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 – 2009……………………..155-159

Table H: Metal Concentrations (Mercury to Strontium) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 – 2009……………………..160-164

Table I: Metal Concentrations (Thalium to Zinc) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 – 2009……………………..165-169

Table J: Concentrations of 26 Metals in Wood Samples from Forest Fire Sites in the North Slave Region, Northwest Territories, and from Alaska, 1997 – 2001……………………………………………………170-178

Heavy Metals in Soil and Edible Wild Mushrooms

in the North Slave Region, Northwest Territories, Canada,

and Assessment of the potential Human Health Risk

from the Consumption of Edible Wild Mushrooms

1. INTRODUCTION

The analysis of potential contaminants in edible wild mushrooms is a requisite for the safe consumption of fungi by people. In the Northwest Territories (NWT), wild mushrooms are used privately by residents and visitors, and as a commercial product sold locally and for export. Increasing interest in harvesting and consuming northern fungi prompted J. Obst to instigate an investigation of heavy metals in edible wild mushrooms in 1997, with collections and metal analyses continuing through 2009.

This paper provides a review of the baseline data and human health risk assessments in regard to the intakes of arsenic, lead, cadmium and mercury through the consumption of edible wild mushrooms growing in the Yellowknife area and in the North Slave region, NWT.

2. OBJECTIVES

Samples were collected in the Yellowknife area and in the North Slave region to:

- determine concentrations of heavy metals in soil and fungi;
- compare the human intake of heavy metals through the consumption of fungi to national health standards;
- present the results to health authorities for a human health risk assessment; and
- inform the public about the results of this study and the human health risk assessment.

3. STUDY AREA

1) Mushroom and soil samples were collected in the North Slave region at 106 locations in a study area of about 400 km x 150 km (Figure 1). The core of the study area is centered roughly on the city of Yellowknife (population about 20,000). From west to east, the study area stretches along a corridor formed by Highways # 4 and # 3 from 100 km south of Behchoko to Yellowknife and along the Ingraham Trail road to Tibbitt Lake (total of 260 km). In addition, four assumed unspoiled background areas were sampled in distances of 50 km southeast, 110 – 140 km southwest, 100 km northwest, and 240 – 300 km northeast of Yellowknife (Figures 1 – 3).

Sampling locations represent:

a) the known spatial extent of harvest activities by local people (Figure 2);

b) popular harvest areas of mushrooms known to be exposed to emissions in and around Yellowknife (e.g., old town meadow, Jolliffe Island, Frame Lake area, forest around the YK golf course, road sides, and areas around Con mine, Giant mine, and Treminco mine (also called Ptarmigan mine) (Figure 3);

c) popular harvest areas potentially impacted by emissions in and around Yellowknife (e.g., sewage road area, Vee Lake area, Yellowknife River Park; Figure 3);

d) popular harvest areas in assumed less impacted areas 30 – 140 km away from Yellowknife, and 0.1 – 3.3 km away from roads (e.g., along the Ingraham Trail, Prelude Lake Nature Park, Camp Antler, Cameron River Park, Tibbitt Lake, and areas south of Behchoko; Figures 1 and 2);

e) control sites in known unspoiled background areas 50 – 300 km away from Yellowknife (Figure 1); and

f) a diversity of environments, habitats, and species of mushrooms.

2) The majority of the study area is typical subarctic boreal forest of the Canadian Shield, covered with numerous lakes, streams and rock outcrops, and underlying permafrost in many places. Two sites in the north-eastern part consist of low arctic dwarf shrub heath tundra and sandy eskers. The five different bedrock formations found in the study area include archean mixed rocks, granitoid rocks, volcanic rocks, sedimentary rocks, and metamorphic rocks.

During the past 70 years, five gold mines have operated in the center of the core study area including the now abandoned Giant, Con, Negus, Crestaurum and Treminco (also called Ptarmigan) mines. Exploration and smaller gold mining operations also occurred in the eastern part of the study area, including the east side of the Yellowknife Bay (Burwash area) and the Ingraham Trail road area (e.g., Cassidy Point, Hidden and Tibbitt lakes) (Figure 2). Several additional abandoned gold mines are present in the North Slave region.

Mining of the gold bearing and arsenic-rich ore in the Yellowknife greenstone belt area caused elevated levels of arsenic and other elements in the soil of the surrounding environment (Kerr 2006; ESG 2001a). However, elevated levels of arsenic and other elements naturally existed in both bedrock and soil prior to exploration and mining activities (for more details see Section 6.2).

4. METHODS

4.1. General

Standard methodology for heavy metal studies of fungi were employed, following Bargan *et al.* 1998; Garcfa 1998; Melgar *et al.* 1998; Zurera *et al.* 1998; Falandysz and Chwir 1997; Vetter and Berta 1997; Kalac *et al.* 1996; Pop and Nicoara 1996. For the assessment of heavy metals in fungi and potential related health risks for local consumers, it was required to replicate the activities of resident mushroom harvesters by accompanying and interviewing them in the field and assessing their harvest.

From 1985 – 2009, more than 400 individual residents, 120 tourists and their guides, were accompanied by the author of this paper together with local hobby mushroom experts during almost annual mushroom harvesting trips or commercial harvests in the Yellowknife area (e.g., Obst and Brown 2000; B. Kosta pers. comm. 1990 – 2000; U. Daniel-Kosta pers. comm. 1990 – 1995; W. Brown pers. comm. 1998 – 2009; V. Sterenberg pers. comm. 2000 – 2009). Typical activities of harvesters were identified and 26 long-time harvesters were interviewed. Recorded were harvest locations, weights of harvested mushrooms, and estimated annual consumption per person of individual species of fungi from different locations. Based on this information, a consistent protocol was designed for the collection of mushrooms and the soil in which they grow.

4.2. Collection of Samples

4.2.1. Selection and Description of Samples

1) A total of 208 samples were collected in the study area from 106 locations representing 114 samples of edible wild mushrooms of 17 species; 10 samples of two poisonous species of fungi for comparison; 16 wood samples from forest fire sites for comparison with morel mushrooms which grow in forest fire sites after the fire; and 68 samples of subsurface (5 – 10 cm depth) soil in which the mushrooms grew.

2) The soil samples were selected to represent impacted areas and assumed or known unspoiled background areas. They consisted of various components including natural surficial sediments and anthropogenic materials (Table A). The soil samples served as indicators of available metal levels in the environments in which the mushrooms grew and nourished (for more details see Section 6.4.2).

3) The first 45 fungi- and 33 soil samples were collected in 45 locations from 1997 – 1999, and the first analytical results of these samples were provided in Obst *et al.* (2001) (for locations see Figures 1 to 3, and Table A; for species list see Table B). A review of the preliminary results in Obst *et al.* (2001) warranted further collections and

analyses and the sample size was more than doubled from 2002 – 2009. An additional 79 fungi- and 35 soil samples were collected in 61 new locations of the study area. This was done to fill in gaps and to include a representative number of samples from assumed or known unspoiled areas located 50 – 300 km away from Yellowknife.

4) From 1997 – 1999, the first set included 24 fungi and 19 soils sampled collected in the city of Yellowknife and within 10 km of the Giant mine before mine closure in 1999. The second set included 19 fungi- and 11 soil samples collected in the same general area in 2001 and 2002. However, the latter samples are not comparable with the former samples to indicate any potential changes in the concentrations of metals in soil and fungi after the Giant mine closure, because they were collected to fill in gaps and did not come from the exact same locations as the former sample set from 1997 – 1999 (fungi are collected wherever they are available which may not be exactly the same spot year after year but the same area or habitat).

In addition, the underground network of the mycelium (the actual living organism) of fungi, which produces a short-living fruiting body (the mushroom) above ground for only about one week before the mushroom expires, does not absorb air borne contaminants directly from the air (unlike lichens) but from the substrate and organic materials in which they grow (for more details see Section 6.4.2). Hence, after the Giant mine closure and the ceasing of roaster emissions, the availability of metals for fungi most likely remained nearly unchanged because heavy metals are in the soil, organic material, and in the environment for long periods to come.

5) For clarification of highly elevated levels of lead in morel mushrooms (*Morchella atrotomentosa*) collected in 1999, 20 additional samples of morels from four new forest fire sites in the study area were randomly collected by W. Brown (pers. comm.) in 2006, 2008 and 2009, after a long absence of morels. As well, from 2001 – 2002, 16 wood samples of burned and unburned coniferous trees, including jack pine (*Pinus banksiana*), white spruce (*Picea glauca*) and black spruce (*Picea mariana*), were collected in three forest fire sites for comparison with morels sampled at these sites by three different sources (S. Carrière pers. comm. in 1999; W. Brown pers. comm. in 2009; and this study).

6) Besides wood samples of coniferous trees, other vascular plants were not sampled in this study because:

a) sufficient data are available from other local and regional studies on the metal uptake from soil by vascular plants and fungi (e.g., Kerr 2006; Macdonald 2004, 2003a and b; ESG 2001b; Koch *et al.* 2001); and

b) the majority of the scientific literature located and cited in this paper compared the metal levels in soil with the uptake of metals by fungi.

4.2.2. Collection Methods and Preparation of Samples before Analyses

1) The sampling of soil followed the methods used for regional mine remediation projects and baseline studies on the uptake of heavy metals by vascular plants and fungi around abandoned mines, such as the Colomac gold mine in the North Slave region and Port Radium uranium mine at Great Bear Lake (Macdonald 2004, 2003a, and 2003b). Soil samples were collected with a plastic spoon in the exact spots where mushroom samples were gathered. After removing the leaf litter from the surface, soil samples were excavated in a depth of 5 – 10 cm and placed in labelled Whirl Pak™ bags and frozen.

2) Mushrooms were collected in the same manner as practiced for culinary purposes (Kalac *et al.* 1991 and 1996). In the field, debris on fungi was gently removed with a small brush. Mushroom caps were placed individually in labelled Whirl Pak™ bags. For consistency and comparison, only the caps of mushrooms were used for analyses because mostly the caps were analyzed in comparable scientific literature since concentrations of metals can slightly differ between the stems and caps of fungi.

3) The fresh weights, and later the dry weights, of fungi samples were measured using an electronic scale. In the laboratory, mushroom caps were washed (Kuehnelt *et al.* 1997) with distilled, deionised water (Type 1 grade). The caps were then cut into slices with a plastic knife on labelled, sterilized laboratory glass dishes, and placed in a dehydration oven at 45 degrees Celsius for 48 hours until completely dry (Falandysz and Chwir 1997; Sleijkovec *et al.* 1997; and Kalac *et al*. 1996).

4) For measuring differences of metal concentrations in washed versus brushed fungi, 14 samples from the same species and clusters of fungi were divided into two groups of which the first group (7 samples) was washed (Kuehnelt *et al*. 1997) with tap water (to replicate the common practice of washing mushrooms before cooking) and the second group (7 samples) was only brushed to remove any potential debris.

5) In order to measure differences of metal concentrations in adult versus young fungi (Pop and Nicoara 1996), 10 samples were separated into five fully grown adult mushrooms with open caps and five young mushrooms with firmly closed caps. The samples were collected in five pairs each representing an adult and a young mushroom of the same species and from the same cluster of fungi.

4.2.3. Comparable Samples from Other Regions

In addition to the 208 samples collected in the study area, a total of 17 fungi- and 10 wood samples were obtained from other regions and analyzed for comparison with this study. The long absence of local morels in the study area warranted to request 10 samples of morels (*Morchella*) and 10 wood samples of partially burned trees from a 2001-forest fire site near Fairbanks, Alaska, USA, which were obtained from the USDA

Forest Service (T. L. Wurtz pers. comm. in 2002). For further comparison with local fungi, two additional samples of morels, imported either from British Columbia, Canada, or the US Pacific Northwest, were purchased in a local (Yellowknife) grocery store, as well as three other species of imported mushrooms from British Columbia and China.

4.3. Laboratory Analysis

All samples were quantitatively analyzed for 26 heavy metals (and some individual samples for 27 metals) including 10 samples and two duplicates of fungi which also were speciated for four arsenic compounds. The analysis was sponsored by the Environment and Conservation Division, Indian and Northern Affairs Canada (INAC), Yellowknife, and conducted by the Taiga Environmental Laboratory (INAC), Yellowknife. The following paragraphs describe laboratory methods used for the analysis of fungi, soil and wood samples (the paragraphs were provided by the Taiga Environmental Laboratory, W. Coedy and G. Hudy pers. comm. in 2001 and 2007).

1) Total Metals in Mushrooms

Dried mushrooms were ground in a mortar to a fine powder. Approximately 0.2 g of dried, ground mushroom was weighed into a 120-mL Teflon digestion µwave vessel. The mushroom was acid digested with 2 ml Type 1 water, 3 mL conc Seastar HNO_3 and 0.2 mL of TM grade HF according to procedure CEM 1573 in a CEM Corp Mars 5 microwave system. The extract was diluted 1:10 with 0.5 % nitric acid and analyzed for 24 elements (except for As and Fe) on a Agilent 7500a ICP-MS according to EPA Method 200.8 (EPA 1991).

Iron and arsenic were analyzed by different techniques on separate aliquots of the prepared extract. Iron was determined on a Varian SpectrAA-200 flame Atomic Absorption Spectrometer. Arsenic was determined on a Varian SpectraAA-640Z Zeeman corrected Graphite Furnace Spectrometer according to a procedure designed by Slekovec and Irgolic (1996). Detection limits in dry weight of fungi were: arsenic = 0.1 µg/g; cadmium = 0.1 µg/g; lead = 0.1 µg/g; and mercury = 0.01 µg/g (Table C).

2) Arsenic Speciation

Arsenic species were extracted from the dried, ground mushroom powder (0.1 g) using a mixture of methanol / Type 1 water (1:9) according to the procedure used by Larson et al. (1998). The 5 mL extract was applied to the selective speciation method using tandem solid phase extraction (SPE) cartridges (Yalcin and Le 2001). In this method, arsenicals were selectively retained on a specific type of SPE cartridge for preconcentration and eluted by using suitable buffers for quantitation by Graphite Furnace AA. Extraction cartridges (Supelco) were preconditioned with 5 mL of Type 1 water prior to assembly. SPE cartridges were assembled in tandem in order of cation exchange (SCX), anion exchange (SAX) and alumina. Dimethyl arsinic acid (DMAA) was eluted with 1M HCl from the SCX, monomethyl arsonic acid (MMAA) and arsenate (As^5) were eluted from the SAX using 0.06M Acetic Acid and 1M HCl respectively. Arsenite (As^3) was eluted from the alumina cartridge using 2M HF (Yalcin and Le 2001).

The collected eluent (5 mL) was analyzed for arsenic using an automated Varian Zeeman corrected Graphite Furnace AA. The program used was a modified procedure of the determination of arsenic in water from the Varian (1988) procedure manual.

3) Quality Control

Certified Reference Materials – Orchard Leaves NBS 1571 and Bovine Liver NIST 1577b – were used to determine accuracy and precision of the analytical techniques used in the mushroom analysis for metals by the Taiga Environmental Laboratory (INAC). Duplicate samples were analyzed on a random basis and the relative percent difference was monitored to be within 15%. This difference partially occurs because metal concentrations can vary in different parts of mushroom caps in particular after washing them (for more details see Section 4.2.2, points c and d; and Section 6.6).

In addition to the quality control provided by the Taiga Environmental Laboratory, the mean concentrations of four metals (As, Pb, Cd, and Hg) in 16 blind duplicate samples (the second half of mushroom caps) submitted by the author to the Taiga Environmental Laboratory differed only by a mean of 5.5% from the measurements of these metals in the original 16 samples.

4) Extractable Metals in Soil

Approximately 0.25 g of 0.5 g of freeze dried, ground and sieved (125 µm) soil, were weighed and digested with 5 mL 1:4 hydrochloric acid and 2 mL 1:1 nitric acid in a block heater at 85C. Digests were diluted to 50 mL with Type 1 water and further diluted 10x with 0.5 % nitric acid prior to analysis by Agilent 7500a ICP-MS. Digest extracts were analyzed for Fe by a Varian flame AA-200 and arsenic was determined by Hydride AA. Arsenic was determined on a Varian SpectraAA-640Z Zeeman corrected Graphite Furnace Spectrometer. Detection limits in soil were: arsenic = 0.1 µg/g; cadmium = 0.2 µg/g; lead = 0.2 µg/g; and mercury = 0.005 µg/g (Table C).

5) Quality Control of the Soil Analysis

Certified Reference Materials – LKSD-2 was used to determine accuracy and precision of the analytical techniques used in the soil analysis for metals. Duplicate samples were analyzed on a random basis and the relative percent difference was monitored to be within 15% difference because metal concentrations can vary in different parts of the soil sample.

6) Total Metals in Wood Samples

The same analytical methods used for mushrooms (see above point 1) were applied for partially burned and unburned fresh wood samples from forest fire sites (for metal detection limits in wood see Table C).

4.4. Calculation of Metal Intake through the Consumption of Fungi by Humans and Health Standards

4.4.1. Availability of Edible Wild Mushrooms for Consumption

From 1985 – 2009, the availability of edible wild mushrooms for consumption varied largely from year to year based on field notes by the author, as follows:

a) on average, only 2 of 4 – 5 years produced an enormous crop of nearly all species of mushrooms;

b) another 1 – 2 of 4 – 5 years produced a moderate crop for some species of mushrooms; and

c) about 1 – 2 of 4 – 5 years produced absolutely nothing at all for nearly all species of edible and popular local mushrooms.

In very few good years, the maximum mushroom season lasted for 120 days starting in early to mid-June with the genus *Morchella*, followed by the family Boletaceae in July/August, and ending in late September or early October with *Tricholoma*. In most good and moderate years, however, the average mushroom season was about 60 days for this region.

Hence, for the calculations in this study, the availability of fungi and the average mushroom season was defined as 60 days in 3.5 of 5 years with mushrooms completely absent in 1.5 years. The seasonal (60 days) human intake of heavy metals through fungi also was used to represent the total annual intake.

4.4.2. Calculation of Metal Intake by Humans through Fungi

1) The annual and seasonal intakes of four heavy metals (As, Pb, Cd, and Hg) through the consumption of local wild fungi was calculated for 26 resident harvesters interviewed from 1998 – 1999. The data represent the stated amounts of fresh

mushrooms consumed during 365 days by each interviewee for the period from September 01, 1998 to August 31, 1999. Recorded were the individual amounts of mushroom species consumed and harvested from known popular mushroom harvesting areas (for harvest areas see Section 3, points c, d and e; and Tables 1a – c).

The harvesters were placed in six categories ranging from low to high consumption of mushrooms (0.25 – 15 kg/year/person of fresh or rehydrated mushrooms). Based on discussions during public mushroom excursions with more than 400 residents, 120 tourists, guides, and local restaurant owners, the six categories (in Table D) were assumed to represent more than 400 known local harvesters and over 1,000 consumers (residents and visitors) in restaurants of Yellowknife (population about 20,000).

2) The following factors were considered for the calculations:

a) For 20 of 26 interviewees, it remained unknown if all of the reported amounts of mushrooms actually were consumed by the interviewee alone within the defined mushroom season of 60 days; or if mushroom meals eventually were shared with others; or if some mushrooms were stored (dried/frozen) for later use throughout the year. Only six harvesters with the highest consumption rate (9 – 15 kg of fresh fungi per person/year) are known to have consumed the full reported amounts during 365 days and much of it during the mushroom season of 60 days in 1999.

b) The period of the interviews coincidently represented a time with a high consumption of fungi by residents (as shown in Table D) because of excellent mushroom crops including large amounts of morel mushrooms (*Morchella*) which contained high concentrations of lead. These morels originated from a specific location in the Tibbitt Lake forest fire site in 1999. However, consecutive sampling of morels at other forest fire sites revealed very low levels of lead. This was considered in the calculations (for more details see Sections 5.4.3, point 3; and 5.5.2, point 3b).

3) The laboratory analyses measured the concentrations of heavy metals in mushrooms in dry weight of fungi following standard procedures. For recalculating the amount of metal present in the fresh weight of mushrooms for health risk assessments, a mean drying ratio of 1:10 (dry:fresh weight of fungi) is most often used in the scientific literature for ease of calculations and comparison with other studies. A mean drying ratio of 1:10 was used for calculations of the preliminary results (Obst *et al.* 2001) submitted for the human health risk assessments (for more details see Section 4.4.3).

However, the actual mean drying ratio in all former and consecutive samples was 1:12 (dry:fresh weight of fungi) as shown in Table E. In this paper, a drying ratio of 1:12 was used for all calculations of arsenic in fungi, because this ratio was closer to the actual drying ratios of mushroom species with the highest concentrations of arsenic, such as matsutake, shaggy mane and meadow mushrooms (Table E). The drying ratio of 1:12

also was used for all calculations of cadmium and mercury in fungi. Therefore, the reported concentrations of arsenic, cadmium and mercury in fungi are lower by a mean value of 16.7% compared with calculations using a mean drying ratio of 1:10 for fungi.

In contrast, a mean drying ratio of 1:10 was used for all calculations of lead levels in fungi, because this ratio was closer to the actual drying ratios of mushroom species with the highest concentrations of lead, such as morel and boletus mushrooms (Table E).

4.4.3. Human Health Risk Assessment and Health Standards

1) The preliminary results of the first 45 fungi- and 33 soil samples (Table 1) were provided in an unpublished report (Obst *et al*. 2001) to the Department of Health and Social Services (HSS), Health Protection Unit, Government of the Northwest Territories, Yellowknife, requesting human health risk assessments on the intakes of four heavy metals (As, Pb, Cd, and Hg) through the consumption of edible wild mushrooms from popular harvest areas in and around Yellowknife. Hence, the first two assessments (Health Canada 2002; Richardson 2001) were based on the first 45 fungi samples only.

A third health risk assessment, based on the final results of all 124 mushroom samples, was requested by the author in early 2012 in respect to highly elevated levels of arsenic and lead found in mushrooms from popular harvest areas. An assessment on lead in mushrooms was received in November 2012 from Health Canada (2012), while the assessment on arsenic is still pending. The original three assessments (see Appendix 1) are compared with the health risk assessments of this study.

2) The calculated intake of four metals (As, Pb, Cd, and Hg) through the consumption of fungi was compared with the Canadian health standards which are based on the recommended guidelines of the World Health Organization (WHO). The WHO established guidelines for the “provisional Tolerable Daily Intake” (pTDI). The pTDI is the acceptable or tolerable intake of heavy metals per day and per kg of body weight based on a weight of 60 – 70 kg (mean 65 kg) for adults (WHO 1995, 1993a, 1993b, 1992, 1989, 1981, 1977, 1976a, 1976b). All calculations on metal intake for adults in this paper were adjusted to and based on a body weight of 65 kg.

The units used for calculations are: 1 mg = 1000 µg; 1 µg = 0.001 mg; 1 µg/g = 1 mg/kg = 1 ppm (parts per million). The analytical values for all samples represent dry weights (d.w.) unless it is noted that the values for mushrooms were recalculated into fresh weight (f.w.) using a drying ratio of 1:12 for arsenic, cadmium and mercury, and 1:10 for lead in fungi (for more details see Section 4.4.2, point 3).

5. RESULTS

5.1. Heavy Metals in Soil and Bedrock

In general, the concentrations of heavy metals in soil from the study area are dictated by the bedrock geology, glacial deposits, and anthropogenic impacts (Table A). The natural background levels of arsenic (As) and lead (Pb) in five different bedrock formations of the study area vary from very low (0 – 1 ppm As; and <2 ppm Pb) to extremely high (>10000 – 30000 ppm As; and up to 494 ppm Pb) (Tables A1 and A2).

The highest levels of both metals are present in volcanic rocks and gold ore at the mines in the Yellowknife greenstone belt area located in the center of the study area (Figure 2). The naturally elevated levels of arsenic, lead and other heavy metals in the soil and environment in the Yellowknife area were increased during nearly seven decades of mining and anthropogenic activities. In contrast, lower background levels of heavy metals were present in bedrock and soil of the remaining four of five different bedrock formations in the study area (for more details on bedrock geology see Section 6.2).

5.1.1. Arsenic in Soil

1) The concentrations of total arsenic in 68 samples of subsurface soil (5 – 10 cm depth) were highest in 30 samples collected within the city limits of Yellowknife. The values of arsenic in the city ranged from 9.9 – 123 µg/g dry weight (d.w.), from 11.9 – 7310 µg/g at the Frame Lake sand beach, and from 550 – 1730 µg/g near the former Giant mine.

Three of these soil samples with the highest levels of arsenic, such as 999, 1730 and 7310 µg/g, were collected 0.5 km, 1 km and 5 km south-southwest of the Giant mine roaster, respectively (or downwind of prevailing eastern and northern winds). At Rat Lake near Con mine, two soil samples contained 1430 and 2460 µg/g of arsenic (Figures 2 and 3; and Table 1). In general, the levels of arsenic in soil within the city limits were highest in areas around Giant and Con mines, and elevated in areas located 4.5 – 9.2 km south to west or downwind of the former two mine roasters.

The arsenic levels in soil appeared to approximate background values about 40 km west and 33 – 49 km east of Yellowknife (Tables 1 and A1). In distances from 40 – 140 km west and southwest of Yellowknife, declining levels of arsenic in soil ranged from 16.5 – 0.5 µg/g. From 30 – 300 km east and northeast of the city, declining arsenic levels ranged from 15.7 – 0.8 µg/g. The exception was a soil sample (ID# 109, Table 1) with 11.6 µg/g As collected 300 km northeast of Yellowknife (Figures 4 and 5). Arsenic levels in soil also declined gradually with increasing distances from roads (Figure 6).

The mean concentrations of total arsenic in 68 soil samples (Figure 7) were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 519.8 µg/g, range = 9.9 – 7310 µg/g (*N* = 30).

b) In less impacted areas 30 – 140 km away from Yellowknife:

mean = 4.5 µg/g, range = 0.5 – 16.5 µg/g (*N* = 30).

c) In known unspoiled areas 50 – 300 km away from Yellowknife:

mean = 4.8 µg/g, range = 1.3 – 11.6 µg/g (*N* = 8).

2) The concentrations of arsenic in most soil samples within and around Yellowknife exceed the soil quality guidelines recommended by the Canadian Council of Ministers of the Environment (CCME 2002). The CCME recommended a maximum limit of 12 µg/g arsenic in soil for all land use categories, such as agriculture, residential/park, commercial, and industrial use.

However, the guidelines are not binding and recommend that specific local or regional guidelines should be derived if the local/regional background soil concentrations are markedly above 10 µg/g arsenic. Most soils in Yellowknife, including residential and park areas, exceed the guidelines for arsenic by factors ranging from 3 – 205 times. A soil sample with 7310 µg/g arsenic (ID # 34, Table 1) collected in a recreational sand beach area beside a playground for children on Frame Lake exceeded the guidelines by a factor of 609 times.

5.1.2. Lead in Soil

1) The highest levels of lead in subsurface soil (5 – 10 cm depth) were found in and around Yellowknife, and near mining infrastructure and road sides. In Yellowknife, lead levels in soil ranged from 3.2 – 296 µg/g (d.w.). A general trend of widely varying but declining levels was observed moving away from Yellowknife, mine sites, heavily used roads, and the Prelude Lake community.

Elevated lead levels in soil were present particularly within a radius of 6.5 – 7.2 km around Giant mine, including the Con and Treminco mine areas. The lead levels in soil appeared to approximate background values somewhere between 40 - 113 km west and 33 – 52 km east of Yellowknife (Tables 1 and A2).

In distances from 40 – 113 km west of Yellowknife, lead values in some soil samples ranged from 10 – 31.8 µg/g and in others from 2 – 3 µg/g. Along a stretch of the Ingraham Trail road corridor 33 – 52 km east of Yellowknife, elevated lead levels in soil ranged from 10.0 – 66.5 µg/g and gradually declined from 9.0 – 1.0 µg/g further away from the road (Figures 8 and 9; and Tables 1 and A2).

Levels of lead in soil were highest within the first 50 m beside roads, gradually declined within 500 m of roads, and further declined within 1 – 3 km of roads (Figure 10). In known unspoiled background areas 230 – 300 km northeast of Yellowknife, lead levels in soil ranged from 1.0 – 3.0 µg/g except for a sample with 14 µg/g (Table 1).

The mean concentrations of total lead in 68 soil samples (Figure 7) were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 60.6 µg/g, range = 3.2 – 296 µg/g (*N* = 30).

b) In less impacted areas 30 – 140 km away from Yellowknife:

mean = 13.7 µg/g, range = 2.0 – 66.5 µg/g (*N* = 30).

c) In known unspoiled areas 50 – 300 km away from Yellowknife:

mean = 3.6 µg/g, range = 1.0 – 14 µg/g (*N* = 8).

2) With a few exceptions, most soils sampled within and around Yellowknife (Table 1) did not exceed the soil quality guidelines for lead (CCME 2002) of 70 µg/g for agriculture, 140 µg/g for residential/park areas, 260 µg/g for commercial areas, and 600 µg/g for industrial areas.

5.1.3. Cadmium in Soil

1) Natural background levels of cadmium in soil (5 – 10 cm depth) ranged from 0.1 – 0.2 µg/g (d.w.) in most locations sampled in the study area. This included locations in and around Yellowknife, near mines, infrastructure, road sides, and also assumed unspoiled background areas in distances from 50 – 300 km of Yellowknife.

These low background levels often occurred within a few hundred meters of locally elevated cadmium levels around mines ranging from 0.6 – 3.1 µg/g. At the edge of tailings near the former Treminco mine, a soil sample contained 6.1µg/g. A declining trend of cadmium in soil was noticeable with increasing distances away from

Yellowknife, mines and infrastructure (Figure 11; and Table 1).

The mean concentrations of total cadmium in 68 soil samples (Figure 7) were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 0.7 µg/g, range = 0.1 – 6.1 µg/g (*N* = 30).

b) In less impacted areas 30 – 140 km away from Yellowknife:

mean = 0.16 µg/g, range = 0.1 – 0.4 µg/g (*N* = 30).

c) In known unspoiled areas 50 – 300 km away from Yellowknife:

mean = 0.17 µg/g, range = 0.1 – 0.3 µg/g (*N* = 8).

2) The levels of cadmium in all soil samples collected in and around Yellowknife were well below the soil quality guidelines (CCME 2002) which recommended maximum limits of 1.4 µg/g of cadmium in soil used for agriculture, 10 µg/g in residential/park areas, and 22 µg/g for commercial and industrial areas.

5.1.4. Mercury in Soil

1) Background levels of total mercury in subsurface soil (5 – 10 cm depth) generally ranged from 0.005 – 0.050 µg/g (d.w.) in most of the study area, except for a value of 0.1 µg/g in esker sand from an unspoiled area 240 km northeast of Yellowknife.

Elevated mercury levels in soil around mines ranged from 0.120 – 0.360 µg/g. A declining trend of mercury in soil was observed with increasing distances away from Yellowknife and mines (Figure 12; and Table 1).

The mean concentrations of mercury in 68 soil samples (Figure 7) were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 0.06 µg/g, range = 0.005 – 0.36 µg/g (*N* = 30).

b) In less impacted areas 30 – 140 km away from Yellowknife:

mean = 0.014 µg/g, range = 0.005 – 0.04 µg/g (*N* = 30).

c) In known unspoiled areas 50 – 300 km away from Yellowknife:

mean = 0.036 µg/g, range = 0.005 – 0.1 µg/g (*N* = 8).

2) The levels of total mercury in all soil samples in and around Yellowknife were far below the soil quality guidelines (CCME 2002) which recommend a maximum limit of 6.6 µg/g for agriculture and residential/park areas, 24 µg/g in commercial, and 50 µg/g for industrial areas.

5.2. Heavy Metals in Coniferous Trees

1) Sixteen wood samples of burned coniferous trees from three forest fire sites of the study area include jack pine (*Pinus banksiana*), white spruce (*Picea glauca*) and black spruce (*Picea mariana*). These burned trees represent the following wood types:

a) wood coal, completely burned wood;

b) unburned wood inside charred dead trees; and

c) unburned wood inside a living but charred tree.

The levels of arsenic (As), lead (Pb) and mercury (Hg) in all 16 wood samples, and the mean values in the three types of wood (a – c), were low ranging from:

- 0.5 – 4.5 µg/g As (d.w.), mean values = 0.5 – 1.3 µg/g As for three wood types;
- 0.1 – 2.7 µg/g Pb, mean values = 0.1 – 0.8 µg/g Pb for three types; and
- 0.01 – 0.09 µg/g Hg, mean values = 0.01 – 0.04 µg/g Hg for three types.

For cadmium, the values in all 16 wood samples were at the metal detection limit of 0.1 µg/g Cd (Table 2; for detection limits see Table C).

2) The mean accumulations of total arsenic, lead and mercury from soil to wood were highest in completely burned wood or wood coal, and lowest in unburned wood inside of burned dead trees and a living but charred tree.

However, even the higher accumulations of these metals in wood coal actually were quite low with mean accumulation factors from soil to wood of 0.23 times the value in soil for arsenic, and 0.1 times for lead.

The values of cadmium in all 16 wood samples and in six of seven soil samples were at the detection limit of 0.1 µg/g, except for a soil samples with 0.4 µg/g. Thus, the mean value of cadmium in soil samples was 0.143 µg/g and the mean accumulation of cadmium in wood samples ranged from 0.7 – 1.0 times the value in soil.

The values were highest for mercury with a mean accumulation factor in wood of 3.33 times the value in soil (Table 2).

With the exception of cadmium, the seven samples of wood coal contained higher levels of nearly all 26 heavy metals tested in this study compared with the nine unburned wood samples from charred trees (Table J).

3) The concentrations of arsenic, lead, cadmium and mercury in 10 wood samples of burned coniferous trees (spruce and/or pine) requested for comparison from a 2001-forest fire site in Alaska were similar low as those found in the study area (Table J).

5.3. Uptake of Heavy Metals from Soil by Fungi

A trend of increasing levels of heavy metals in fungi with rising metal levels in soil was apparent for all four metals examined (As, Pb, Cd, and Hg) when looking at the spatial distribution of metal levels in all soil- and fungi samples. Heavy metals in soil and fungi increased from background areas with low metal levels to impacted areas with higher concentrations (Figures 4 to 12).

The highest concentrations of heavy metals in soil and fungi were found around Yellowknife and the mines. In some cases, however, there were no direct correlations between the bio-accumulation ratio of heavy metals by individual specimens of the same species of fungi and the metal levels in soil.

For example, a sample (ID # 49, Table 1) of the shaggy mane mushroom, genus *Coprinus* (for common and scientific names see Table B), with a low level of arsenic of 6.6 µg/g dry weight (d.w.) was collected in soil with a high level of 1730 µg/g As.

Whereas, another shaggy mane sample (ID # 57) with a high level of 494 µg/g As originated from soil with 23.1 µg/g As (the soil sample ID # 56 was shared soil representing shaggy mane samples ID # 56 and # 57 in Table 1). Levels of arsenic in four shaggy mane samples (ID #s 56 to 59) from the same location varied significantly ranging from 3.6 – 494 µg/g (Table 1).

However, all samples of shaggy manes and the soil in which they grew originated from anthropogenic soil, gravel and road side fill material which comprise the typical habitat for this species in the study area.

Hence, the individual soil samples collected at these sites likely represent the values of arsenic in anthropogenic impacted and introduced soil, gravel and crushed rocks from various locations of the core study area. Thus, individual specimens of shaggy manes from the same spot or cluster of shaggy manes probable had access to varying metal concentrations in the soil and decaying organic material.

5.4. Heavy Metals in Fungi

5.4.1. Arsenic in Fungi

1) The concentrations of total arsenic in 124 samples of mushroom (Table 1; and Figures 4 – 7), including poisonous and unpopular fungi which are not consumed by local people (Table 1a), were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 89.6 µg/g As (d.w.), range = 1.0 – 1370 µg/g As (N = 43).

b) In less impacted background areas 30 – 140 km away from Yellowknife:

mean = 9.0 µg/g As (d.w.), range = 0.2 – 101 µg/g As (N = 58).

c) In known unspoiled background areas 50 – 300 km away from Yellowknife:

mean = 2.1 µg/g As (d.w.), range = 0.5 – 20.3 µg/g As (N = 23).

The arsenic levels in fungi within the city limits of Yellowknife ranged from 1.0 – 1370 µg/g (d.w.). Elevated arsenic levels ranging from 50 – 1370 µg/g were found mostly in the American white matsutake (*Tricholoma magnivelare*) and in a few samples of the genus *Agaricus*, *Lycoperdon*, and *Coprinus* (for common and scientific names see Table B).

Elevated levels of arsenic >100 µg/g were found in fungi from the pine forest around the Yellowknife golf course and the sewage road area. The former area is located 6.5 km west-southwest of the former Giant mine roaster and 6.5 km northwest of the former Con mine roaster. The latter area is 4.5 km west of the former Con mine roaster and 8 – 9.2 km southwest of the former Giant mine roaster. Both areas are located downwind of prevailing eastern and northern winds and roaster emissions. At Rat Lake near Con mine, arsenic levels in fungi ranged from 10.2 – 38.2 µg/g, and near the former Treminco mine outside of town from 3.6 – 494 µg/g (Table 1).

In distances from 40 – 140 km west, southwest and northwest of Yellowknife, levels of arsenic in mushrooms ranged from 0.4 – 1.7 µg/g except for two samples of *Tricholoma* with 30.8 and 101 µg/g (d.w.). Levels of arsenic in fungi 30 – 300 km southeast, east and northeast of Yellowknife generally ranged from <0.2 – 4.1 µg/g.

The exceptions included all samples of *Tricholoma* which contained elevated arsenic levels ranging from 11 – 92.3 µg/g, as well as a sample of *Leccinum* (ID# 110) with 20.3 µg/g (Table 1).

When excluding all 13 samples of *Tricholoma* and the latter sample of *Leccinum*, then the levels of arsenic in the remaining 110 samples of fungi gradually declined with increasing distances from the city, mines, and roads (Figures 4, 5, 6, and 7).

2) The bio-accumulations of arsenic from soil to fungi in seven of nine mushroom families were very low with mean factors ranging from 0.004 – 0.5 times the levels in soil. The highest accumulations of arsenic were found in the genus *Tricholoma* and *Lycoperdon* with means of 7.6 and 1.2 times the levels in soil, respectively (Table 3).

However, a sample of *Tricholoma* (ID # 13, Table 1) which grew in soil with low arsenic levels of < 0.5 µg/g (soil ID # 12 is shared soil with fungi ID # 13, Table 1) in an assumed unspoiled background area accumulated 101 µg/g of total arsenic of which 76% was inorganic arsenic (ID # 13, Tables 1 and 4). This is equivalent to a bio-accumulation of 202 times the levels of arsenic in soil.

3) The values of arsenic in mushrooms provided above represent conservative values because all mushrooms, except for morels and seven control samples (as indicated in Table 1), were washed prior to the analysis. This was done in order to replicate the practice of washing mushrooms before cooking. However, washing reduced arsenic levels in fungi by a mean of 38.4% (for more details see Sections 4.2.3 and 5.4.6).

5.4.2. Arsenic Speciation in Fungi

Two organic arsenic compounds, dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA), and two inorganic arsenic forms, arsenite (As III) and arsenate (As V), were speciated in 10 samples of fungi (plus two duplicates).

In 8 of 10 samples, DMA concentrations ranged from 0.1 – 1.5 µg/g and in two samples (plus two duplicates) from 178 – 456 µg/g (d.w.). MMA in all 10 samples (plus two duplicates) ranged from 0.1 – 2.6 µg/g.

In 8 of 10 samples (plus two duplicates), As (III) levels ranged from 0.2 – 4.7 µg/g and two samples contained 76.1 µg/g and 256 µg/g. Levels of As (V) in all samples ranged from <0.1 – 1.1 µg/g (Table 4).

For all 10 samples (plus two duplicates) the mean percentage (based on column "1. Test" in Table 4) for organic arsenic (DMA and MMA) was 60.95%, and for inorganic arsenic it was 22.36% (mostly As III and small amounts of As V). The remaining 16.69% were un-speciated arsenic forms included in 100% of total arsenic (Table 4).

A meadow mushroom (*Agaricus campestris*) sample (ID # 30, Table 4) from the popular sewage road area in Yellowknife contained elevated arsenic levels of 286 µg/g of which 89.8% was inorganic arsenic including 89.5% As (III).

A sample (ID # 13, Table 4) of *Tricholoma* from an assumed unspoiled background area located 113 km west of Yellowknife contained elevated arsenic levels of 101 µg/g of which 76% was inorganic arsenic including 75.3% As (III) (Table 4). This sample grew in soil containing merely < 0.5 µg/g of total arsenic (soil ID # 12 is shared soil with fungi ID # 13, Table 1).

5.4.3. Lead in Fungi

1) The concentrations of lead in all 123 samples of mushrooms tested for lead (Table 1; and Figures 7 – 10), including poisonous and unpopular fungi which are not consumed by residents (Table 1a), were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 64.4 µg/g (d.w.), range = 0.1 – 1010 µg/g (*N* = 43).

b) In less impacted background areas 30 – 140 km away from Yellowknife:

mean = 76.1 µg/g (d.w.), range = 0.1 – 993 µg/g (*N* = 57).

c) In known unspoiled background areas 50 – 300 km away from Yellowknife:

mean = 0.17 µg/g (d.w.), range = 0.1 – 0.5 µg/g (*N* = 23).

The levels of lead in wild mushrooms within Yellowknife ranged from <0.1 – 1010.0 µg/g (d.w.). Highly elevated lead levels from >100 – 1010 µg/g were found in the genus *Agaricus*, *Lycoperdon*, *Leccinum*, *Suillus*, and *Tricholoma* collected in and around

Yellowknife, mine sites, the Ingraham Trail road corridor, and near roads and highways.

In distances from 40 – 140 km west, southwest and northwest of Yellowknife, levels of lead in fungi ranged from 0.1 – 0.3 µg/g except for two samples with 5.2 and 22.2 µg/g (d.w.). In assumed unspoiled background areas 50 – 300 km southeast, east and northeast of Yellowknife, lead levels ranged from <0.1 – 1.9 µg/g.

In contrast, in popular mushroom harvest areas 20 – 52 km east of Yellowknife, lead levels in fungi varied significantly from very low (<0.1 µg/g) to highly elevated levels in morel mushrooms (>50 – 993 µg/g) from the Tibbitt Lake forest fire site.

When excluding the morels from Tibbitt Lake, then a gradual decline of lead levels in fungi was apparent when going further away from Yellowknife, mines and the Ingraham Trail. Declining lead levels in fungi also were measured with increasing distances away from roads and highways (Figures 7 to 10; and Table 1).

2) Highly elevated lead levels ranging from >50 – 993 µg/g were found in most morel mushrooms, *Morchella* (ID #s 87 – 97, Table 1), harvested in 1999 from the 1998-Tibbitt Lake forest-fire site about 45 – 50 km east of Yellowknife (Figure 2). These extremely high concentrations of lead in morel mushrooms were puzzling. Therefore, the matter was scrutinized further, as following examples demonstrate.

a) The sources of lead in morels from Tibbitt Lake included naturally moderately elevated background levels found in soil samples from the same area (Table 1), as well as elevated levels in the bedrock. Some additional natural factors likely accelerated the high accumulation of lead in morels (for more details on lead levels in morels see Sections 6.2, point 4; and 6.5, point 3).

b) The mean level of lead in 8 of 11 morel samples from the Tibbitt Lake forest fire site was 422.2 µg/g (d.w.) (range 50.5 – 993 µg/g), and in three samples the mean was only 0.37 µg/g (range 0.2 – 0.5 µg/g).

In four samples of other fungi species (ID #s 98 – 101, Table 1) collected from the same site in 1998 a few days before the forest fire, elevated lead levels ranged from 7.2 – 35.1 µg/g.

In contrast, in six samples of other fungi species (ID #s 81 – 86, Table 1) collected from the same site in 2001 three years after the fire, the levels of lead merely ranged from <0.1 – 0.2 µg/g.

Hence, there is no apparent relationship between the levels of lead in morels and other mushrooms from the same area collected before and after the forest-fire.

c) In comparison, in four soil samples (ID #s 98 – 101, Table 1) collected from the Tibbitt Lake site in 1998 before the forest fire, the mean level of lead was 9.9 µg/g (range 7.5 – 12.7 µg/g).

In five soil samples (ID #s 81, 82, 84, 85 and 86, Table 1) collected from this site in 2001 three years after the fire, the mean level of lead was 9.2 µg/g (range 5.0 – 14.0 µg/g).

Hence, the levels of lead in soil samples collected before and after the 1998-Tibbitt Lake forest-fire were quite similar.

d) In 11 wood samples of jack pine (*Pinus banksiana*), white spruce (*Picea glauca*) and black spruce (*Picea mariana*) collected from the Tibbitt Lake site in 2001 three years after the forest fire, the mean level of lead was 0.6 µg/g (range <0.1 – 2.7 µg/g).

Five samples of wood coal contained slightly higher levels of lead (mean of 0.8 µg/g, range <0.1 – 2.7 µg/g) than the other six samples of unburned wood inside burned trees (mean 0.5 µg/g, range 0.1 – 1.0 µg/g) (Table 2).

An additional five wood samples from two other forest fire sites, located over different bedrock formations than the Tibbitt Lake site, contained similar values of lead as the Tibbitt Lake wood samples (for more details see Section 5.2).

e) For comparison to the Tibbitt Lake morels, the mean lead level in 10 morel samples from two other forest fire sites in the study area was only 0.17 µg/g (d.w.) (range <0.1 – 0.3 µg/g) (ID #s 1 – 7, and 112 – 114, Table 1).

In an additional 10 morel samples (ID #s 115 – 124) collected in two more forest fire sites of the study area in 2009, the mean lead level was only 0.19 µg/g (range <0.1 – 0.5 µg/g).

f) The lead levels in 10 morel samples (ID #s 125 – 134, Table 1) requested from a forest fire site near Fairbanks, Alaska, USA (for more details see Section 4.2.2), also were low with a mean value of 0.48 µg/g (range 0.1 – 1.6 µg/g).

In 10 partially burned wood samples from the same site in Alaska, the mean value for lead was 0.26 µg/g (range 0.1 – 0.6 µg/g) (Table J) (for more details see Section 5.2).

g) Two morel samples obtained in a local grocery store in Yellowknife contained both only 0.2 µg/g of lead. Both morel samples were imports from British Columbia or the

US Pacific Northwest (for more details see Section 4.2.2).

3) The bio-accumulations of lead from soil to fungi in four of nine mushroom families were low with mean factors ranging from 0.01 – 0.76 times the levels in soil (Table 3).

The highest accumulations of lead were found in the genus *Suillus*, *Morchella* and *Lycoperdon* with factors of 67, 33.4 and 4.1 times the levels in soil, respectively (Table 3).

The mean accumulation of lead in *Agaricus* was a factor of 1.8 times the levels in soil. However, a sample of *Agaricus* (ID # 43, Table 1) with high lead levels of 1010 µg/g (d.w.) grew in soil containing 92.1 µg/g of lead. This resulted in an accumulation of lead in fungi of 11 times the levels in soil. This sample was collected in the old town of Yellowknife on a meadow used for recreational activities, as well as for meadow mushroom picking. The lawn sits on top of a former landfill located beside a former welding shop.

4) The values of lead in fungi given above represent conservative values because all fungi, except for morels and seven control samples (as indicated in Table 1), were washed prior to the analysis to replicate the washing of mushrooms before cooking.

Washing reduced lead levels in fungi by a mean of 31.2% (for more details see Sections 4.2.3 and 5.4.6).

5.4.4. Cadmium in Fungi

1) The concentrations of total cadmium in 123 samples of mushrooms (Table 1; and Figure 11), including poisonous and unpopular fungi which are not consumed by local people (Table 1a), were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 4.1 µg/g Cd (d.w.), range = 0.1 – 32.4 µg/g Cd (N = 43).

b) In less impacted background areas 30 – 140 km away from Yellowknife:

mean = 0.8 µg/g Cd (d.w.), range 0.1 – 1.7 µg/g Cd (N = 57).

c) In known unspoiled background areas 50 – 300 km away from Yellowknife:

mean = 1.08 µg/g Cd (d.w.), range = 0.1 – 3.9 µg/g Cd (*N* = 23).

In distances from 40 – 140 km west, southwest and northwest of Yellowknife, levels of cadmium in mushrooms ranged from <0.1 – 0.9 µg/g except for a sample with 1.2 µg/g (d.w.).

Elevated cadmium levels in fungi ranging from 2.8 – 17.1 µg/g were found in *Agaricus* and *Amanita* from various locations in and around Yellowknife, mine sites, and road corridors. A sample of *Coprinus* from tailings of the former Treminco mine contained the highest concentration of cadmium with 32.4 µg/g.

A declining trend of cadmium in fungi was noticeable from 30 – 300 km east and northeast of Yellowknife generally ranging from <0.1 – 1.7 µg/g except for two samples of *Amanita* with 3.5 µg/g and 3.9 µg/g (Figure 11; and Table 1).

2) The bio-accumulations of cadmium from soil to fungi in seven of nine mushroom families were mean factors ranging from 2 – 6.5 times the levels in soil. The highest accumulations of cadmium were found in *Agaricus* and *Amanita* with mean factors of 9.6 and 17.8 times the levels in soil, respectively (Table 3).

3) The values of cadmium in fungi provided above represent slightly conservative values because all fungi, except for morels and seven control samples of fungi (as indicated in Table 1), were washed prior to the analysis to replicate the washing of mushrooms before cooking. Washing reduced cadmium levels in fungi by a mean of 1.9% (for more details see Sections 4.2.3 and 5.4.6).

5.4.5. Mercury in Fungi

1) The concentrations of total mercury in 120 samples of mushrooms (Table 1; and Figure 12), including poisonous and unpopular fungi which are not consumed by local people (Table 1a), were as follows.

a) Within the city limits of Yellowknife and as far as the Treminco mine:

mean = 0.641 µg/g Hg (d.w.), range = 0.03 – 4.29 µg/g (*N* = 43).

b) In less impacted background areas 30 – 140 km away from Yellowknife:

mean = 0.19 µg/g Hg (d.w.), range = 0.01 – 0.7 µg/g (*N* = 57).

c) In known unspoiled background areas 50 – 300 km away from Yellowknife:

mean = 0.059 µg/g Hg (d.w.), range = 0.01 – 0.27 µg/g (*N* = 20).

In distances from 40 – 140 km west and southwest of Yellowknife, levels of mercury in fungi generally ranged from 0.01 – 0.48 µg/g (d.w.).

Elevated mercury levels ranged from 1.05 – 4.29 µg/g in *Coprinus*, *Lycoperdon*, *Tricholoma* and *Agaricus* from locations in and around Yellowknife, mine sites, and road corridors.

Levels of mercury in fungi collected 30 – 300 km east and northeast of Yellowknife generally ranged from <0.1 – 0.70 µg/g (Table 1). A declining trend of mercury in fungi was noticeable with increasing distances from roads, mines and the city (Figure 12).

2) The bio-accumulations of mercury from soil to fungi in four of nine mushroom families were mean factors ranging from 1.8 – 4.6 times the levels in soil.

The accumulations of mercury in the remaining five families ranged from mean factors of 8 – 46.2 times the levels in soil and were highest in the genus *Tricholoma*, *Sarcodon* and *Coprinus* (Table 3).

3) The levels of mercury in fungi represent conservative values because all fungi, except for morels and seven control samples (as indicated in Table 1), were washed prior to the analysis to replicate the washing of mushrooms before cooking. Washing reduced mercury levels in fungi by a mean of 28.3% (for more details see Sections 4.2.3 and 5.4.6).

5.4.6. Metal Concentrations in Age Classes and Washed Mushrooms

a) In three species of mushrooms tested, the concentrations of arsenic in adult mushrooms (*N* = 5) were 42% lower, and mercury levels 28.3% lower, than in young mushrooms (*N* = 5) of the same species and from the same cluster of fungi.

In contrast, levels of lead in adult fungi were 190% higher, and cadmium levels 8% higher, than in young fungi (the samples of adult versus young fungi are indicated in Table 1).

b) Metal concentrations in four species of mushrooms washed with water (*N* = 7) were lower than those of mushrooms (*N* = 7) which were only brushed to remove debris before the analysis. These samples were collected in pairs from the same species and cluster of fungi.

The metal concentrations of washed mushrooms were lower by 38.4% for arsenic, 31.2% for lead, 28.3% for mercury, and 1.9% for cadmium compared with the mushrooms which were only brushed (the samples of washed versus brushed fungi are indicated in Table 1).

With the exception of all morels and the seven unwashed samples from above, the heavy metal levels in all other mushroom samples likely represent conservative values because they were rinsed with distilled, deionised water (Type 1 grade) (for more details see Sections 4.2.3 and 6.6).

5.4.7. Metal Concentrations in Poisonous Mushrooms

The concentrations of arsenic (As), lead (Pb), cadmium (Cd) and mercury (Hg) in five samples of the poisonous hooded false morel (*Gyromitra infula*, Helvellaceae family) from less impacted background areas were low (Table 1a) with the following mean levels in fungi and in the soil in which they grew:

- 0.5 µg/g As (d.w.) in fungi, 4.06 µg/g As in soil;
- 0.12 µg/g Pb in fungi, 7.8 µg/g Pb in soil;
- 0.88 µg/g Cd in fungi, 0.16 µg/g Cd in soil; and
- 0.056 µg/g Hg in fungi, 0.013 µg/g Hg in soil (Table 1).

The bio-accumulations of these metals in *Gyromitra* from soil to fungi were very low for arsenic and lead, and fairly low for cadmium and mercury (Table 3).

The values of the four heavy metals in five samples of the poisonous fly agaric (*Amanita muscaria*, Amanitaceae family) and in the soil in which they grew were as follows:

- 0.5 µg/g As (d.w.) fungi, 4.5 µg/g As soil, in unspoiled background areas;
- 3.8 – 17.2 µg/g As fungi, 49.4 – 7310 µg/g As soil, in Yellowknife;
- 0.2 µg/g Pb fungi, 2.0 µg/g Pb soil, in unspoiled background areas;

- 0.95 µg/g Pb fungi, 27 µg/g soil, in Yellowknife;

- 3.7 µg/g Cd fungi, 0.1 µg/g Cd soil, in unspoiled background areas;
- 12.4 µg/g Cd fungi, 0.15 µg/g Cd soil, in Yellowknife;

- 0.15 µg/g Hg fungi, 0.01 µg/g Hg soil, in unspoiled background areas; and
- 0.117 µg/g Hg fungi, 0.020 µg/g Hg soil, in Yellowknife (Tables 1 and 1a).

The bio-accumulation of these metals from soil to fungi was low in *Amanita* for arsenic, lead and mercury, but very high for cadmium with a mean factor of 17.8 times the levels in soil (Table 3).

5.4.8. Metal Concentrations in Mushrooms from Other Regions

For comparison, 17 samples of four species of mushrooms (ID #s 125 – 141, Table 1) were obtained from other regions and analyzed (for more details see Section 4.2.2).

1) Arsenic

The mean concentration of total arsenic in 10 samples of morels, *Morchella* (ID #s 125 – 134, Table 1), from Fairbanks, Alaska, was 4.13 µg/g (d.w.) (range 1.0 – 11.1 µg/g).

In comparison, the mean value of arsenic in all morels from the study area was 0.98 µg/g (range 0.2 – 3.5 µg/g; N = 31).

The levels of arsenic were very low (<0.5 µg/g) in all seven fungi samples (ID #s 135 – 141, Table 1) from a local grocery store in Yellowknife, including morels (*Morchella* sp.), wood ear (*Auricularia* sp.), Chinese shiitake (*Lentinula edodes*, Tricholomataceae family), and oyster mushroom (*Pleurotus porrigens*, Tricholomataceae) (Table B).

2) Lead

The low levels of lead in morels from Alaska, a Yellowknife grocery store, and from four forest fire sites in the study area, already were presented together with the high levels of lead in morels from Tibbitt Lake (for more details see Section 5.4.3, point 2).

The levels of lead in an additional five fungi samples of three species (ID #s 135 – 141,

Table 1) from a local grocery store also were very low ranging from 0.2 – 0.3 µg/g (d.w.). The exception was a sample of an oyster mushroom with a slightly higher value of 1.9 µg/g.

3) Cadmium and Mercury

The mean level of cadmium in 10 samples of morels (ID #s 125 – 134, Table 1) from Fairbanks, Alaska, was 0.97 µg/g (d.w.) (range 0.2 – 2.2 µg/g).

These values were comparable with the mean value of 0.83 µg/g (range <0.1 – 2.5 µg/g, N = 31) in all morel samples from the study area.

The levels of cadmium in seven fungi samples (ID #s 135 – 141) from a local grocery store were very low (range <0.1 – 0.6 µg/g) and were comparable with low levels in fungi from many areas in the study area.

The levels of mercury in all 17 samples of fungi from other regions (ID #s 125 – 141) also were low ranging from <0.01 – 0.08 µg/g (d.w.). These levels of mercury were comparable with low levels in fungi from many areas of the study area (Table 1).

5.5. Heavy Metal Intakes through the Consumption of Mushrooms and Human Health Risk Assessments

5.5.1. Arsenic Intake through Mushrooms and Health Risk Assessment

The following five main points, calculations and scenarios demonstrate that the maximum tolerable consumption of edible wild mushrooms growing in and around Yellowknife is very low regarding the intake of toxic inorganic arsenic.

For example, based on calculations using several scenarios, an adult weighing 65 kg could consume only from 1.4 – 5.5 gram (g) per day, 2.8 – 11.2 g/day, 6 – 24.3 g/day, and up to 19 – 76.3 g/day of fresh wild mushrooms before exceeding the Canadian health standard for inorganic arsenic of 0.14 mg/day.

The wide range of calculations considered the best and worst case scenarios demonstrating that a 50:50 chance exists of unknowingly harvesting mushrooms with moderately to highly elevated levels of total arsenic and inorganic arsenic within and around Yellowknife.

Thus, consumers could exceed the health standard for inorganic arsenic even with a very small helping of fresh mushrooms. Additional intake of arsenic through daily dietary also must be considered.

1) Health Standard for Inorganic Arsenic

The Canadian health standard for inorganic arsenic, which is considered to be more toxic than organic arsenic (for more details on toxicity see Section 6.8.1), are based on the “provisional Tolerable Daily Intake” (pTDI) of arsenic recommended by the World Health Organization (WHO 1993a and 1989).

The pTDI for inorganic arsenic is 2.14 µg or 0.00214 milligram (mg) per kilogram (kg) of body weight per day. The pTDI is equivalent to a daily intake of 0.1391 mg (= 0.14 mg) of inorganic arsenic for an adult weighing 65 kg, or equivalent to an annual intake of 50.77 mg or a seasonal (60 days) intake of 8.3 mg inorganic arsenic.

2) Considerations for Health Risk Calculations of Arsenic Intake through Mushrooms

a) For a human health risk assessment, control samples of wild mushrooms from unpopular, inaccessible or remote background areas, and poisonous or unpopular mushrooms, need to be excluded. These mushrooms are not available or consumed by local people (for harvest areas and harvest activities see Tables 1a – c).

Hence, from the total of 124 local fungi samples tested for arsenic, only 67 samples (54%) of edible wild mushrooms from accessible and popular harvest areas represent the mushrooms which typically are harvested and consumed by residents in the Yellowknife area (Table 1b).

The remaining 57 samples (46%) of fungi include 24 samples from unpopular and distant background areas; 21 samples from inaccessible and remote pristine areas; 10 poisonous fungi and two unpopular fungi which are avoided by local people (Table 1a).

b) The health risk calculations on the intake of total arsenic and inorganic arsenic through the consumption of edible wild mushrooms by residents of the Yellowknife area are based on the following values.

- The above mentioned 67 samples of representative edible wild mushrooms (see point 2a) consumed by local people (Table 1b).

- A mean drying ratio of 1:12 dry:wet weight of mushroom (for details see point 5d below).

- The reported percentage of inorganic arsenic (for details see Section 5.4.2) found in edible wild mushrooms: scenario 1 = 22.36% inorganic arsenic, and scenario 2 = 89.8% inorganic arsenic contained in 100% total arsenic found in fungi.

3) Human Health Risk Assessment of Arsenic Intake through Mushrooms

Based on the above considerations for health risk calculations (see point 2b), the appropriate values and calculations for a human health risk assessment of total arsenic and inorganic arsenic concentrations in edible wild mushrooms are as follows.

a) Mean levels of total arsenic and inorganic arsenic in 67 samples of edible wild mushrooms from all popular harvest areas which are frequented by local harvesters. This includes areas in and around Yellowknife, and along the Ingraham Trail road 5 – 52 km east of Yellowknife. The following calculations include morel mushrooms from Tibbitt Lake in 1999 (as shown in Table 1b).

- Mean value = 61.7 ppm total As dry weight (d.w.) or 5.14 mg/kg total As fresh weight (f.w.) in fungi (based on 1:12/dry:wet; 1 ppm = 1 mg/kg) = 1.15 and 4.62 mg/kg inorganic As (f.w.) in fungi (based on 22.36% and 89.8% inorganic As of total As in fungi, respectively); range = <0.2 – 1370 ppm total As (d.w.) in fungi (*N* = 67) (Table 1b).

- An adult weighing 65 kg could consume 30.3 g/day (scenario 1) or up to a maximum of 121 g/day (scenario 2) of fresh mushrooms before exceeding the pTDI of 0.14 mg/day inorganic arsenic for an adult of 65 kg.

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

b) When excluding the Tibbitt Lake morels, which were available only in 1999 (Table 1b), then the mean values of arsenic in 56 samples of edible wild mushrooms from all popular harvest areas in and around Yellowknife, and along the Ingraham Trail road 5 – 52 km east of Yellowknife, are as follows.

- Mean value = 73.6 ppm total As (d.w.) or 6.13 mg/kg total As (f.w.) = 1.37 and 5.5 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range = 0.2 – 1370 ppm total As (d.w.) in fungi (*N* = 56) (Table 1b).

- An adult weighing 65 kg could consume 25.5 g/day (scenario 1) or up to a maximum of 102.2 g/day (scenario 2) of fresh wild mushrooms before exceeding the pTDI of inorganic arsenic.

c) Concentrations of total arsenic and inorganic arsenic in edible wild mushrooms from popular harvest areas in and around Yellowknife.

- Mean value = 97.8 ppm total As (d.w.) or 8.15 mg/kg total As (f.w.) = 1.82 and 7.3 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range = 1.0 – 1370 ppm total As (d.w.) in fungi (*N* = 39) (Table 1b).

- An adult weighing 65 kg could consume 19 g/day (scenario 1) or up to a maximum of 76.3 g/day (scenario 2) of fresh wild mushrooms before exceeding the pTDI of inorganic arsenic.

d) However, the above mean values do not reflect the levels of arsenic in mushrooms from specific popular harvest areas or hot spots, and/or in specific species of popular fungi. For example, one of the most popular and closest harvest areas for Yellowknifers (for harvest areas see Table 1c) is the pine forest around the YK golf course, where the following levels of arsenic in edible wild mushrooms were found.

- Mean value = 307.4 ppm total arsenic (d.w.) or 25.62 mg/kg total arsenic (f.w.) = 5.73 and 23.0 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range 1.0 – 1370 ppm total arsenic (d.w.) in fungi (*N* = 7) (Table 1c).

- An adult weighing 65 kg could consume only from 6 – 24.3 g/day (scenarios 1 and 2) of fresh mushrooms before exceeding the pTDI for inorganic arsenic.

For popular matsutake mushroom from the forest around the YK golf course.

- Mean value = 663.33 ppm total arsenic (d.w.) or 55.28 mg/kg total arsenic (f.w.) = 12.36 and 49.64 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range 280 – 1370 ppm total arsenic (d.w.) in fungi (*N* = 3) (Table 1c).

- An adult weighing 65 kg could consume only from 2.8 – 11.2 g/day (scenarios 1 and 2) of fresh matsutake mushrooms before exceeding the pTDI for inorganic arsenic.

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

e) Mean concentrations of total arsenic and inorganic arsenic in all matsutake mushrooms from all areas, including distant and less impacted background areas (Table 1a).

- Mean value = 190.01 ppm total As (d.w.) or 15.83 ppm total As (f.w.) = 3.54 and 14.21mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range 11.0 –

1370 ppm total As (d.w.) in fungi (*N* = 13) (Table 1a).

- An adult weighing 65 kg could consume only 9.8 g/day (scenario 1) or up to a maximum of 39.3 g/day (scenario 2) of fresh matsutake mushrooms before exceeding the pTDI for inorganic arsenic.

f) Mean concentrations of total arsenic and inorganic arsenic in other mushroom species growing in popular harvest areas in the Yellowknife area (Table 1b).

- Shaggy mane mushrooms: mean value = 112.78 ppm total arsenic (d.w.) or 9.4 mg/kg total arsenic (f.w.) = 2.1 and 8.44 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range = 3.6 – 494 ppm total arsenic (d.w.) in fungi (*N* = 8) (Table 1b).

- An adult weighing 65 kg could consume only 16.6 g/day (scenario 1) and up to 66.6 g/day (scenario 2) of fresh shaggy mane mushrooms before exceeding the pTDI for inorganic arsenic.

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

- Meadow mushrooms: mean value = 72.92 ppm total arsenic (d.w.) or 6.08 mg/kg total arsenic (f.w.) = 1.36 and 5.46 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range 2.3 – 286 ppm total arsenic (d.w.) in fungi (*N* = 8) (Table 1b).

- An adult weighing 65 kg could consume only 25.6 g/day (scenario 1) and up to 103 g/day (scenario 2) of fresh meadow mushrooms before exceeding the pTDI for inorganic arsenic.

- Puffballs: mean value = 75.83 ppm total arsenic (d.w.) or 6.32 mg/kg total arsenic (f.w.) = 1.41 and 5.67 mg/kg inorganic As (f.w.) in fungi (based on point 2b above); range 1.8 – 135 ppm total arsenic (d.w.) in fungi (*N* = 3) (Table 1b).

- An adult weighing 65 kg could consume only 24.7 g/day (scenario 1) and up to 99.1 g/day (scenario 2) of fresh puffballs before exceeding the pTDI for inorganic arsenic.

g) However, when using the highest levels of total arsenic found in edible wild mushrooms, such as 1370 ppm (d.w.) in matsutake (ID # 25, Table 1a) from popular harvest areas, results in the following calculations.

The intake of inorganic arsenic for a person consuming 1 kg of fresh mushrooms from this site would be 25.5 mg of inorganic arsenic (based on point 2b above) or equivalent to about half the annual pTDI of 50.77 mg of inorganic arsenic for an adult weighing 65 kg.

- An adult weighing 65 kg could eat only 5.5 g/day of fresh mushrooms before exceeding the pTDI for inorganic arsenic, without even considering additional dietary intake of arsenic.

h) Considering the worst case scenarios and the highest concentrations of inorganic arsenic with 89.8% found in a meadow mushroom (ID # 30, Table 4) from Yellowknife, and 76% inorganic arsenic in matsutake (ID # 13, Table 4) from an assumed less impacted background area, and using the highest levels of total arsenic with 1370 ppm found in matsutake (ID # 25, Table 1c), results in the following calculations.

- An adult weighing 65 kg could eat only 1.4 – 1.5 g/day or 0.5 – 0.6 kg/year of fresh mushrooms before exceeding the pTDI for inorganic arsenic, without considering additional daily dietary intake of arsenic.

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

The above samples (ID # 13 and 25) with highly elevated levels of total arsenic and inorganic arsenic represent the prized American white matsutake (*Tricholoma magnivelare*) also called pine mushroom. Pine mushrooms are very popular and harvested in large quantities in pine forests adjacent to the Yellowknife golf club, and in many other areas around town and along road corridors.

Samples of two other matsutake from the golf club area also contained high levels of total arsenic with 280 µg/g and 340 µg/g (d.w.) (ID #s 23 and 24, Table 1c). As well, elevated levels of arsenic were present in all matsutake samples from all areas (Table 1).

i) In contrast to all of the above points (3a – h) and the points below (4a – d), if wild mushrooms are harvested in distant or remote background areas far away from the city of Yellowknife, mines and roads, then considerable amounts of edible wild mushrooms can be consumed safely without exceeding the pTDI for inorganic arsenic.

- An adult weighing 65 kg could eat about from 185 – 580 g/day of fresh mushrooms every day for 365 days without exceeding the pTDI for inorganic arsenic (based on data and background areas in Table 1a).

4) Results of Interviews with Harvesters and Health Risk Assessment of Arsenic

a) Based on interviews with 26 local mushroom harvesters (for more details see Section 4.4.2), this study calculated the following intake of arsenic during a 12-month period from 1998 – 1999.

The annual intake of arsenic for six of 26 adult harvesters and residents with the highest consumption of fungi (9 – 15 kg of fungi/person/year, category 1 in Table D) was 12.97 – 73.84 mg total arsenic (Table 5). This is equivalent to 2.90 – 16.51 mg of inorganic arsenic per person/year (based on 22.36% inorganic As of 100% total As in fungi; for more details see Section 5.4.2).

- This translated into a low intake ranging from 0.0079 – 0.0452 mg/day of inorganic arsenic or 0.06 – 0.32 times the pTDI of 0.14 mg inorganic arsenic for an adult of 65 kg.

b) If all six harvesters would have consumed all of their mushrooms fresh during the 60-day-season in 1998/99, the seasonal intake (based on 22.36% inorganic As in total As of fungi; see Section 5.4.2) would range from 0.048 – 0.275 mg/day/person of inorganic arsenic for 60 days, or 0.34 – 1.96 times the pTDI for 60 days.

- Three of six harvesters (ID # 2, 3 and 6; Table 5) would exceed the pTDI by a factor of 1.96 times every day for 60 days (based on 65 kg body weight); and a fourth harvester (ID # 1) would exceed the pTDI for inorganic arsenic slightly by a factor of 1.17 times every day for 60 days.

c) However, based on 89.8% inorganic arsenic of total arsenic in fungi (for more details see Section 5.4.2), the calculated intake of inorganic arsenic would be about four times higher or 11.65 – 66.31 mg of inorganic arsenic per person/year.

- Three of these six harvesters would have exceeded the pTDI for inorganic arsenic by a factor of 1.3 times every day for 365 days for an adult weighing 65 kg.

- The calculated seasonal (60 days) intake of inorganic arsenic would be ranging from 0.19 – 1.1 mg/day of inorganic arsenic for 60 days. All six harvesters would have exceeded the pTDI for inorganic arsenic by factors ranging from 1.4 – 7.8 times every day for 60 days.

d) Applying the same calculations and worst case scenario from above for all 26 interviewed local mushroom harvesters and consumers, resulted in the following calculations.

- Thirteen of 26 people would have exceeded the pTDI for inorganic arsenic every day during a 60-day harvest season.

- The intake of inorganic arsenic for the other half of the interviewees was low or insignificant (categories 2 – 4, in Table 5 and Table D).

- For the general population with lower consumption of fungi (categories 5 and 6 in Table 5 and Table D) the intake of inorganic arsenic was insignificant and far below the pTDI for every day during the 12-month period from 1998 – 1999.

5) Other Considerations for Health Risk Assessments of Arsenic in Mushrooms

a) For health risk assessments, it must be considered that the mean values of arsenic in mushrooms used for the calculations above (points 3 and 4) do not represent the concentrations of arsenic in certain locations, hot spots and patches of mushrooms. Typically, local mushroom harvesters frequent their favorite specific spots and productive patches of mushrooms they know. There is a chance that someone may harvest the same bad spot or contaminated patch of mushrooms over and over again.

For example, in popular harvest areas and/or in specific locations or spots in the Yellowknife area, a local harvester takes the following chances of collecting and consuming a bad mushroom with highly elevated levels of arsenic (calculations based on Tables 1a and b).

- There is a 1:1 chance of consuming one of two mushrooms with moderately to highly elevated levels of arsenic ranging from 5.0 – 1370 ppm (d.w.) (N = 67) with much greater tendency towards the higher value.

- There is a 1:2 chance of consuming one of three mushrooms with highly elevated levels of arsenic ranging from 19.9 – 1370 ppm (d.w.) with much greater tendency towards the higher value.

- There is a 1:4 chance of consuming one of five mushrooms with highly elevated levels of arsenic of which up to 89.8% are toxic inorganic arsenic forms including up to 89.5% of arsenite (As III) (for more details see Section 5.4.2).

b) Also considered must be that many local passionate mushroom harvesters, including 15 of 26 interviewees from above (point 4), dry or freeze large quantities of mushrooms from the above mentioned popular harvest areas (points 3 and 4) and hot spots (point 5a) in and around Yellowknife.

- The consumption of 9 – 15 kg/person/year of fresh or rehydrated edible wild mushrooms is typical for mushroom lovers in the Yellowknife area (for more details see Section 4.4.2; and Tables 5 and D).

- The consumption of 100 – 150 g of fresh mushrooms per day during the mushroom season is not unusual for local mushroom lovers.

- Most harvesters share their mushroom meals with family, friends and children. The tolerable consumptions of mushrooms presented in the health risk scenarios above (points 3a – h) would be even smaller for children and people with lower body weights (for more details see above point 1).

c) Avid hobby mushroom harvesters, including many of the 26 interviewees from above, anticipate a life time of this enjoyable recreational activity and consumption of edible wild mushrooms, and believe they are enjoying and sharing a healthy wild mushroom meal each time.

- However, as demonstrated above (points 3 and 4), local mushroom harvesters in the Yellowknife area ingest moderately to highly elevated levels of total arsenic and toxic inorganic arsenic in mushrooms nearly at all times and for long periods or a life time.

- The long term intake even of low but moderately elevated levels of toxic metals, such as inorganic arsenic, is reported to cause adverse effects on the human health (for more details on toxicity see Section 6.8).

- In addition, residents in the Yellowknife area already are exposed to natural and anthropogenic elevated arsenic levels in the environment, including garden produce, dust from road gravel and sand beaches, etc. (for more details see Section 6.7.1., point 6).

- Additional daily dietary intake of arsenic through foods and liquids also must be considered (for more details see Section 6.7.1., point 6).

- All of the above cumulative impact factors (points 5a – c) must be considered for a human health risk assessment on arsenic intake through the consumption of edible wild mushrooms.

d) The concentrations of total arsenic and inorganic arsenic in mushrooms presented in this study are conservative values because of the following reasons.

- The mushroom samples were rinsed with water before analysis to replicate a common practice of washing fungi before cooking (for more details see Section 4.2.3). Washing reduced total arsenic levels in fungi by a mean value of 38.4% (for more details see Sections 5.4.6 and 6.6). However, not all interviewed local harvesters washed their mushrooms before cooking. Some rinsed only certain hardy species of fungi while species with soft tissues were cleaned with a brush or cloth.

  Thus, the intake of arsenic through unwashed mushrooms could be higher by a mean value of 38.4% than the values and calculations reported above (points 3 and 4).

- In this study, a mean value of 16.7% of arsenic included unspecified arsenic forms likely containing certain percentages of inorganic arsenic species which were not considered in the above health risk calculations (for more details see Section 5.4.2; and Table 4). There is potential that edible wild mushrooms in and around Yellowknife also could contain inorganic arsenic species such as highly toxic arsenic trioxide (As_2O_3) from mine roaster emissions (for more details see Section 6.1.1, point 2a).

- This study used the actual mean drying ratio of 1:12 (dry:wet weight) for all mushroom samples and health risk calculations regarding the conversion from arsenic levels in the dry weight of fungi to the wet/fresh weight of fungi. Therefore, the arsenic levels in fresh fungi reported here are lower by 16.7% compared with calculations using a mean drying ratio of 1:10 for mushrooms (for more details see Section 4.4.2, point 3).

  This value of 16.7% incidentally is the same as the percentage of 16.7% for unidentified arsenic species in fungi (see above), however, there are no connections between these two measurements.

- The worst case scenarios in this paper were based on the highest levels of inorganic arsenic with 89.8% of total arsenic found in mushrooms. Usually, health risk assessments also consider the worst case by assuming that all arsenic is inorganic arsenic thus marking conservative lower limits for the amount of mushrooms which can be consumed.

5.5.2. Lead Intake through Mushrooms and Health Risk Assessment

The following twelve points demonstrate that the maximum acceptable consumption of edible wild mushrooms growing in and around Yellowknife ranged from 2.3 – 4.5 g/day, 11.3 – 23 g/day, and up to 32.5 – 35.2 g/day of fresh mushrooms before exceeding the pTDI of lead for an adult weighing 65 kg.

The wide range of calculations considered the best and worst case scenarios. The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights. Additional daily dietary intake of lead through foods and liquids also must be considered.

1) Health Standard for Lead

The Canadian health standard for lead is founded on the WHO pTDI of 3.57 µg (= 0.00357 mg) per kg of body weight/day for adults and children; or a daily intake of 0.23 mg of lead for an adult weighing 65 kg (WHO 1995, WHO 1993b.). The pTDI is equivalent to an annual intake of 84.70 mg or a seasonal (60 days) intake of 13.8 mg of lead for an adult weighing 65 kg.

2) Considerations for Health Risk Calculations of Lead Intake through Mushrooms

a) For a human health risk assessment, control samples of mushrooms from distant background areas and poisonous fungi need to be excluded, because these mushrooms are not available or consumed by local people (for harvest areas see Tables 1a – c).

Hence, from the total of 123 fungi samples tested for lead, only 66 samples (53.7%) from accessible and popular harvest areas represent the edible wild mushroom species which are consumed by residents (Table 1b).

The remaining 57 samples (46.3%) of mushrooms include 24 samples from unpopular and/or distant background areas; 21 samples from inaccessible and remote pristine areas; 10 poisonous fungi and two fungi which are avoided by local people (as indicated in Table 1a).

b) The health risk calculations on the intake of lead through the consumption of edible wild mushrooms by residents of the Yellowknife area are based on the following values.

- The above mentioned 66 samples of representative edible wild mushrooms (see point 2a) consumed by local people (Table 1b).

- A mean drying ratio of 1:10 dry:wet weight of mushroom was used for calculating lead levels in fresh fungi (in contrast, a ratio of 1:12 was used for arsenic in fungi; for more details see Sections 4.4.2, point 3).

3) Human Health Risk Assessment of Lead Intake through Mushrooms

Based on the above considerations for health risk calculations (see point 2b), the appropriate values and calculations for a human health risk assessment of lead concentrations in edible wild mushrooms from the study area are as follows.

a) Mean lead levels in 66 samples of edible wild mushrooms from all popular harvest areas frequented by residents in the Yellowknife area and along the Ingraham Trail 5 – 50 km east of Yellowknife. The following calculations include morel mushrooms from Tibbitt Lake (as shown in Table 1b).

- Mean value = 105.6 ppm dry weight (d.w.) or 10.56 mg/kg fresh weight (f.w.) in fungi; range = <0.1 – 1010 ppm (d.w.) in fungi (*N* = 66) (Table 1b).
- An adult weighing 65 kg could consume only 21.8 g/day of fresh mushrooms before exceeding the pTDI of 0.23 mg/day for lead.
- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

b) When excluding the Tibbitt Lake morel mushrooms, which were available only in 1999 and contained elevated lead levels (see below point c), then the values of lead in all other edible wild mushrooms from all popular harvest areas in the study area are as follows.

- Mean value = 65.3 ppm (d.w.) or 6.53 mg/kg (f.w.) in fungi; range = <0.1 – 1010 ppm (d.w.) in fungi (*N* = 55) (Table 1b).
- An adult weighing 65 kg could consume 35.2 g/day of fresh mushrooms before exceeding the pTDI for lead.

c) Regarding the Tibbitt Lake morel mushrooms from 1999, the author of this paper found out in 2013, that some residents still consume dried morels which they harvested in large quantities in 1999 from the Tibbitt Lake forest fire site. The levels of lead in these morels from Tibbitt Lake were as follows.

- Mean value = 307.16 ppm (d.w.) or 30.7 mg/kg (f.w.) in fungi; range = 0.2 – 993 ppm (d.w.) in fungi (*N* = 11). More than half of the morels (6 of 11) contained lead levels ranging from 25.5 – 99.3 mg/kg (f.w.) (Table 1b).

- An adult weighing 65 kg could consume only 7.5 g/day of fresh or rehydrated morels (based on the mean value of 30.7 mg/kg Pb) before exceeding the pTDI of 0.23 mg/day for lead.

- However, there is a 1:2 chance of consuming one of three morels with extremely high levels of lead, thus lowering the tolerable consumption to smaller amounts.

  An adult weighing 65 kg could consume only from 2.3 – 5.6 g/day of fresh or rehydrated morel mushrooms before exceeding the pTDI of 0.23 mg/day for lead.

- The tolerable consumption of morels from Tibbitt Lake would be even smaller for children and people with lower body weights (for more details see above point 1).

d) In contrast to the Tibbitt Lake morels from above, all other morel mushrooms from four different forest fire sites in the study area (Table 1a) contained very low levels of lead, as follows.

- Mean value = 0.18 ppm (d.w.) or 0.018 mg/kg (f.w.) in fungi; range = <0.1 – 0.5 ppm (d.w.) in fungi (*N* = 20) (Table 1a).

- An adult weighing 65 kg could consume 1277.8 g/day (almost 1.3 kg/day) of fresh or rehydrated morels every day for 365 days without exceeding the pTDI of lead.

e) Lead levels in mushrooms from popular harvest areas in and around Yellowknife.

- Mean value = 70.8 ppm (d.w.) or 7.08 mg/kg (f.w.) in fungi; range = <0.1 – 1010 ppm (d.w.) in fungi (*N* = 39) (Table 1b).

- An adult weighing 65 kg could consume 32.5 g/day of fresh mushrooms before exceeding the pTDI for lead.

f) However, the mean values of lead from above do not reflect the concentrations of lead in edible wild mushrooms from specific areas and hot spots (Table 1c). For example, the levels of lead in fungi from three of the most popular mushroom harvest areas around Yellowknife are as follows.

Lead levels in fungi from the sandy pine forest areas around the YK golf course

- Mean value = 100.0 ppm (d.w.) or 10 mg/kg (f.w.) in fungi; range = 0.2 – 509 ppm (d.w.) in fungi (*N* = 7); and for boletus mushrooms: mean = 203.3 ppm (d.w.) or 20.33 mg/kg (f.w.) in fungi; range = 46 – 509 ppm (d.w.) in fungi (*N* = 3) (Table

1c).

- An adult weighing 65 kg could consume only from 11.3 – 23 g/day of fresh mushrooms before exceeding the pTDI for lead.

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

Yellowknife old town recreational meadow, Jolliffe Island, Giant mine and Vee Lake road areas, and Yellowknife River park

- Mean value = 165.9 ppm (d.w.) or 16.59 mg/kg (f.w.) in fungi; range = 0.8 – 1010 ppm (d.w.) in fungi (*N* = 12) (Table 1c).

- An adult weighing 65 kg could consume only 13.8 g/day of fresh mushrooms before exceeding the pTDI for lead.

Prelude Lake nature park

- Mean value = 94.2 ppm (d.w.) or 9.42 mg/kg (f.w.) in fungi; range = 18.3 – 192 ppm (d.w.) in fungi (*N* = 3) (Table 1c).

- An adult weighing 65 kg could consume 24.4 g/day of fresh mushrooms before exceeding the pTDI for lead.

g) The worst case scenario and the highest levels of lead found in edible wild mushrooms from popular harvest areas within the city limits of Yellowknife, including the golf course area, old town, and Yellowknife River park, are as follows.

- Lead levels of 51.1 and 101 mg/kg (f.w.) in meadow mushrooms (ID # 43 and 55, Table 1b); and 50.9 mg/kg (f.w.) in boletus mushroom (ID # 22) (Table 1b).

- An adult weighing 65 kg could eat only from 2.3 – 4.5 g/day of fresh mushrooms before exceeding the pTDI of 0.23 mg/day for lead, without considering additional daily dietary intake of lead.

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights (for more details see above point 1).

h) In contrast to nearly all of the health risk scenarios from above (points 3a – g), if wild mushrooms are harvested in distant or remote background areas far away from the city of Yellowknife, mines and roads, then considerable amounts of edible wild mushrooms can be consumed safely, as the following examples demonstrate.

Lead levels in edible wild mushrooms, including morel mushrooms, from unpopular areas with no or few harvest activities (or only one morel harvest after a forest fire) located in assumed less impacted background areas 33 – 140 km away from Yellowknife.

- Mean value = 4.5 ppm (d.w.) or 0.45 mg/kg (f.w.) in fungi; range = <0.1 – 1010 ppm (d.w.) in fungi (*N* = 24) (Table 1a).
- An adult weighing 65 kg could eat 511 g/day (or about 0.5 kg/day) of fresh mushrooms every day for 365 days without exceeding the pTDI of lead.

Lead levels in edible wild mushrooms, including morel mushrooms, from inaccessible pristine areas located 50 – 300 km away from Yellowknife where there are no mushroom harvests.

- Mean value = 0.16 ppm (d.w.) or 0.016 mg/kg (f.w.) in fungi; range = <0.1 – 0.5 ppm (d.w.) in fungi (*N* = 21) (Table 1a).
- An adult weighing 65 kg could eat 14,375 g/day (or about 14 kg/day) of fresh mushrooms every day for 365 days without exceeding the pTDI of lead.

4) Results of Interviews with Harvesters and Health Risk Assessment of Lead

a) The worst case scenario of the calculated annual intake of lead through edible wild mushrooms for 16 of 26 local adult harvesters, interviewed during a 12-month period from 1998 – 1999, ranged from 102.76 – 472.02 mg of lead per person/year (Table 5).

- This is equivalent to an annual intake of 1.2 – 5.6 times the pTDI of lead every day for 365 days, or a seasonal intake of 7.4 – 32.2 times the pTDI every day for 60 days, if the harvesters alone consumed all mushrooms during these periods.

Most harvesters shared their mushroom meals with others. Only six of 26 harvesters with the highest consumption of fungi (category 1, Table 5) consumed the full reported amounts of mushrooms during 365 days, and much of it during the mushroom season of 60 days in 1999 (for more details see Section 4.4.2, points 2 and 3).

- The calculated intake of lead for these six harvesters ranged from 1.3 – 5.6 times the pTDI every day for 365 days during a 12-month period from 1998 – 1999.

However, it must be considered that these calculations were founded partially on the consumption of large amounts of available morels containing extremely elevated levels of lead in 1999. In addition, other mushroom species with high lead levels also were available in abundance during the same year.

b) Most interviewed harvesters typically hoarded as many mushrooms as possible from high-producing patches to compete with others from finding or harvesting them. There is a good chance of harvesting a bad patch of mushrooms over and over again.

For example, the meadow mushroom (*Agaricus*) with extremely high lead levels of 1010 ppm (d.w.) (ID # 43, Table 1b) originated from a well-known patch of meadow mushrooms growing in a large meadow located on top of a former landfill and beside a former welding shop in the old town of Yellowknife. The meadow is a recreational area and a popular meadow mushroom picking site for residents in the area.

The lead intake of a person consuming 1 kg of fresh meadow mushrooms from this site would be 101 mg or well above the annual pTDI of 84.7 mg of lead for an adult weighing 65 kg.

In 1999, two adult harvesters (ID # 4 and 5, Table D) consumed each about 4 kg of fresh meadow mushrooms from this site within a growing season of 60 days or equivalent to a daily consumption of 66.7 g fresh mushrooms per person.

- The two harvesters may have exceeded the pTDI of lead by a factor of 29 times every day for 60 days.

c) In summary, the lead intake through fungi for six interviewed harvesters ranged from 1.3 – 5.6 times the annual tolerable intake in 1999. Another 10 of 26 harvesters (categories 1 to 3, Table 5) may have exceeded the pTDI for lead on a seasonal basis for 60 days or potentially even their annual tolerable intake.

Adults with lower consumptions of fungi (categories 4 to 6, Table 5) may have exceeded the pTDI for lead on some days during the 1999-season because of the consumption of large amounts of morel mushrooms.

The general population of >1000 consumers (Table D) would not have exceeded the pTDI for lead at any time in 1999.

After 1999, the intake of lead through fungi probably was lower for many consumers because of the absence of lead-contaminated morels from Tibbitt Lake. However, this likely was offset by high concentrations of lead found in many of the new samples of other mushroom species presented in this paper. Also, as mentioned above (point 3c), some people still consume lead-contaminated dried morels which were harvested at Tibbitt Lake in 1999.

5) Other Considerations for Health Risk Assessments of Lead in Mushrooms

a) For health risk assessments, it must be considered that the mean values of lead in mushrooms used for the calculations above (points 3 and 4) do not represent the concentrations of lead in certain locations, hot spots and patches of mushrooms. There is a chance that someone may harvest the same bad spot with contaminated mushrooms over and over again.

For example, in popular harvest areas and/or in specific locations or spots in the Yellowknife area, a local harvester takes the following chances of collecting and consuming a bad mushroom with highly elevated levels of lead (calculations based on Table 1b).

- There is a 1:1 chance of consuming one of two mushrooms with moderately to highly elevated levels of lead ranging from 18.3 – 1010 ppm (d.w.) (N = 66) with greater tendency towards the higher value.

- There is a 1:2 chance of consuming one of three mushrooms with highly elevated levels of lead ranging from 46 – 1010 ppm (d.w.) with much greater tendency towards the higher value.

- There is a 1:4 chance of consuming one of five mushrooms with extremely elevated levels of lead ranging from 110 – 1010 ppm (d.w.) with much greater tendency towards the higher value (Table 1b).

b) Also, it must be considered that many local passionate mushroom harvesters, including 15 of 26 interviewees from above (point 4), dry or freeze large quantities of mushrooms from popular harvest areas in the Yellowknife area.

The consumption of 9 – 15 kg of fresh or rehydrated mushrooms per person/year, and/or 100 – 150 g per day during the mushroom season, is not unusual for residents (for more details see Section 4.4.2; Table 5; and Table D). Additional daily dietary intake of lead through foods and liquids also must be considered.

c) The values of lead in fungi in this paper are conservative because all fungi, except for all morels and seven control samples (as indicated in Table 1), were rinsed with water which reduced lead levels in fungi by a mean value of 31.2% (for more details see Sections 4.2.3 and 5.4.6).

d) The levels of lead reported for morel mushrooms (points 3c and d above) represent conservative values and could be 28% higher considering that the actual drying ratio of morels was 1:7.8 and not 1:10 as used for the calculations of lead in all mushrooms (for more details see Section 4.4.2, point 3; and Table E).

5.5.3. Cadmium Intake through Mushrooms and Health Risk Assessment

1) Health Standard for Cadmium

The Canadian health standard for cadmium is based on the WHO pTDI of 1.0 µg (= 0.001 mg) per kg of body weight per day for adults, or a daily intake of 0.065 mg of total cadmium for an adult weighing 65 kg. The pTDI is equivalent to an annual intake of 23.7 mg or a seasonal (60 days) intake of 3.9 mg of cadmium for an adult weighing 65 kg (WHO 1992, WHO 1977, WHO 1976a).

2) Human Health Risk Assessment of Cadmium Intake through Mushrooms

a) The highest concentrations of cadmium in popular edible wild mushrooms were found in meadow mushrooms (*Agaricus*) from Rat Lake and the Yellowknife River park with 8.4 and 17.1 ppm (d.w.) (Table 1) or 0.7 and 1.425 mg/kg (f.w.) in fungi (based on 1:12 dry:wet weight of fungi).

- An adult weighing 65 kg could eat only from 45.6 – 92.8 g/day of fresh meadow mushrooms before exceeding the pTDI of cadmium. Meadow mushrooms are very popular amongst local mushroom harvesters and available in large numbers.

- The tolerable consumption of mushrooms would be smaller for children and people with lower body weights (for more details see above point 1).

The highest level of cadmium, however, was found in the unpopular Tippler's Bane mushroom (*Coprinus*) with 32.4 ppm (d.w.) (Table 1) or 2.7 mg/kg (f.w.). This mushroom is edible with caution (no alcoholic beverages before and after consumption) but unpopular amongst northern mushroom harvesters.

- An adult weighing 65 kg could eat only 24.1 g/day of fresh mushrooms before exceeding the pTDI of cadmium.

b) The highest calculated annual intakes of cadmium for two of 26 harvesters in this study (category 1, ID# 3 and # 6, Table 5) were low with 1.58 mg and 1.70 mg. This is equivalent to 0.4 times the seasonal (60 days) and 0.07 times the annual pTDI of cadmium for an adult weighing 65 kg.

- For the remaining consumers in all categories, the intake of cadmium through local edible wild mushrooms was insignificant (Table 5).

c) The cadmium levels in fungi represent slightly conservative values in this paper because rinsing of mushrooms before analysis reduced cadmium levels in fungi by a mean of 1.9% (for more details see Sections 5.4.6 and 6.6).

As well, this study used a mean drying ratio of 1:12 dry:wet weight of fungi for all calculations of cadmium levels from dry to fresh weight of fungi. Thus, the cadmium levels in fresh mushrooms reported here are lower by 16.7% compared with calculations using a mean drying ratio of 1:10 for mushrooms (for more details see Section 4.4.2, point 3).

5.5.4. Mercury Intake through Mushrooms and Health Risk Assessment

1) Health Standard for Mercury

The Canadian health standard for mercury is based on the WHO pTDI of 0.71 µg (= 0.00071 mg) per kg of body weight per day for adults, or a daily intake of 0.046 mg for an adult weighing 65 kg. This is equivalent to an annual intake of 16.84 mg for an adult weighing 65 kg (WHO 1976a and b).

The intake risk of mercury to children and woman of child bearing age is higher, and therefore, the pTDI is lower with 0.2 µg (= 0.0002 mg) per kg of body weight per day for this group. For example, the pTDI for mercury is equivalent to a daily intake of 0.013 mg or an annual intake of 4.75 mg for a woman of child bearing age weighing 65 kg.

2) Human Health Risk Assessment of Mercury Intake through Mushrooms

a) The highest concentrations of mercury in edible wild mushrooms were found in shaggy mane mushrooms (*Coprinus*) from the Giant mine area with 2.69 and 4.29 ppm (d.w.) (Table 1) or 0.224 and 0.3575 mg/kg (f.w.) in fungi (based on 1:12 dry:wet weight of fungi).

- An adult weighing 65 kg could eat from 128.7 – 205.3 g/day of fresh mushrooms before exceeding the pTDI of mercury.

- A woman of child bearing age weighing 65 kg could eat only from 36.3 – 58 g/day of fresh mushrooms before exceeding the pTDI of mercury.

- The tolerable consumption of mushrooms would be smaller for children and people with lower body weights (for more details see above point 1).

The highest concentrations of mercury in meadow mushrooms (*Agaricus*) were found in mushrooms from the Giant mine area and the sewage road area with 1.33 and 1.65 ppm (d.w.) (Table 1) or 0.111 and 0.1375 mg/kg (f.w.) in fungi.

- An adult weighing 65 kg could eat from 334.5 – 414.4 g/day of fresh mushrooms before exceeding the pTDI of mercury.

- A woman of child bearing age weighing 65 kg could eat from 94.5 – 117 g/day of fresh mushrooms before exceeding the pTDI of mercury.

b) The calculated annual intake of total mercury through local fungi for four of 26 harvesters (ID# 1, 2, 3 and 6, Table 5) with a high consumption of mushrooms (9 - 15 kg/year) ranged from 0.37 – 0.59 mg, or 0.13 – 0.21 times the seasonal (60 days) and 0.02 – 0.03 times the annual (365 days) pTDI.

- The intake of mercury through fungi was insignificant for all interviewed 26 harvesters (categories 1 to 6, Table 5) and all consumer groups, including women of child bearing age and children.

- However, it must be considered that women of child bearing age and children consuming a single mushroom meal easily could exceed the tolerable amounts for shaggy mane mushrooms (*Coprinus*) from above with maximum tolerable consumptions ranging from 36.3 – 58 g/day. A typical mushroom meal contains 100 – 150 g.

c) Also, it must be considered that the concentrations of mercury in fungi represent conservative values in this paper because rinsing of mushrooms before analysis reduced mercury levels in fungi by a mean of 28.3% (for more details see Sections 5.4.6 and 6.6).

In addition, this study used a mean drying ratio of 1:12 dry:wet weight of fungi for all calculations of mercury levels from dry to fresh weight of fungi. Thus, the mercury levels in mushrooms reported here are lower by 16.7% compared with calculations using a drying ratio of 1:10 for mushrooms (for more details see Section 4.4.2, point 3).

5.6. Other Metals

All samples presented in this paper were analyzed for 26 heavy metals and some individual samples for 27 metals. No further interpretations of 22 – 23 metals are given in this paper since the focus was only on four heavy metals of special concern (As, Pb, Cd, and Hg).

However, when scrolling through the tabular data of the remaining metals (see Tables F to J), it is apparent that the levels of many metals in soil and fungi were higher within and around Yellowknife, mines, infrastructure, roads or other impacted areas than in background areas. These levels of metals decline gradually with increasing distances away from Yellowknife, mines and roads reaching lower concentrations in assumed or known undisturbed background areas.

6. DISCUSSION

6.1. Heavy Metals in Soil

6.1.1. Arsenic in Soil

1) In this study, arsenic concentrations in subsurface soil samples from Yellowknife ranged from 9.9 – 123 µg/g and up to 550 – 7310 µg/g in some locations (Table 1).

In comparison, ESG (2001a) concluded that background levels of arsenic in soil within the city of Yellowknife naturally ranged from 3 – 150 µg/g and were much higher than in the surrounding areas. ESG (2001a and b) reported the following sampling locations and ranges of arsenic levels in surface and subsurface soil samples (N = 219):

City of Yellowknife, 3 – 148 µg/g; community of Ndilo, 7 – 645 µg/g; Giant mine town site, 19 – 1,850 µg/g; soil and tailings on the Giant mine property, 41 – 3,821 µg/g; Giant mine roaster area, 21,500 and 87,000 µg/g; soil and tailings on the Con mine property, 29 – 12,600 µg/g up to 25,000 µg/g; community of Dettah, 7.2 – 144 µg/g; and Ingraham Trail road before the Yellowknife River bridge within city limits, 10 – 127 µg/g.

Arsenic levels in soil from vegetable gardens in residential areas of Yellowknife ranged from 11 – 56 µg/g. The highest arsenic values with 174 and 351 µg/g were reported in an abandoned garden at the former Giant mine town site (Koch *et al.* 2001).

EBA (2000) reported that arsenic levels in surface and subsurface soil samples collected in and around Yellowknife ranged from 40 – 310 µg/g (N = 11). Surface soil samples from control sites 3 – 9 km north of Yellowknife contained arsenic levels ranging from 8.36 – 36.7 µg/g (N = 13).

The findings by ESG (2001a and b), Koch *et al.* (2001), and EBA (2000) are comparable with the results of this study when looking into the specific sampling locations in and around Yellowknife.

In all of these studies, most of the soil samples collected within Yellowknife exceeded many times the soil quality guidelines for arsenic (CCME 2002). The guidelines recommend a maximum limit of 12 µg/g of arsenic in soil for all land use categories, such as agriculture, residential and park, commercial, and industrial use.

The arsenic species found in the environment in and around Yellowknife included harmless or less toxic organic arsenic compounds as well as toxic inorganic arsenic forms, such as arsenite (As III)), arsenate (As V), and arsenic trioxide (As_2O_3) from mine roaster emissions (INAC 2002; ESG 2001a; EBA 2000; Koch *et al*. 2000; this study).

2) Comparable regional contaminant studies on metal levels in soil and mushrooms in the North Slave region and NWT reported the following arsenic levels in soil.

Around the abandoned Colomac gold mine, located 222 km north of Yellowknife, arsenic levels in soil ranged from 0.27 – 56.2 µg/g (N = 236) (background and impacted areas) (Macdonald 2003a and b; Obst 2004 and 2003).

At the abandoned Port Radium uranium mine, located 475 km north-northwest of Yellowknife, arsenic levels in soil ranged from 13.3 – 68 µg/g up to 2142 – 5790 µg/g (background and impacted areas) (Macdonald 2004).

The arsenic levels in soil samples from the Colomac gold mine were much lower than those reported around the gold mines in the Yellowknife area. The Colomac mine used different gold extraction methods without roaster emissions of arsenic. The soil arsenic levels at the Port Radium uranium mine were about in the middle ranges of values found within Yellowknife. Roaster emissions were not present at Port Radium.

In comparison, Slovenian and Russian studies on metals in soil and mushrooms reported arsenic levels in soil ranging from 6.5 – 65.5 µg/g (Slekovec and Irgolic 1996); 3 – 40 µg/g (polluted areas), and 2 – 9 µg/g (background) (Barcan *et al*. 1998). Arsenic levels in metallurgical dust ranged from 0.1 – 0.9 % (Bargan *et al*. 1998; Kalac *et al*. 1991 and 1996).

These reported arsenic levels in Europe fall within the lower ranges of values found in many of the soil samples from Yellowknife in this study and other local studies from above.

3) This study reports gradually but significantly declining levels of arsenic in soil further away from Yellowknife and mines. Arsenic levels appear to approximate background values over granite about 40 km west and 33 – 49 km east of Yellowknife over sedimentary rocks and granite. The highest arsenic levels in soil were found around Giant and Con mines, and 0.5 – 5 km south-southwest (downwind) of the Giant mine roaster. Elevated arsenic levels were present within a radius of 6.5 – 9.2 km around Giant mine and 4.5 – 9.2 km south to west (downwind) of both former Giant and Con mine roasters (Tables 1 and A1).

In comparison, Kerr (2006) reported that the exact imprint of airborne anthropogenic contamination around Yellowknife currently is unknown but may extend within at least a 10 km radius of the city. Kerr (2006) concluded that only one sampling site 35 km west of Yellowknife may approximate background values over granite but minor airborne contamination cannot be completely ruled out. The findings by Kerr (2006) are comparable with the results of this study as well as with the following global studies.

European studies on metal levels in soil and mushrooms reported that dispersal and fallout of airborne heavy metals from mine roaster emissions caused highly elevated levels in distances up to 6 km. Elevated levels of 20 times the background levels occurred up to 30 km from smelters, and 2 – 3 times the background levels up to 40 – 50 km away. Elevated levels were detected up to 80 km from roasters (Bargan *et al*. 1998; Kalac *et al*. 1991 and 1996). In Russia, metal levels from mine emissions gradually decreased within 10 – 100 km of mine sites (AMAP 1997 and 1998).

4) ESG (2001a) and Kerr (2006) concluded that distinguishing between natural and anthropogenic arsenic sources would be a significant challenge because of the anthropogenic contamination in the vicinity of Yellowknife. Kerr (2006) reported that studies have shown an anthropogenic component is likely dominant in the Con and Giant mine areas (e.g., Nickerson 1999) (for more details see Section 6.3).

Natural sources of elevated arsenic levels in soil and environment are arsenic-rich volcanic bedrock and outcropping ore-grade mineralization in the Yellowknife greenstone belt area. The levels of arsenic in bedrock range from low levels in granite (<2 µg/g) to extremely high levels in volcanic rocks and gold ore (>10,000 – 30,000 µg/g) around the mines (van Hees *et al*. 2006; Kerr 2006; Tables A1 and A2) (for more details see Section 6.2, point 3).

Mining of arsenic-rich gold ore by five former gold mines released considerable amounts of arsenic and other metals into the environment around Yellowknife during six decades of mining and seven decades of anthropogenic activities. The combined anthropogenic contributions of arsenic into the environment through roaster emissions, tailings, outflows, waste rock, road gravel and dust, was significant in Yellowknife from 1938 – 1999 (INAC 2002; ESG 2001a; EBA 2000).

According to EBA (2000) several tons of arsenic were released daily into the atmosphere in Yellowknife during the early and mid 1950's, and reduced by the early 1970's to 8.8 tons per year, or approximately 20 to 30 kg/day. The major contribution of arsenic into the atmosphere presumably came from roaster emissions. This included the former Con mine gold roaster ceasing operation in 1970, and the Giant mine roaster operating until the closure of the mine in 1999.

INAC (2002) reported that 237,000 tons of highly toxic arsenic trioxide (As_2O_3) dust, which contains approximately 60% arsenic, are stored underground at the Giant mine site. Airborne arsenic trioxide fallout from roaster emissions is present in the surrounding environment and surface material. At the base of the former Giant mine roaster stake, arsenic levels reached up to 21,500 and 87,000 µg/g (ESG (2001a).

6.1.2. Lead in Soil

This study reports levels of lead in soil within and around Yellowknife ranging from 3.2 – 296 µg/g, 10 – 66.5 µg/g near roads, 1.0 – 9.0 µg/g further away from Yellowknife and roads, and 0.2 – 0.3 µg/g in undisturbed background areas.

Comparable regional contaminant studies on soil and mushrooms in the North Slave region and NWT reported levels of lead in subsurface and surface soil ranging from <0.05 – 6.06 µg/g (background) to 13.5 – 154 µg/g (impacted areas) at the abandoned Colomac gold mine. At the abandoned Port Radium uranium mine, lead levels ranged from 14.5 – 26.5 µg/g (background) to 251 – 966 µg/g and up to 1780 – 2100 µg/g (impacted areas) (Macdonald 2004, 2003a and b).

The lead levels at the Port Radium mine are much higher than those reported in this and other studies. In comparison, the lead levels at the Colomac mine fall within similar ranges of values found within and around Yellowknife in this study, as well as in the following global studies.

In Russia, comparable studies on metals in soil and mushrooms reported that lead levels in soil ranged from 10 – 46 µg/g (background), 12 – 72 µg/g (polluted areas), and 60 – 120 µg/g (highly polluted areas). Lead concentrations in metallurgical dust from smelters ranged from 0.02 – 0.6 %.

Highly elevated levels of lead in soil continued for distances of 6 – 10 km from smelters. Elevated levels occurred 30 – 50 km and up to 80 km from roasters (Bargan *et al*. 1998; Kalac *et al*. 1991 and 1996). In Russia, metal levels from mine emissions gradually decreased within 10 – 100 km of mine sites (AMAP 1997 and 1998).

In comparison, this study also reports elevated lead levels in soil within a similar radius of 6.5 – 7.2 km around Giant mine, including the Con and Treminco mine areas. The lead levels in soil appeared to approximate background values somewhere between 40 - 113 km west and 33 – 52 km east of Yellowknife (Tables 1 and A2).

The largest anthropogenic sources of lead in the global environment included the use of leaded gasoline for several decades prior to the early or mid-1980s, and mine emissions (AMAP 1997 and 1998; Garcia *et al*. 1998; Kalac *et al*. 1991). Large scale natural sources of lead and other heavy metals in the global environment were forest fires and volcanoes (AMAP 1998).

In this study, a forest fire over bedrock was the likely cause of elevated lead levels in morel mushrooms (for more details see Sections 5.4.3 and 6.5, point 3).

6.1.3. Cadmium and Mercury in Soil

Levels of cadmium in soil in this study ranged from 0.1 – 0.2 µg/g and up to 0.6 – 6.1 µg/g in a few samples from impacted areas.

Comparable regional contaminants studies on soil and mushrooms reported similar concentrations of cadmium in subsurface and surface soil ranging from <0.02 – 1.62 µg/g at the abandoned Colomac gold mine, and from 0.2 – 5.47 µg/g at the abandoned Port Radium uranium mine (Macdonald 2004, 2003a and b).

For mercury, comparable regional data on soil and mushrooms were not available. In other studies, elevated levels of mercury in soil were reported in the vicinity of smelters in Europe and Russia (Falandysz and Chwir 1997; Kalac *et al*. 1991; Kalac *et al*. 1996; Minagawa *et al*. 1980; Vetter and Berta 1997; Zurera *et al*. 1998). However, these data were not comparable with the low or slightly elevated levels of mercury in soil found in this study.

6.2. Bedrock Geology and Background Levels of Arsenic and Lead

In general, low background values of arsenic and lead in bedrock, till and soil were present in and over four of five different bedrock formations of the study area, including archean mixed rocks, granitoid rocks, sedimentary rocks, and metamorphic rocks.

Highly elevated levels of arsenic and lead in soil samples were found over volcanic bedrock and outcropping ore-grade mineralization in the Yellowknife greenstone belt area.

The levels of arsenic and lead in soil samples collected over all five bedrock types declined gradually with increasing distances from Yellowknife and the gold mines (Figures 4 – 10; Tables A and A1 to A3; for more details see Section 6.1).

The following five paragraphs summarize the general bedrock geology of the study area and background levels of arsenic and lead in bedrock and till based on data from literature. The values of arsenic and lead found in soil and mushrooms in this study were added for comparison and discussion (for more information on bedrock geology see Geological Association of Canada, Mineral Deposits Division 2006).

1) Archean Mixed Rocks

Twenty-six samples of mushrooms and eight soil samples were collected 100 – 140 km west and southwest of Yellowknife on the west side of the North Arm of Great Slave Lake underlain by archean mixed rocks. Data on the concentrations of arsenic and lead in archean mixed rocks underlying the sampling locations were not available.

However, the levels of arsenic (As) and lead (Pb) in soil and mushroom samples collected over archean mixed rocks were very low ranging from 0.5 – 2.4 ppm As and 2.0 – 3.0 ppm Pb in soil, and from <0.2 – 1.7 ppm As and <0.1 – 0.5 ppm Pb (d.w.) in fungi.

The exceptions were two samples of Matsutake mushrooms with elevated levels of 30.8 and 101 ppm As; two samples of soil with levels of 11.3 and 31.8 ppm Pb; and a boletus mushroom with 22.2 ppm Pb (Tables A1 and A2).

Matsutake mushrooms accumulated high levels of arsenic in sandy soil with low and/or elevated arsenic levels (Tables 3 and A1). Therefore, they are not a reliable indicator of background levels for arsenic in soil, bedrock and the surface environment (for more details see Section 5.4.1). Similar, some boletus mushrooms accumulated high levels of lead (Table A2) although the accumulation of lead from soil to fungi generally was low in boletus mushrooms (Table 3).

2) Archean Granitoid Rocks

Twenty-six mushroom- and 20 soil samples were underlain by archean granitoid rocks with low background values of arsenic ranging from 0 – 1 ppm in regional till over granite, and 7 – 48 ppm in silt and clay over granite (Kerr 2006; Tables A1 and A3).

The levels of arsenic and lead in soil samples underlain by archean granitoid rocks ranged from 1.6 – 86.9 ppm As and 1.0 – 47.7 ppm Pb, and in fungi from 0.5 – 1370 ppm As and <0.1 – 509 ppm Pb.

The highest levels of arsenic in soil and fungi over granitoid rocks were found around the Yellowknife golf course and sewage road areas, and for lead around the golf course. Both areas are located 4.5 – 9.2 km downwind of prevailing winds and roaster emissions from both former Giant and Con mine roasters.

Some elevated levels of arsenic and lead in soil and fungi over granitoid rocks also were found along the Ingraham Trail road (Tables A1 and A2).

3) Archean Volcanic Rocks

Twenty-three samples of fungi and 15 soil samples were collected in the Yellowknife greenstone belt area underlain by archean volcanic rocks, intermediate to mafic volcanic rocks, granite, basalt, dacite, gabbro, and other rocks.

a) The background values of arsenic reported in these rocks ranged from 5 – >6500 ppm (EBA 2000); and from <2 – 6 ppm in least-altered rocks, 52 – 10000 ppm in most-altered rocks, and >10000 ppm in low and high grade gold ore at Giant mine (van Hees *et al*. 2006). High grade ore may contain 7000 – 30000 ppm at Giant and Con mines (Kerr 2006; Tables A1 and A3). The higher levels of arsenic usually were associated with higher levels of gold in the same samples (Kerr 2006; van Hees *et al*. 2006).

The background values of arsenic in till reported by Kerr (2006) ranged from 10 – 30 ppm in regional till over granite, and from 320 – 813 ppm in reworked till at Giant, Con and Ptarmigan (also called Treminco) mines. In silt and clay from the Yellowknife greenstone belt area, background values of arsenic ranged from 5 – 62 ppm reaching 10 – 1560 ppm over felsic and intermediate to mafic volcanic rocks (Kerr 2006; Tables A1 and A3).

In comparison, the values of arsenic over volcanic rocks in this study ranged from 11.9 – 7310 ppm in soil and from 1.4 – 90.7 ppm in mushrooms (Tables A1 and A3).

b) The background values of lead reported at Giant mine in least-altered rocks ranged from <2 – 6 ppm; in most-altered rocks from <2 – 494 ppm; and in low and high grade gold ore from 302 – 354 ppm (van Hees *et al*. 2006).

In comparison, the values of lead over volcanic rocks in this study ranged from 4.0 – 296 ppm in soil and from <0.1 – 1010 ppm in mushrooms.

c) The elevated levels of arsenic and lead in soil and fungi in this study reflect natural background values in volcanic rock and terrestrial environment, and anthropogenic contributions from mining and other activities (for more details see Section 6.1).

4) Archean Sedimentary Rocks

Fourty-two mushroom- and 20 soil samples were underlain by archean sedimentary rocks with background values of arsenic ranging from 5 – 10 ppm in regional till over metasedimentary rocks to 18 – 46 ppm in reworked till at Giant, Con and Ptarmigan (also called Treminco) mines (Kerr 2006; Tables A1 and A3).

a) The arsenic levels in six soil samples from road side fill over metasedimentary rocks near mines ranged from 14.7 – 120 ppm, and in 14 background samples over metasedimentary rocks from 0.8 – 11.5 ppm.

The arsenic levels in eight mushroom samples from road side fill over metasedimentary rocks ranged from 1.4 – 494 ppm, and in 34 background fungi samples collected over metasedimentary rocks from <0.2 – 56.2 ppm (Tables 1, A1 and A3).

Elevated concentrations of arsenic in fungi collected over metasedimentary rocks ranged from >11.0 – 494.0 ppm in the American white matsutake and shaggy mane mushroom (Table A1). Matsutake accumulated high arsenic levels and are not a reliable indicator of background levels (for more details see Section 5.4.1). The shaggy mane mushrooms with high arsenic levels from the Ptarmigan (Treminco) mine area reflect elevated arsenic levels in anthropogenic roadside fill and dust from the mine.

Lower arsenic levels in soil collected over metasedimentary rocks 42 – 52 km east of Yellowknife ranged from 0.8 – 11.5 ppm, and in fungi from <0.2 – 7.8 ppm (Tables 1 and A1).

b) The levels of lead in soil samples from anthropogenic road side fill over metasedimentary rocks ranged from 17.5 – 288 ppm (N = 6), and in soil from backgrounds over metasedimentary rocks from 5.0 – 66.5 ppm (N = 14).

Lead levels in mushrooms from road side fill over metasedimentary rocks ranged from 0.3 – 511 ppm (N = 8), and in mushrooms from backgrounds over metasedimentary rocks from <0.1 – 993 ppm (N = 34) (Table A2).

Low lead levels in fungi collected over metasedimentary rocks ranged from <0.1 – 0.5 ppm. Elevated lead levels ranged from 11.7 – 993 ppm in matsutake, boletus, meadow mushrooms and morels (Table A2).

The extremely elevated levels of lead (50.5 – 993 ppm) in morels from the Tibbitt Lake forest fire site in 1999, likely are linked to the lead contents of the underlying archean sedimentary rocks (for more details see Sections 5.4.3, point 2; and 6.5, point 3).

Potential airborne lead contamination or anthropogenic impacts likely are not the cause of these elevated lead levels in morels. Because most other samples of fungi, wood and soil from the same area contained low lead levels before and after the forest fire (for more details see Sections 5.2, point 2; 6.2, point 4; and 6.5, point 3).

However, some elevated levels of lead were present, including 5.0 – 14.0 ppm in soil and < 0.1 – 23 ppm in fungi (Table A2).

Morel mushrooms from four other forest fire sites over two different bedrock formations, including archean mixed rocks and granitoid rocks, contained very low levels of lead ranging from <0.1 – 0.5 ppm in fungi (Table A2).

5) Esker Surficial Sediments over Archean Metamorphic and Granitoid Rocks

Ten mushroom- and eight soil samples were collected in surficial sediments on eskers in inaccessible pristine areas 240 – 300 km northeast of Yellowknife (Figure 1). Seven of the 10 mushroom samples and five of eight soil samples were collected on sandy esker slopes underlain by archean metamorphic rocks. The levels of arsenic and lead in esker sand ranged from 1.3 – 6.2 ppm As and 2 – 14 ppm Pb, and in fungi from 0.5 – 1.7 ppm As and 0.1 – 0.3 ppm Pb (Tables A1 and A2, ID # 102 – 108).

Similar arsenic and lead levels were present in three fungi- and three sandy soil samples from a nearby esker underlain by archean granitoid rocks. The levels in soil ranged from 3.2 – 11. 6 ppm As and 1.0 – 3.0 ppm Pb, and in fungi from 1.0 – 20.3 ppm As and 0.1 – 0.3 ppm Pb (Tables A1 and A2, ID # 109 – 111).

These background values of soil and mushrooms were low compared with most other samples listed above (point 1 to 4). The exceptions were a few elevated values of 11. 6 ppm As and 14 ppm Pb in esker sand and 20.3 ppm As in fungi. The samples most likely do not represent the local background levels of arsenic or lead for these two bedrock formations since the sediments are long-distance glacial deposits.

6.3. Arsenic and Lead Levels in Plants and Organic Material

1) In this study, the bioaccumulations of arsenic and lead in coniferous trees were low with mean accumulations of 0.23 times the values of arsenic in soil in which the trees grew, and only 0.1 times for lead.

Other regional studies also reported low bioaccumulations of arsenic and lead in vascular plants from background and impacted areas at abandoned mines in the North Slave region and the NWT.

For example, based on data in Macdonald (2003a) from the abandoned Colomac gold mine, the arsenic levels in soil samples (N = 106) ranged from 0.32 – 55.5 ppm, and in vascular plants (N = 437) from <0.05 – 0.75 ppm (d.w.). The values of lead in soil ranged from 0.89 – 35.5 ppm and in plants from <0.04 – 0.23 ppm (d.w.).

The calculated mean bioaccumulations of arsenic and lead from soil to vascular plants resulted in factors generally ranging from 0.045 – 0.5 times the values of arsenic in the soil, and from 0.005 – 0.07 times the values of lead in soil.

The values of arsenic and lead in the majority of plant samples generally were closer towards the lower range of the bioaccumulation factors, including plants growing in soil with highly elevated levels. Similar low bioaccumulations of arsenic and lead in vascular plants were reported at the abandoned Port Radium uranium mine (Macdonald 2004).

In contrast, Kerr (2006) reported high levels of arsenic in samples of spruce bark ranging from 330 – 4800 ppm (d.w.), and from 170 – 560 up to 2000 ppm in Labrador tea near Giant and Con mines (Tables A3 and A4). Kerr (2006) concluded that a) airborne contamination cannot be completely ruled out, and b) only one site 35 km west of Yellowknife may approximate background values of arsenic in spruce bark with 27 ppm. However, minor airborne contamination cannot be completely ruled out (Kerr (2006).

The low bioaccumulations of arsenic in plants and spruce trees reported above support Kerr's (2006) conclusion.

In addition, based on data in Macdonald (2003a) from the Colomac mine, the calculated bioaccumulations of arsenic from soil to Labrador tea resulted in mean factors ranging from 0.0009 – 0.03 times the values of arsenic in soil. Higher accumulations occurred only in a few samples of Labrador tea ranging from 0.1 – 0.81 times the values in soil. The arsenic levels in Labrador tea samples (N = 49) ranged from <0.05 – 3.8 ppm (d.w.), and in the soil in which the Labrador tea grew from 0.95 – 53.4 ppm (N = 49).

In comparison, the calculated bioaccumulations of lead in Labrador tea from the Colomac mine (Macdonald 2003a), generally ranged from 0.006 – 0.02 times the values of lead in soil, and up to 0.03 – 0.3 times in a few samples. The lead levels in Labrador tea samples (N = 49) ranged from 0.04 – 1.41 ppm (d.w.), and in the soil in which the Labrador tea grew from 3.1 – 13.1 ppm (N = 49).

A trend of increasing levels of arsenic and lead in Labrador tea with increasing levels in soil was observed. However, the bioaccumulations of both metals were low (Macdonald 2003a).

2) In the Yellowknife greenstone belt area, elevated arsenic levels reported in organic materials and plants ranged from 3 – 1900 ppm (d.w.) in humus; 750 – 830 ppm in leaf litter around Giant, Con and Ptarmigan (Treminco) mines; 330 – 4800 ppm in spruce bark and 170 – 560 up to 2000 ppm in Labrador tea near Giant and Con mines (Kerr 2006; Tables A3 and A4).

Kerr (2006) reported that the highest arsenic levels in humus, spruce bark and Labrador tea occurred over volcanic bedrock and ore-grade mineralization near Con and Giant mines. On the east side of the Yellowknife Bay, elevated arsenic values in humus ranged from 300 – 1100 ppm (d.w.). The latter sites are underlain by unmineralized metasedimentary rocks and some are associated with volcanic rocks. In the granitic terrain 5 km west of Con and Giant mines, and north and east of the Yellowknife greenstone belt, arsenic levels in humus ranged from 57 – 253 ppm up to 710 ppm (Kerr 2006; Tables A3 and A4).

The higher arsenic levels reported in bedrock, till, plants, surface and organic materials were associated with higher gold levels in the same samples (Kerr 2006; and van Hees *et al*. 2006).

3) In comparison to the above two points, the arsenic levels in Yellowknife garden soil ranged from 11 – 56 ppm (d.w.); in vegetables from 0.017 – 0.27 mg/kg (f.w.); and in berries from 0.09 – 0.440 mg/kg (f.w.). Arsenic levels generally were more elevated in berries, leafy vegetables, and greens than in other produces (Koch *et al.* 2001).

The bioaccumulation of arsenic in garden vegetables was similar low as reported for wild vascular plants above. However, the reported mean level of arsenic in vegetables from Yellowknife gardens was ten-fold above the national average for the same produce (Koch *et al.* 2001). Inorganic arsenic species were predominant in plants and berries from Yellowknife (Koch *et al.* 2000). Elevated arsenic levels also were reported in berries growing in Yellowknife (Dene Nation *et al.* 1999; Dene Nation 2000).

6.4. Uptake of Heavy Metals from Soil by Mushrooms

6.4.1. Bio-accumulation of Metals by Fungi

In general, this study reports increasing levels of heavy metals (As, Pb, Cd, and Hg) in fungi with increasing levels of metals in soil. In many cases, however, there were no direct correlations between the bioaccumulation of metals by individual specimens of the same species of fungi and the metal levels in soil.

This indicates that individual specimens and species of fungi have the ability to preferentially accumulate high levels of specific metals from soil and environments with low or high metal contents. Vice versa, they may only absorb certain amounts of metals from sources with high levels of these metals (for more details on biological aspects of metal uptake by fungi see Section 6.4.2).

These findings are consistent with the scientific literature. The following families of mushrooms reportedly accumulated high levels of specific metals from soils which contained varying levels of these metals.

Agaricaceae: accumulated cadmium, cesium, lead, mercury, nickel, selenium, and silver (Falandysz 1998; Melgar *et al*. 1998; Tuzen *et al*. 1998; Van Elteren *et al*. 1998; Vetter and Berta 1997; Kalac *et al*. 1991 and 1996; and this study).

Boletaceae: accumulated arsenic, cadmium, cesium 137, gold, lead, mercury, selenium and strontium (Barcan *et al*. 1998; Weber *et al*. 1997; Falandysz and Chwir 1997; Kalac *et al*. 1991 and 1996; Slekovec and Irgolic 1996; Korky and Kowalski 1989; and this study).

Coprinaceae: accumulated arsenic, cadmium and lead (Slekovec and Irgolic 1996; and this study).

Hydnaceae: accumulated mercury (Kalac *et al*. 1996); cesium and lead (this study).

Lycoperdaceae: accumulated arsenic, lead, and mercury (Macdonald 2004; Vetter and Berta 1997; Slekovec and Irgolic 1996; and this study).

Tricholomataceae: accumulated arsenic and lead (Pop and Nicoara 1996; and this study).

Morchellaceae: accumulated high concentrations of lead (this study) which likely were caused by a forest fire over bedrock containing elevated contents of lead (for more details see Sections 5.4.3 and 6.2, point 4). No data were located in the scientific literature.

6.4.2. Biological Aspects of Metal Uptake by Fungi

The mushroom families, genus and species analyzed in this paper represent mycorrhizal and saprophyte fungi some of which also may have parasitic properties (Pilz *et al*. 2007).

Mycorrhizal fungi (e.g., families Boletaceae and Tricholomataceae) exchange nutrients, minerals and water in a symbiotic association with roots of vascular plants. In return, fungi receive carbohydrates from their host plants which fungi cannot produce. A symbiosis of fungi and plants (an underground network of mushroom mycelium with the roots of host plants) can cover relatively large areas of substrate soil and bedrock.

Some mycorrhizal fungi (e.g., *Tricholoma*) also may have saprophytic and/or parasitic properties (Pilz *et al*. 2007; Hosford *et al.* 1997). Saprophytic fungi (e.g., *Agaricus* and *Coprinus*) nourish on dead or decaying organic material. Parasitic fungi can kill or harm the live organisms they feed on. The genus *Morchella* may have mycorrhizal, saprophytic and other properties but the biology is not yet fully understood (Pilz *et al*. 2007; Hosford *et al.* 1997).

Pilz *et al*. (2007) summarized that “Among fungi as a group, almost any other organism can serve as a source of food, even other fungi. Each species of fungi, however, usually concentrates on just a few types or sources of nutrition”. Pilz *et al*. (2007) also reported that “Fungi absorb nutrients directly through their cell walls from the nutritional substrate in which they grow. They also can excrete enzymes that break down resistant compounds (such as lignin in wood) into simpler molecules that can then be absorbed”.

The mycelium of fungi, and a symbiosis of fungi and plants, can absorb nutrients and metals from a relatively large area. Therefore, the levels of metals in soil and mushroom samples collected from the same spot may not necessarily indicate a direct correlation between the contents of metals in soil and metals in fungi. As well, different fungi species and individual specimens of the same species growing in the same spot, may accumulate significant variations of the same metals as reported in this paper.

However, there is a relationship and similar trend between the metal levels in soil and in fungi when examining spatially distributed clusters of soil- and fungi samples (e.g., Slejkovec *et al*. 1997; Slekovec and Irgolic 1996; this study; Figures 4 – 12).

6.5. Heavy Metals in Fungi

1) Arsenic in Fungi

a) In this study, most samples from all nine mushroom families contained similar arsenic levels reported for the same families in impacted or background areas in Europe, Russia, and other countries.

The arsenic levels in mushrooms reported in other studies generally ranged from 0.03 – 11.8 µg/g (d.w.) in unpolluted areas, and from 19.8 – 56.1 µg/g in polluted areas. The genus *Tricholoma* accumulated the highest arsenic levels in polluted areas around the globe ranging from 125.6 – 250 µg/g up to 1420 µg/g (Barcan *et al*. 1998; Larsen *et al*. 1998; Slejkovec *et al*. 1997; Slekovec and Irgolic 1996).

In comparison, this paper also reports that elevated arsenic levels ranging from >50 up to 280 – 1370 µg/g were found particularly in the American white matsutake (*Tricholoma magnivelare*).

However, all of the above specimens represent large species of the genus *Tricholoma*.

In contrast, the arsenic levels were low in an unidentified small species of *Tricholoma* at the abandoned Colomac gold mine 222 km north of Yellowknife. The arsenic levels in fungi ranged from 0.13 – 0.93 µg/g (d.w.) (*N* = 7) in impacted and background sites, and up to 1.22 and 13.3 µg/g in impacted sites (*N* = 2). The arsenic levels in the soil in which the fungi grew ranged from 0.46 – 16.02 µg/g (Macdonald 2003a).

The arsenic levels in shaggy mane mushrooms (*Coprinus comatus*) collected around the Colomac mine also were low ranging from 0.31 – 5.16 µg/g (*N* = 11), and in soil from 1.16 – 41.7 µg/g. A sample of the hooded false morel (*Gyromitra infula*) from the same site contained only 0.16 µg/g arsenic (Macdonald 2003b).

Arsenic levels in another 11 samples of fungi (Macdonald 2004) from the abandoned Port Radium uranium mine (475 km north of Yellowknife), ranged from 0.29 – 5.93 µg/g (d.w.) (*N* = 6) for birch boletus (*Leccinum insigne*) and 1.96 – 3.61 µg/g (*N* = 2) for red-capped boletus (*L. aurantiacum*). These fungi grew in soil with arsenic levels ranging from 24 – 68 µg/g. Elevated arsenic levels in birch boletus were 14.1 and 17.2 µg/g (*N* = 2), and 91.5 µg/g in a sample of the puffball (*Lycoperdon perlatum*). These fungi grew in soil with arsenic levels ranging from 2142 – 5690 µg/g (Macdonald 2004).

b) This paper reports mean percentages for organic arsenic (DMA and MMA) in fungi of 60.95%, for inorganic arsenic 22.36%, and the remaining 16.69% were unspeciated arsenic forms. Maximum levels of 76% for inorganic arsenic (including 75.3% As III) were found in the genus *Tricholoma* and 89.8% (including 89.5% As III) in *Agaricus*.

The unspeciated arsenic forms (16.69%) may contain other species of organic and inorganic arsenic, including arsenic trioxide (for more details see Section 6.1.1, points 1 and 4).

In comparison, Slejkovec *et al*. (1997) reported the following percentages of organic and inorganic arsenic species in fungi from various countries.

- From traces (<) to 0.5 – 11 % of As (III), and up to 72% As (V) in the genus *Tricholoma*.
- From traces (<) to 1 – 12 % As (V) and 30 – 45% As (V), and up to 94 % As (V) in the family Tricholomataceae.
- From traces (<) to 1.5 – 88% As (DMA) and up to 100% As (DMA) in the genus *Tricholoma*.
- From traces (<) to 1 – 7% As (MMA).

2) Lead in Fungi

a) In this study, lead levels in fungi ranged from <0.1 – 1.7 µg/g (d.w.) (background) to >100 µg/g, and up to 509 – 1010 µg/g (impacted and background areas). The highest lead levels occurred in the genus *Agaricus*, *Lycoperdon*, *Leccinum*, *Morchella*, *Suillus*, and *Tricholoma*. These levels were much higher than those reported in literature.

Other regional studies in the North Slave region and in the NWT at abandoned mines reported the following lead levels in 32 fungi samples (Macdonald 2004, 2003a and b).

- From <0.04 – 3.11 µg/g (*N* = 9) in *Tricholoma* at the Colomac gold mine.
- From 0.35 – 1.19 µg/g (*N* = 11) in *Coprinus comatus* at Colomac.
- A sample of *Gyromitra infula* contained 0.11 µg/g at Colomac.

- From 0.05 – 4.25 µg/g (*N* = 8) in *Leccinum insigne* at the Port Radium mine.
- From 0.63 – 0.81 µg/g (*N* = 2) in *Leccinum aurantiacum* at Port Radium.
- A sample of *Lycoperdon perlatum* contained 8.9 µg/g at Port Radium.

For comparison, in Europe and Russia, lead levels in fungi ranged from 0.15 – 60 µg/g, except for a sample of *Agaricus* with 194 µg/g (Falandysz and Chwir 1997; Garcia *et al*. 1998; Kalac *et al.* 1991; Melgar *et al*. 1998; Pop and Nicoara 1996; Tuzen *et al*. 1998; Vetter and Berta 1997).

3) Lead in Morels

The extremely elevated levels of lead (50.5 – 993 ppm) in morels harvested in 1999 from the 1998-Tibbitt Lake forest-fire site, likely are linked to the lead contents of the underlying archean sedimentary rocks (for more details see Sections 5.4.3, point 2).

Potential airborne lead contamination or anthropogenic impacts likely are not the cause of these elevated lead levels in morels. Most other samples of fungi, wood and soil from the same area contained low lead levels before and after the forest fire (for more details see Sections 5.2, point 2; and 6.2, point 4). Some elevated levels of lead were present, including 5.0 – 14.0 ppm in soil and < 0.1 – 23 ppm in fungi (Table A2).

In contrast, morel mushrooms from four other forest fire sites over two different bedrock formations, including archean mixed rocks and granitoid rocks, contained very low levels of lead ranging from <0.1 – 0.5 ppm in fungi (Table A2).

The following points may help to explain the extremely elevated levels of lead in morels from Tibbitt Lake.

a) Naturally low to moderately elevated background levels of lead are present in the soil (Table 1) and most likely in the bedrock (for more details see Section 6.2, point 4).

b) The impact, intensity and heat of the forest fire which burned the humus layer and exposed the bedrock contributed to the release of lead and other metals into the environment.

c) Forest fires and volcanoes are the largest natural sources of lead and other heavy metals in the global environment (AMAP 1998).

d) The high absorption capability of wood coal and the accumulation of lead and other metals by wood coal in forest fire sites (for more details see Section 5.2, point 2).

e) Apparently, burned wood, wood coal, ash and dead trees are important factors in the environment in which morel mushrooms preferential grow and nourish. Morels are known to grow in abundance in forest fire sites or even in camp fire sites the year after the fire. The genus *Morchella* may have mycorrhizal, saprophytic and other properties but the biology is not yet fully understood (Pilz *et al*. 2007; Hosford *et al.* 1997) (for more details see Section 6.4.2).

f) This paper reports that some species of mushrooms are specialized in the accumulation of certain heavy metals (for more details see Section 5.4.3, point 3).

It appears that morels only accumulate high levels of lead if it is readily available in the terrestrial environment because all other morels from different forest fire sites contained very low lead levels.

g) Based on all of the above points, this study concludes that the concentrations of lead in the bedrock most likely were the natural source of lead in morels from Tibbitt Lake in 1999.

4) Cadmium and Mercury in Fungi

Levels of cadmium in fungi in the study area ranged from <0.1 – 1.7 µg/g (background) to 2.8 – 17.1 µg/g (impacted areas) particularly in the genus *Agaricus* and *Amanita*. A sample of *Coprinus* from tailings contained 32.4 µg/g cadmium.

Other studies from two abandoned local mines reported the following ranges of cadmium levels in 32 fungi samples (Macdonald 2004, 2003a and b).

- From 0.28 – 5.31 µg/g (N = 9) in *Tricholoma* at the Colomac gold mine.

- From 0.24 – 0.8 µg/g (N = 12) in 11 samples of *Coprinus comatus* and a sample of *Gyromitra infula* at Colomac.

- From 0.3 – 2.03 µg/g (N = 11) in *Leccinum insigne*, *L. aurantiacum*, and *Lycoperdon perlatum* at the Port Radium uranium mine.

In Europe and Russia, cadmium levels in fungi ranged from 0.05 – 26 µg/g, except for a sample of *Agaricus* with 85.79 µg/g.

In this study, mercury levels in fungi ranged from 0.01 – 4.29 µg/g (d.w.). Comparable local or regional studies on mercury levels in fungi were not available. In Europe and Russia, mercury levels in fungi ranged from 0.04 – 460 µg/g, except for a sample of *Agaricus* with 1,700 µg/g.

In particular, the genus *Agaricus* accumulated high levels of lead, cadmium and mercury in all studies including this study (Falandysz and Chwir 1997; Garcia *et al*. 1998; Kalac *et al.* 1991; Melgar *et al*. 1998; Pop and Nicoara 1996; Tuzen *et al*. 1998; Vetter and Berta 1997).

6.6. Metal Concentrations in Age Classes and Washed Mushrooms

This study found that adult mushrooms contained 42% less arsenic and 28.3% less mercury than young mushrooms. In contrast, lead levels were 190% higher and cadmium levels 8% higher in adult versus young fungi.

For arsenic and mercury, these findings are consistent with other studies which reported 15 – 47% lower concentrations of heavy metals in fully grown fungi than in young specimens (Pop and Nicoara 1996).

However, the higher levels of lead and cadmium in adult versus young mushrooms of this study were lower in adult versus young mushrooms in Pop and Nicoara (1996).

In this paper, metal levels in mushrooms washed with water were lower by 38.4% for arsenic, 31.2% for lead, 1.9% for cadmium, and 28.3% for mercury compared with unwashed fungi.

This finding is consistent with other studies where washing reduced heavy metals in mushrooms by 30 – 40% (Zrodlowski 1995; Barcan *et al*. 1998; Chiu *et al*. 1998). Fungi can absorb nutrients directly through their cell walls from the nutritional substrate in which they grow (Pilz *et al*. 2007) and easily absorb water which can flush out metals.

6.7. Health Risk Assessments of Heavy Metal Intake through Mushrooms

Three human health risk assessments on the intake of four heavy metals through the consumption of edible wild mushrooms by residents in the Yellowknife area were initiated by the author of this paper (for more details see Section 4.4.3).

Two risk assessments on arsenic, lead, cadmium and mercury, as well as a third assessment on lead intake, were received from Health Canada (2002 and 2012) and an independent health risk consultant (Richardson 2001).

The risk assessments are summarized below (Sections 6.7.1 to 6.7.4) and compared with the final results of all 124 mushroom samples presented in this paper (for original assessments see Appendix 1).

6.7.1. Arsenic Intake through Fungi and Health Risk Assessment

1) Based on the highest level of total arsenic with 494 µg (d.w.) found in the first set of 45 mushroom samples (Obst *et al.* 2001; for original 45 samples see Table 1), and considering that 99.75% of arsenic was organic, Health Canada (2002) concluded:

a) an adult weighing 65 kg would have to consume greater than 1 kg of fresh mushrooms/day before exceeding the pTDI for inorganic arsenic; and

b) the arsenic levels would not pose any concern for either harvesters or general consumers (for original assessment see Appendix 1).

2) Founded on the mean value of total arsenic in all 45 fungi samples (Obst *et al.* 2001), and assuming all arsenic is inorganic, Richardson (2001) estimated that an adult weighing 65 kg could consume 40 g/day of fresh mushrooms.

Richardson's (2001) conclusion was similar to Health Canada's (2002) stating that there are no concerns about arsenic intake for harvesters or general consumers (for assessments see Appendix 1).

3) However, the calculations in both health risk assessments of arsenic (Health Canada 2002; Richardson 2001) were based on mean values of arsenic in all mushroom samples, including unavailable mushrooms from distant or inaccessible control sites in background areas.

The latter samples do not represent the mushrooms which typically are consumed by residents. Therefore, these samples need to be excluded for a health risk assessment as reported in the results of this paper (for more details see Section 5.5.1).

4) In contrast to the above assessments (Health Canada 2002; Richardson 2001), the final results of all 124 fungi samples in this paper report higher levels of total arsenic and inorganic arsenic than the first set of 45 samples (Obst *et al.* 2001).

Total arsenic levels reached up to 1370 ppm (d.w.) and inorganic arsenic up to 89.8% of total arsenic in mushrooms from popular harvest areas around Yellowknife (Tables 1a and 4; for more details see Section 5.4.2).

- Depending on harvest location and mushroom species, an adult person weighing 65 kg may only be able to ingest from 1.4 – 5.5 g/day and up to 19 – 76.3 g/day of fresh mushrooms before exceeding the provisional Tolerable Daily Intake (pTDI) for inorganic arsenic (for more details see Section 5.5.1).

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights.

- Typical mushroom meals contain from 100 – 150 g/day/person and avid mushroom harvesters consume up to 9 – 15 kg/person/year of fresh or rehydrated mushrooms (for more details see Section 5.5.1, point 5d; and Tables 5 and D).

- Also, it must be considered that the values of total arsenic and inorganic arsenic used for health risk calculations in this paper are conservative and the actual arsenic values could be higher (for more details see Section 5.5.1, point 5d).

5) Hence, the two former health risk assessments on arsenic in edible wild mushrooms (Health Canada 2002; Richardson 2001), which concluded that there are no concerns for consumers, need to be reassessed (for assessments see Appendix 1).

The calculations for a new health risk assessment should be based on the additional information and data provided in this report (primarily Section 5.5.1; and Tables 1a – c).

The appropriate values for health risk calculations of total arsenic in edible wild mushrooms consumed by residents range from mean values of 5.14 to 55.28 mg/kg (wet weight) of total arsenic in fresh mushrooms.

The proper percentages of inorganic arsenic in total arsenic of mushrooms were a mean value of 22.36% (scenario 1) and a maximum of 89.8% (scenario 2) of inorganic arsenic (for more details see Sections 5.4.2 and 5.5.1).

The revisions of the former two health risk assessments on arsenic also must consider the following cumulative impact factors listed in point 6, below.

6) The tolerable consumption of mushrooms calculated in this paper for inorganic arsenic would be somewhat smaller when considering the daily dietary intake of arsenic through food and liquids by the average Canadian adult with a mean intake of 53.6 µg/day of total arsenic (Dabeka *et al.* 1993).

In this context, however, it must be considered that mushroom harvesters and residents of Yellowknife are exposed to higher arsenic levels in the environment than the average Canadian adult or child, as the following examples demonstrate.

- The arsenic levels in garden produce from Yellowknife gardens are ten-fold above the national average for the same produce (Koch *et al.* 2001).

- Toxic inorganic arsenic species are predominant in plants and berries from Yellowknife (Koch *et al.* 2000). Elevated arsenic levels were reported in berries growing in Yellowknife (Dene Nation *et al.* 1999; Dene Nation 2000).

- Harvesting berries and growing food in residential and community gardens are increasingly popular activities in Yellowknife.

- Most soils in Yellowknife exceed the guidelines for arsenic of 12 ppm for all land use categories (CCME 2002) by factors ranging from 3 – 205 times and up to 609 times (7,310 ppm) at a recreational sand beach beside a playground for children (for more details see Section 5.1.1).

- Naturally elevated arsenic levels in bedrock and soil combined with anthropogenic activities caused extremely elevated arsenic levels in the soil and environment of Yellowknife, including values >10,000 ppm (for more details see Section 6.1.1).

  The potential exists for human exposure to elevated arsenic levels from dust, road gravel, sand beaches, tailings, and other sources within Yellowknife.

- In addition, avid mushroom harvesters in Yellowknife consume up to 9 – 15 kg/person/year and 100 – 150 g/day of fresh mushrooms and believe they are enjoying a healthy wild mushroom meal each time (for more details see Section 5.5.1, point 5d).

  However, this study demonstrates that these harvesters may not consume healthy wild mushrooms but rather toxic inorganic arsenic in moderate to high levels nearly at all times and for long periods or a life time.

- The long term intake even of low but moderately elevated levels of toxic metals, such as inorganic arsenic, is reported to cause adverse effects on the human health (for more details see Section 6.8).

All of the above points demonstrate that this particular consumer group in Yellowknife is much more exposed to the intake of elevated levels of inorganic arsenic in their environment and food than the average Canadian.

Hence, the tolerable consumption of edible wild mushrooms with elevated arsenic levels in the Yellowknife area could be even smaller for avid mushroom harvesters and their children.

These cumulative impact factors need considerations for a health risk assessment.

In addition, it must be considered that harvesters may not only ingest highly elevated levels of inorganic arsenic but also highly elevated levels of lead with the same wild mushroom meal (for more details see Sections 5.5.2, and 6.7.2 below).

Therefore, the human health risk assessments of arsenic in edible wild mushrooms (Health Canada 2002; Richardson 2001) need to be reassessed by Health Canada (for assessments see Appendix 1).

Readers of this paper are invited to review the data for their own conclusions.

6.7.2. Lead Intake through Fungi and Health Risk Assessment

1) Richardson (2001) calculated that the tolerable consumption was 20 g/day of fresh mushrooms per day before exceeding the pTDI for lead for an adult weighing 65 kg.

The calculation was based on the mean concentration of lead in the first set of 45 mushroom samples (Obst *et al.* 2001; for the original 45 samples see Table 1)

Richardson (2001) suggested that persons with high or very high consumption of fungi may be ingesting relatively large amounts of lead. Richardson (2001) concluded that lead intake is a concern (for assessment see Appendix 1).

2) Health Canada (2002) concluded that an adult weighing 65 kg could only ingest approximately 18 g/day of fresh mushrooms before exceeding the pTDI for lead.

The calculation was based on the mean concentration of lead in the first set of 45 mushroom samples (Obst *et al.* 2001; for the original 45 samples see Table 1). The daily dietary intake of lead from other foods also was considered (for assessment see Appendix 1).

3) Health Canada (2012) concluded that an adult could consume only a few grams per day of fresh mushrooms before exceeding the pTDI of lead for an adult weighing 65 kg.

The calculation was based on the mean lead level of 5.78 ppm in all 123 mushroom samples tested for lead and presented in this paper (for assessment see Appendix 1).

4) However, the calculations in all three health risk assessments (Health Canada 2002 and 2012; Richardson 2001) were based on mean values of lead in all mushroom samples, including poisonous and unavailable mushrooms from remote backgrounds.

The latter mushroom samples need to be excluded for a health risk assessment as reported in the results of this paper (for more details see Section 5.5.2).

5) The final results of all 123 mushroom samples tested for lead in this paper, demonstrate that the tolerable consumption of edible wild mushrooms growing in the Yellowknife area is very low.

- An adult weighing 65 kg could consume only from 2.3 – 35.2 g/day of fresh mushrooms before exceeding the pTDI for lead (for more details see Section 5.5.2).

- The tolerable consumption of mushrooms would be even smaller for children and people with lower body weights.

- A typical mushroom meal contains 100 – 150 g/day of fresh mushrooms. Avid mushroom harvesters consume up to 9 – 15 kg/person/year (for more details see Section 4.4.2; and Tables 5 and D).

- The tolerable consumption of mushrooms calculated in this paper for lead would be somewhat smaller when considering the daily dietary intake of lead through food and liquids.

- The long term intake of even low but moderately elevated levels of toxic metals, such as lead, is reported to cause adverse effects on the human health (for more details see Section 6.8).

- The values of lead used for health risk calculations in this paper are conservative and the actual values could be higher (for more details see Section 5.5.2, point 5c and d).

6) Hence, all three health risk assessments on lead intake through edible wild mushrooms from the Yellowknife area (Health Canada 2002 and 2012; Richardson 2001) need to be reassessed by Health Canada.

The calculations for a new health risk assessment should be based on the additional information and data provided in this report (primarily Section 5.5.2; and Tables 1a – c).

The appropriate values for health risk calculations of lead in edible wild mushrooms consumed by residents range from mean values of 6.53 – 20.33 mg/kg and up to 30.7 mg/kg (wet weight) of lead in fresh mushrooms (for more details see Section 5.5.2; and Tables 1b and c).

In addition, it must be considered that harvesters may not only ingest highly elevated concentrations of lead but also highly elevated levels of toxic inorganic arsenic with the same mushroom meal (for more details see Section 5.5.1).

Readers of this paper are invited to review the data for their own conclusions.

6.7.3. Cadmium Intake through Fungi and Health Risk Assessment

1) Health Canada (2002) calculated that the average consumer could still ingest up to 180 g/day of fresh mushrooms before exceeding the pTDI of cadmium. Health Canada stated that the cadmium levels would not pose any concern for either harvesters or general consumers (for assessment see Appendix 1).

The calculation was based on the mean cadmium concentration of 0.24 µg/g (wet weight) in the first set of 45 mushroom samples (Obst *et al.* 2001; for the original 45 samples see Table 1). The daily dietary intake of an estimated 20 µg cadmium/day from food and liquids also was considered.

2) Richardson (2001) concluded that the tolerable consumption was 290 g/day of fresh mushrooms for adults and there is no concern related to cadmium exposure (for assessment see Appendix 1).

The calculation was based on the mean level of cadmium in the first set of 45 mushroom samples (Obst *et al.* 2001; for the original 45 samples see Table 1).

3) In contrast to the above two assessments (Health Canada 2002; Richardson 2001) the final results of all 124 mushroom samples tested for cadmium and presented in this paper conclude the following.

- An adult weighing 65 kg could eat only from 45.6 – 92.8 g/day of fresh meadow mushrooms (*Agaricus*) before exceeding the pTDI of cadmium. Meadow mushrooms are very popular amongst local mushroom harvesters and readily available in large numbers on lawns and meadows.

- The tolerable consumption of mushrooms would be smaller for children and people with lower body weights.

- A typical mushroom meal contains 100 – 150 g/day of fresh mushrooms.

- There is a chance of exceeding the pTDI of cadmium for people harvesting mostly meadow mushrooms (*Agaricus*). Usually, this is the case for many residents in the Yellowknife area during the last months of the mushroom season.

However, the calculated intake of cadmium through local fungi in this study was insignificant for all interviewed harvesters and consumer groups (for more details see Section 5.5.3).

Nevertheless, it must be considered that harvesters consuming meadow mushrooms (*Agaricus*) may not only ingest elevated levels of cadmium but also highly elevated levels of lead and inorganic arsenic with the same mushroom meal (for more details see Sections 5.5.1, 5.5.2, 6.7.1 and 6.7.2).

6.7.4. Mercury Intake through Fungi and Health Risk Assessment

1) Health Canada (2002) calculated that an adult could consume more than 760 g/day of fresh mushrooms before exceeding the pTDI of mercury. Health Canada concluded that mercury levels in fungi do not pose any risk to consumers of the general population, women of child bearing age or children (for assessment see Appendix 1).

The calculation was based on the first set of 45 mushroom samples (Obst *et al.* 2001; for the original 45 samples see Table 1). Health Canada (2002) considered that the analytical values given for mercury are total mercury and used for the calculation an average mercury concentration of 0.055 µg/g (wet weight) in fresh mushrooms.

2) Richardson (2001) estimated that the tolerable consumption was 900 g/day of fresh mushrooms before exceeding the pTDI of mercury. Richardson (2001) concluded there is no concern related to mercury exposure (for assessment see Appendix 1).

The calculation was based on the first set of 45 mushroom samples (Obst *et al.* 2001; for the original 45 samples see Table 1).

3) In contrast to the above two assessments (Health Canada 2002; Richardson 2001) the final results of all 124 mushroom samples presented in this paper calculated the following.

- Women of child bearing age and children easily could exceed the pTDI of mercury by consuming a single mushroom meal of shaggy mane mushrooms (*Coprinus*) with maximum tolerable consumptions ranging from 36.3 – 58 g/day.

- Shaggy mane mushrooms are very popular amongst local mushroom harvesters and available in large numbers. A typical mushroom meal contains 100 – 150 g.

- There is a good chance of exceeding the pTDI of mercury for women of child bearing age and children consuming mostly shaggy mushrooms. This is often the case for 2 – 3 weeks near the end of the mushroom season when most other mushroom species expired in the Yellowknife area.

However, the calculated intake of mercury through edible wild mushrooms in this study was insignificant for all interviewed harvesters and consumer groups (for more details see Section 5.5.4).

Nevertheless, it must be considered that harvesters consuming mostly shaggy mushrooms (*Coprinus*) may not only ingest elevated concentrations of mercury but also elevated levels of lead and inorganic arsenic with the same mushroom meal (for more details see Sections 5.5.1, 5.5.2, 6.7.1 and 6.7.2).

6.7.5. Health Concerns in other Countries

The accumulation of elevated levels of toxic heavy metals, such as arsenic, cadmium, lead and mercury, in edible wild mushrooms also were a concern in European studies.

In contrast to this study, elevated levels of arsenic and lead in wild mushrooms generally were lower in Europe compared with highly elevated levels in the Yellowknife area. However, elevated levels of cadmium and mercury in wild mushrooms were higher in Europe compared with much lower levels in the Yellowknife area.

In the late 1960's, Western European governments advised the public not to consume certain species of wild meadow mushrooms (genus *Agaricus*) because of heavy metal contamination including cadmium. In the mid 1970's, the public was advised not to consume any wild mushrooms in many regions of Western Europe because of high accumulations of airborne heavy metals in wild mushrooms.

Eastern European and Russian studies also concluded that in general all species of mushrooms accumulate large amounts of toxic heavy metals in the surrounding areas of mine smelters, roads and infrastructure.

Consequently, the public was informed to avoid the harvest and consumption of edible wild mushrooms within a large radius around these pollution point sources (Barcan *et al*. 1998; Falandysz and Chwir 1997; Garcia *et al*. 1998; Kalac *et al*. 1991 and 1996; Korky and Kowalski 1989; Larsen *et al*. 1998; Melgar *et al*. 1998; Pop and Nicoara 1996; Skuterud *et al*. 1997; Tuzen *et al*. 1998; Van Elteren *et al*. 1998; Vetter and Berta 1997; Zurera *et al*. 1998).

After the Chernobyl nuclear accident in 1986, wild mushrooms also were contaminated with elevated levels of radioactive metals and materials in many regions across Europe.

These early concerns in Europe and Russia were founded not only on elevated heavy metal levels in wild mushrooms but also on the traditionally large consumption of edible wild mushrooms.

The consumption of more than 10 kg/year of mushrooms per person was normal for many people (Kalac *et al*. 1996), as well as 20 – 40 kg/year or more for families (Barcan *et al*. 1998). The seasonal consumption of 300 – 500 grams of fresh mushrooms per day/person (or about 18 – 30 kg/person during the mushroom season) also was reported as typical (Kalac *et al*. 1991).

In comparison, the maximum consumption of edible wild mushrooms reported in this paper was 9 – 15 kg per person/year for six (23.1%) of 26 harvesters interviewed in the Yellowknife area. However, some avid mushroom hunters in the Yellowknife area may consume up to 15 – 20 kg/year/person in years with good wild mushroom crops growing in easy accessible and popular harvest areas.

6.8. Heavy Metal Toxicity

Mushrooms are a healthy source of nutrition and minerals including a variety of heavy metals which are generally accepted as essential for the human health.

When consumed in excess, however, some essential metals and other metals are toxic (Calow 1994). Of special concern are highly toxic heavy metals such as arsenic, cadmium, lead and mercury. The long term intake even of low but moderately elevated levels of toxic metals is reported to cause adverse effects on the human health (AMAP 1997; Barcan *et al*. 1998; Larsen *et al*. 1998).

6.8.1. Arsenic Toxicity

Inorganic arsenic compounds, such as arsenite (As III), arsenate (As V), or arsenic trioxide (As_2O_3) from roaster emission, are more toxic than organic arsenic species such as dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA).

Certain organic compounds of arsenic, arsenobetaine (AB; AsB; or fish arsenic) and arsenocholine (AC; AsC), appear to be almost non-toxic (Slejkovec *et al*. 1997; INAC 2002; ESG 2001a).

Inorganic arsenic compounds are carcinogenic, causing skin and lung cancer amongst other types of cancer (Barcan *et al*. 1998; Larsen *et al*. 1998).

Larsen *et al*. (1998) concluded that even low-level but long term intake of slightly elevated levels of organic arsenic such as DMA should be avoided in order to minimize the risk of developing vascular and neurological diseases, and lung cancer in humans. In experimental studies, DMA was used as a promoter for tumours. However, it is still unclear if DMA alone could potentially induce tumours (AMAP 1998; Larsen *et al*. 1998).

In the Canadian Environmental Protection Act (CEPA, Section 11), arsenic and its compounds are designated as toxic. Inorganic arsenic forms are carcinogenic and considered to be non-threshold toxins meaning they may have adverse health effects at any exposure level. Therefore, arsenic and its compounds are listed in Group 1 of the CEPA Priority Substances List.

6.8.2. Lead, Cadmium, and Mercury Toxicity

Lead is toxic to most living organisms and there is no demonstrated biological need of lead. Lead can induce kidney cancer and cause toxic neurologic, hematologic and renal effects, and damage to the nervous system (AMAP 1997; Barcan *et al*. 1998).

Cadmium is a highly toxic metal with an extremely long biological half-life in human tissue, especially in the liver and kidney. Long term effects of low-level intake of cadmium (AMAP 1997; Barcan *et al*. 1998) include chronic obstructive pulmonary disease and emphysema, chronic renal tubular disease, and potential effects on the cardiovascular and skeletal systems. The potential carcinogenicity of cadmium was supported by some experimental studies but has not been confirmed (AMAP 1997; Barcan *et al*. 1998).

Mercury is a nerve toxin effecting and damaging the brain and nervous system, particular in the growing fetus and young children (AMAP 1997 and 1998).

6.9. Human Health Benefits from Edible Wild Mushrooms and Commerce

In the context of this paper, and in fairness and defence of harvesting and consuming edible wild mushrooms, it must be emphasized that edible wild mushrooms substantially benefit the human health for the following reasons.

1) Harvesting edible wild mushrooms provides a popular and healthy recreational outdoor activity for large numbers of the population across the globe including Canada and the Canadian North.

2) Edible wild mushrooms provide a healthy nutrition rich in proteins, fibre, and a variety of minerals and metals which are essential for the human health.

3) Current research now supports ancient Chinese medical claims of anti-cancer agents in selected fungi species (e.g., Babal 1997; Oatman 1998; Willeford 1996; and V. Sterenberg pers. comm. 2012). Some species of mushrooms are commercially traded for medicinal use including the recently established harvest of wild chaga mushrooms (*Inonotus obliquus*) in Alaska for export to Asian markets (Pilz *et al*. 2006).

In most cultures and regions on earth, including aboriginal people across the Northwest Territories (Receveur *et al.* 1996), edible wild mushrooms have been used as traditional food and medicine, and as a tasteful protein-rich supplement for meat, fish and eggs.

The rapidly growing demand on the world market for edible wild gourmet-mushrooms was estimated at $ 1.3 billion (Canadian $), and for morels at $ 70 - 115 million, annually from 1996 - 1999 (Mohammed 1999; Mitchell 1997; Schlosser and Blatner 1997). The United States and Canada were amongst the leading producers of prized edible wild mushrooms such as the American white matsutake and morels. In the US Pacific Northwest, the morel harvest alone was estimated each year at $ 21.5 million (US $) (Pilz *et al*. 2007).

The management of wild mushroom resources and harvests is established in the US Pacific Northwest and other states in order to ensure ecologically responsible and sustainable harvests and renewable wild mushroom resources (Hosford *et al.* 1997; Liegel *et al*. 1998a and 1998b; Love *et al.* 1998; McLain *et al.* 1998; Molina *et al*. 1997 and 1993; Pilz *et al*. 2007; Pilz *et al*. 2006; Pilz *et al.* 1999; Pilz *et al*. 1998a and 1998b; Pilz and Molina 1996; USDA Forestry Service 1999 and 1998).

In Canada, forestry and agricultural government departments, and independent researchers, have been promoting and studying sustainable harvests of wild mushrooms (Brubacher 1999; de Geus 1995; Duchesne 1995; Duchesne and Weber 1993; Mohammed 1999; Obst and Brown 2000; SAF 1997 and 1996).

The commercial harvest of morel mushrooms and other fungi is an established industry in the Yukon Territory (Kenney 1996), Alaska (Pilz *et al.* 2006; Wurtz *et al*. 2005), and a growing industry in the Northwest Territories (Obst and Brown 2000; ENR 1994; Green 1989).

7. CONCLUSIONS

1) This study concludes that edible wild mushrooms should not be consumed at all if they are growing in the city of Yellowknife and within 30 km of the city and mines. Wild mushrooms also should be avoided if they are growing within 1 km of highways and roads (e.g., Hwy # 3; Ingraham Trail road), or near infrastructure and impacted areas.

Mushrooms from these areas contain moderately to highly elevated levels of toxic inorganic arsenic and lead, as well as slightly elevated levels of cadmium and mercury.

In addition, the consumption of edible wild mushrooms from popular harvest areas along road corridors 40 km west and 30 – 50 km east of Yellowknife should be limited to small amounts. Wild mushrooms from these areas still contain elevated levels of arsenic and lead.

The consumption of certain species of edible wild mushrooms from these areas should be avoided completely because of high accumulations of arsenic and lead in fungi.

These conclusions are based on the following facts.

a) Moderately to highly elevated levels of arsenic and lead are present in wild mushrooms and soil within at least a radius of 10 km around the city of Yellowknife.

b) Declining levels of arsenic and lead appear to approximate background values in distances of about 35 – 40 km west and 30 – 50 km east of Yellowknife.

c) These findings and conclusions were based on the results of this study and other local studies (for more details see Section 6.1.1, point 3).

2) Certain mushroom species are specialized in accumulating specific heavy metals more than others in orders of multitudes. These species can accumulate extremely high levels of certain metals even in environments with very low background levels of these metals, and vice versa. The consumption of some of these mushroom species should be avoided or limited to small amounts depending on the harvest location.

For example, the consumption of any species of wild meadow mushrooms (genus *Agaricus*) should be avoided because of high accumulations of lead and cadmium. Shaggy mane mushrooms (genus *Coprinus*) growing on road side fill, gravel or impacted ground, should be avoided because of high accumulations of arsenic and mercury.

The consumption of popular American white matsutake (*Tricholoma magnivelare*), also called pine mushroom, should be limited to small amounts even if they grow in distant background areas. This includes popular harvest areas for pine mushrooms such as the Prelude Lake nature trail, the entire Ingraham Trail road and Hwy # 3 corridors.

Matsutake can accumulate high levels of toxic inorganic arsenic even in environments with very low arsenic levels. Matsutake from popular harvest areas such as the pine forest near the Yellowknife golf course contain extremely high arsenic levels.

The consumption of boletus mushrooms (genus *Boletus*) from the Ingraham Trail road area should be limited and morels avoided completely because of extreme lead levels.

In general, considerable amounts of healthy edible wild mushrooms can be consumed if they are harvested in remote areas further away from the above mentioned locations. The exceptions are certain species with high accumulations of specific heavy metals.

3) The availability of heavy metals in the environment is dictated by the bedrock geology and increased by anthropogenic activities, as the following examples demonstrate.

a) Highly elevated levels of arsenic, lead and other heavy metals are naturally occurring in volcanic bedrock, gold ore, soil, and in the environment of the Yellowknife greenstone belt area located in the center of the study area.

b) Mining of the arsenic-rich gold ore and other anthropogenic activities released significant amounts of arsenic, lead and other heavy metals into the environment of the Yellowknife area for nearly seven decades.

c) The levels of heavy metals in wild mushrooms and soil decline gradually and significantly further away from Yellowknife, mines, roads, and the mineralization zone of the Yellowknife greenstone belt.

d) Wild mushrooms are known to accumulate metals, including toxic heavy metals if they are readily available in the environment. The natural availability and anthropogenic release of these metals are the sources of elevated levels of heavy metals in edible wild mushrooms from the Yellowknife area.

For example, the extreme high levels of lead in morel mushrooms from the forest fire site at Tibbitt Lake in 1999, likely are linked to elevated lead levels in the bedrock combined with the heat of the fire. All other morels from four different forest fire sites and bedrock formations contained very low lead levels near detection limit.

4) Bedrock geology data are useful for identifying potential problem areas where heavy metal levels might be elevated in wild mushrooms. This information is useful for

planning and safeguarding commercial community morel mushroom harvests in the Northwest Territories and elsewhere.

5) In addition to reviewing bedrock geology data for morel harvests, the first few young morels growing at the beginning of the season should be collected for immediate analysis of heavy metals. Prearrangements with a local certified laboratory can produce results within days to confirm the cleanliness of morels. This would give communities and harvesters sufficient time to make quick changes of harvest locations, if necessary. Safer locations could be designated before the actual beginning of the morel harvest.

6) A certified analysis confirming the cleanliness of morels would assist safeguarding the human health as well as the development of a responsible multi-million dollar mushroom industry in the Northwest Territories.

The certification of the cleanliness of northern morel mushrooms from pristine areas would be a huge selling point for national and international markets and consumers.

7) These conclusions are based on the following main points of this study regarding the consumption of edible wild mushrooms growing within and around Yellowknife.

- An adult weighing 65 kg could eat only very small amounts of fresh edible wild mushrooms ranging anywhere from 1.4 – 24.3 gram/day before exceeding the Canadian health standard for toxic inorganic arsenic; 2.3 – 35.2 g/day before exceeding the health standard for lead; and 45.6 – 92.8 g/day of meadow mushrooms (*Agaricus*) before exceeding the health standard for cadmium.

- These tolerable maximum amounts of mushroom consumption would be even smaller for children and people with lower body weights.

- Women of child bearing age and children could exceed the health standard for mercury by consuming 36.3 – 58 g/day of fresh shaggy mane mushrooms (*Coprinus*). For more details on heavy metal intakes see Sections 5.5.1 to 5.5.4.

- In this context, it must be considered that a typical mushroom meal contains up to 100 – 150 g, and that mushroom lovers and harvesters in the Yellowknife area consume considerable quantities (up to 9 – 15 kg/person/year) of fresh or rehydrated edible wild mushrooms. Additional daily dietary intake of these metals through foods and liquids also must be considered.

- The ingestion of moderately to highly elevated levels of at least four toxic heavy metals through the consumption of edible wild mushrooms from the Yellowknife area is not a healthy mixture for the human health.

- Long term intakes even of low but moderately elevated levels of toxic metals, such as arsenic, cadmium, lead and mercury, are reported to cause adverse effects on the human health (for more details see Section 6.8).

5) These findings and conclusions are consistent with the scientific literature and public advisories by European governments (in the early 1970s) to avoid consuming wild mushrooms growing in impacted areas and regions. These advisories included warnings not to consume any wild meadow mushrooms (genus *Agaricus*) because of highly elevated levels of toxic heavy metals.

6) Hobby mushroom harvesters anticipate a life time of this enjoyable recreational activity and consumption of edible wild mushrooms and believe they are enjoying and sharing a healthy wild mushroom meal each time.

These people and the public must be informed about the highly elevated levels of arsenic and lead in edible wild mushrooms around Yellowknife, mines and roads.

There is easy access to areas away from the city where plenty of wild gourmet mushrooms are available, safe, and healthy to eat.

8. RECOMMENDATIONS

1) This study reports that the levels of inorganic arsenic and lead found in edible wild mushrooms in the Yellowknife area are high and these mushrooms should not be eaten. Whereas, the values of heavy metals in distant background areas generally are low and edible wild mushrooms are safe to eat.

Therefore, the author of this paper recommends that health authorities re-assess former assessments on the intakes of inorganic arsenic and lead through the consumption of selected wild mushroom species growing in and around Yellowknife.

2) Local health authorities should consider posting public advisories to avoid the consumption of edible wild mushrooms growing in the city of Yellowknife and within 30 km of the city and mines.

In addition, the consumption of wild mushrooms growing within 1 km of highways, roads, and other impacted areas, also should be avoided. The consumption of wild mushrooms from accessible popular harvest areas along road corridors 40 km west and 30 – 50 km east of Yellowknife should be limited to small amounts.

The consumption of certain species of edible wild mushrooms from these areas should be drastically limited or avoided completely because of high accumulations of arsenic and lead in fungi (for more details see Section 7, point 2).

The consumption of all species of wild meadow mushrooms (genus *Agaricus*) should be avoided completely because of high accumulations of lead and cadmium.

3) The advisory should emphasize that heavy metal levels in edible wild mushrooms are much lower in areas further away from Yellowknife, mines and infrastructure, and that these mushrooms are safe to eat.

4) Periodical random sampling and analysis of contaminants in edible wild mushrooms should be conducted by regional, national and continental health authorities. The wild mushroom industry in North America is a renewable and environmentally responsible multi-billion dollar venture. Monitoring contaminants such as heavy metals in edible wild mushrooms will help this industry to flourish safely and prosperously.

5) Regarding future commercial community morel mushroom harvests in the Northwest Territories, such as planned harvests for 2015, the author recommends the following:

a) A review of the bedrock geology data on heavy metals from that area.

b) Immediate analysis of soil and the first few morels starting to grow before the beginning of the main morel harvest.

c) The results of the analysis can be received within days if prearrangements are made with a certified local laboratory. If there should be any concerns with these morels, there would be enough time to identify hot spots and safe harvest areas before the beginning of the actual harvest activities.

Providing certified laboratory results confirming the cleanliness of pristine subarctic morel mushrooms is good advertisement. This is in the interest of national and international consumers, markets, and northerners to help this new multi-million dollar industry prospering safely in the Northwest Territories.

6) Other heavy metals in edible wild mushrooms were not discussed in this paper but are also of concern in the quoted scientific literature. Therefore, the author invites interested readers, researchers, and health authorities to assess the analytical tabular data provided in this paper for all 26 – 27 metals in soil and fungi.

9. PERSONAL COMMUNICATIONS

Brown, Walter, long time avid mushroom harvester, Yellowknife, NT;

Carrière, Suzanne, Ph.D., Ecosystem Management Biologist, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife;

Coedy, William, former Director of the Taiga Environmental Laboratory, Environment and Conservation Division, Indian and Northern Affairs Canada (INAC), Yellowknife;

Daniel-Kosta, Ursula, late president of the former mycological society in Yellowknife during the 1970's to early 1990's.

Hudy, Glen, Laboratory Technologist, Taiga Environmental Laboratory (INAC), Yellowknife;

Kosta, Bob, late avid mushroom harvester for several decades in Yellowknife;

Sterenberg, Velma, geologist and local mushroom expert in Yellowknife; and

Wurtz, Tricia L., Research Ecologist, US Department of Agriculture, Forest Service, Pacific Northwest Research Station, Boreal Ecology Cooperative Research Unit, University of Alaska, Fairbanks, AK.

10. ACKNOWLEDGEMENTS

Special thanks for sponsoring this report to John Colford, Manager, Traditional Economy, Agriculture and Fisheries, Department of Industry, Tourism and Investment, Government of the Northwest Territories (GNWT), Yellowknife.

Many thanks to David Livingstone, former Director, Environment and Conservation Division, Indian and Northern Affairs Canada (INAC), Yellowknife, for sponsoring the laboratory analysis of samples and an earlier version of this report. Thanks also to the Contaminants and Remediation Directorate, INAC, Yellowknife, for sponsoring a preliminary report in 2001. In addition to funding support provided to this project, the fieldwork, sampling, laboratory preparation of samples, data compilation, analysis, and report writing was volunteered by the author at own expenses and time.

I am indebted to Glen Hudy and laboratory staff of the Taiga Environmental Laboratory (INAC), Yellowknife, for conducting and sponsoring the laboratory analysis. For documenting the analytical methods I am thankful to William Coedy and Glen Hudy, INAC.

Many thanks for the letters of support for this project which were received in 1999/2000 from the Yellowknives Dene First Nation; Dene Nation; Metis Nation; North Slave Metis Alliance; Ecology North; Department of Community Economic Development (GNWT); Department of Environment and Natural Resources (ENR), GNWT; and Department of Health and Social Services (HSS), GNWT, Yellowknife.

For assistance in initiating human health risk assessments in 2001 and 2012, thanks are extended to the staff of the Health Protection Unit (HSS), GNWT.

I highly appreciate the critical additional collections of morel mushroom samples submitted by the following donators: Walter Brown, a long time avid mushroom harvester in Yellowknife; Suzanne Carrière, Ecosystem Management Biologist, ENR, Yellowknife; and Tricia L. Wurtz, Research Ecologist, USDAFS, Pacific Northwest Research Station and University of Alaska, Fairbanks, AK.

Thanks are extended to Brett Elkin, Wildlife Disease and Contaminant Specialist, and Alison Welch, former Librarian, ENR (GNWT), Yellowknife, for assisting in a literature research on contaminants in edible wild mushrooms in 1997.

Special thanks to Velma Sterenberg, Walter Brown, the late Ursula Daniel-Kosta, the late Bob Kosta, and many resident avid mushroom harvesters, for sharing their knowledge about local mushrooms.

Finally, for co-authoring the preliminary results in 2001, I am grateful to Robert G. Bromley and William Coedy. For comments and reviews of earlier drafts of this report I

am thankful to Robert G. Bromley, Velma Sterenberg, Marita Obst, and Tasha Stephenson.

11. LITERATURE CITED

AMAP. 1998. AMAP Assessment Report: Arctic Pollution Issues. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xii + 859 pp.

AMAP. 1997. Arctic Pollution Issues: A State of the Arctic Environment Report. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xii + 188 pp.

Aspler, L.B. 1987. Surfical geology; p. 137 – 154 *in* Padgham (1987). Yellowknife Guide Book: A guide to the geology of the Yellowknife Volcanic belt and its bordering rocks. The Yellowknife Geo-workshop Committee and Geological Association of Canada, Mineral Deposits Division. 209 pp.

Babal, K. 1997. The cancer-fighting qualities of mushrooms. Nutrition Science News: March 1997. 4 pp.

Barcan, V. SH., E. F. Kovnatsky, and M. S. Smetannikova. 1998. Absorption of heavy metals in wild berries and edible mushrooms in an area affected by smelter emissions. Water, Air and Soil Pollution 103: 173 - 195, 1998.

Brubacher, D. and Associates. 1999. Non-timber forest products: exploring opportunities for aboriginal communities. Mitigaawaaki Forestry Marketing Co-operative, Ontario. 133 pp.

Calow, P. 1994. Handbook of Ecotoxicology. Vol. II. Blackwell Scientific Publications, Oxford, UK. 416 pp.

CCME. 2002. Canadian Council of Ministers of the Environment (CCME, 2002). Recommended Canadian Soil Quality Guidelines. Canadian Environmental Quality Guidelines; Summary Table Update 2002. CCME, Winnipeg. 12 pp.

Chiu, S. W., Y. H. Chan, S. C. Law, K. T. Cheung, and D. Moore. 1998. Cadmium and manganese in contrast to calcium reduce yield and nutritional values of edible mushroom *Pleurotus pulmonarius*. J. of Mycol. Res. 102 (4): 449 - 457.

Dabeka, R.W. and A. D. McKenzie. 1995. Survey of lead, cadmium, fluoride, nickel, and cobalt in food composites and estimation of the dietary intake of these elements by Canadians in 1986 – 1988. Journal of AOAC International, 78 (4), 897 – 909.

Dabeka, R.W., A. D. McKenzie, G. M. A. Lacroix, C. Cleroux, S. Bowe, R. A. Graham, H. B. S. Conacher, and P. Verdier. 1993. Survey of arsenic in total diet food composites and estimation of the dietary intake of arsenic by Canadian adults and children. Journal of AOAC International, 76 (1), 14 – 25.

de Geus, N. 1995. Botanical forest products in British Columbia: an overview. Integrated Resources Policy Branch, BC Ministry of Forests, Victoria. 33 pp.

Dene Nation; Dene Nation Lands and Environment Department; and Department of Indian and Northern Development, Contaminants Division. 1999. Arsenic levels in berries and soils from the Weledeh Yellowknives Dene First Nation traditional territory, Summer 1998. Report prepared for Yellowknives Dene First Nation and Northern Contaminants Program, Department of Indian and Northern Development. Yellowknives Dene First Nation, Yellowknife, N.W.T. pp 1 – 46.

Dene Nation. 2000. Risk characterization of arsenic exposure from consumption of berries in the Akaitcho Territory. Yellowknives Dene First Nation, Dene Lands and Environment Department, Yellowknife, N.W.T., Canada.

Duchesne, L. C. 1995. Commercial potential of wild mushroom harvest in Renfrew County. Unpubl. Rep. 10 pp.

Duchesne, L. D., and M. G. Weber. 1993. High incidence of edible morel *Morchella conica* in a jack pine, *Pinus banksiana*, forest following prescribed burning. Can. Field-Nat. 107: 114 - 116.

EBA. 2000. Arsenic control site data compilation Yellowknife, NWT. Report prepared by EBA Engineering Consultants Ltd., Yellowknife, for the Yellowknife Arsenic Soil Remediation Committee, Environment Canada, Project No. 0701-00-14435. 17 pp (plus appendix).

ENR. 1994. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Media Archive: Video about the commercial morel harvest in Norman Wells, NT.

EPA. 1991. EPA Method 200.8, “Determination of Trace Metals in Waters and Wastes by ICP-MS”. Revision 4.4, (April 1991), S. Long & T. Martin, US EPA.

ESG. 2001a. Arsenic levels in the Yellowknife area: distinguishing between natural and anthropogenic inputs. Report prepared by the Environmental Sciences Group (ESG), Royal Military College (RMC) of Canada, Kingston, Ontario, for the Yellowknife Arsenic Soil Remediation Committee; RMC-CCE-ES-01-01. 62 pp.

ESG. 2001b. Characterization of the potential Human Health Risk from consumption of garden produce in Yellowknife, NWT. Report prepared by I. Koch, C.A. Ollson, and K.J. Reimer, Environmental Sciences Group (ESG), Royal Military College (RMC) of Canada, Kingston, Ontario; RMC-CCE-ES-01-16. 69 pp.

Falandysz, J. 1998. Bioconcentration Factors (BCF) of silver in wild *Agaricus campestris*. Bull. Environ. Contam. Toxicol., Vol. 55, No.1: 122 -128.

Falandysz, J., and A. Chwir. 1997. The concentrations and bioconcentration factors of mercury in mushrooms from the Mierzeja Wislana sand-bar, Northern Poland. The Science of the Total Environment, 203 (1997) 221 - 228.

Garcia, M. A., J. Alonso, M. I. Fernandez, and M. J. Melgar. 1998. Lead content in edible wild mushrooms in Northwest Spain as indicator of environmental contamination. Arch. Environ. Contam. Toxicol. 34, 330 - 335 (1998).

Geological Association of Canada, Mineral Deposits Division. 2006. Gold in the Yellowknife Greenstone Belt, Northwest Territories: Results of the EXTECH III Multidisciplinary Research Project, (ed.) C.D. Anglin, H. Falck, D.F. Wright, and E.J. Ambrose; Geological Association of Canada, Mineral Deposits Division, Special Publication No. 3, 442 pp.

Green, B. 1989. Wild mushrooms with known or possible commercial value existing in the South Slave and Decho regions of the N.W.T. Rep. prepared for GNWT Dept. of Economic Development and Tourism. 19 pp.

Health Canada. 2012. Human Health Risk Assessment of the intake of lead through the consumption of mushrooms from the North Great Slave Lake Region [based on the results of this paper]. Unpublished letter (received November 2012) from Health Canada, Chemical Health Hazard Assessment Division, Bureau of Chemical Safety, Food Directorate, Health Products and Food Branch, Ottawa, Ontario. 5 pp. (see original letter in Appendix 1).

Health Canada. 2002. Human Health Risk Assessment of the intake of four heavy metals through the consumption of mushrooms from the North Great Slave Lake Region [based on preliminary results of this study provided in Obst *et al*. 2001]. Unpublished letter (May 6, 2002) from J. Lawrence, Ph.D., Health Canada, Chemical Health Hazard Assessment Division, Bureau of Chemical Safety, Food Directorate, Health Products and Food Branch, Ottawa, ON. 5 pp. (see original letter in Appendix 1).

Hosford, D., D. Pilz, R. Molina, and M. Amaranthus. 1997. Ecology and management of the commercially harvested American Matsutake mushroom. Tech. Rep. PNW-GTR-412, U.S. Dept. Agriculture, Portland, OR. 68 pp.

INAC 2002. Department of Indian and Northern Affairs Canada (INAC). Arsenic trioxide management alternatives Giant Mine, Final Report. Report prepared by Steffen Robertson and Kirsten (Canada) Inc. 125 pp.

Kalac, P., J. Burda, and I. Staskova. 1991. Concentrations of lead, cadmium, mercury and copper in mushrooms in the vicinity of a lead smelter. The Science of the Total Environment, 105 (1991) 109 - 119.

Kalac, P., M. Niznanska, D. Bevilaqua, and I. Staskova. 1996. Concentrations of mercury, copper, cadmium and lead in fruiting bodies of edible mushrooms in the vicinity of a mercury smelter and a copper smelter. The Science of the Total Environment, 177 (1996) 251 - 258.

Kenney, N.W. 1996. An overview of the Yukon Morel Mushroom industry. Yukon Government, Department of Economic Development, and Renewable Resources. Whitehorse, Yukon Territory.

Kerr, D.E. 2006. Surficial geology and exploration geochemistry; Chapter 20 *in* Gold in the Yellowknife Greenstone Belt, Northwest Territories: Results of the EXTECH III Multidisciplinary Research Project, (ed.) C.D. Anglin, H. Falck, D.F. Wright, and E.J. Ambrose; Geological Association of Canada, Mineral Deposits Division, Special Publication No. 3, p. 301 - 324.

Koch, I., L. Wang, C.A. Ollson, W.R. Cullen, and K.J. Reimer. 2000. The predominance of inorganic arsenic species in plants from Yellowknife, Northwest Territories, Canada. Environmental Science and Technology, 34, 22 - 26.

Koch, I., C.A. Ollson, and K.J. Reimer. 2001. Characterization of the potential human health risk from consumption of garden produce in Yellowknife, NWT. Report by the Environmental Sciences Group, Royal Military College of Canada, Kingston, Ontario; RMC-CCE-ES-01-16. 69 pp.

Korky, J. K., and L. Kowalski. 1989. Radioactive cesium in edible mushrooms. J. Agric. Food Chem. 1989, 37, 568 - 569.

Kuehnelt, D., W. Goessler, and K.J. Irgolic. 1997. Arsenic Compounds in Terrestrial Organisms I: *Collybia maculata*, *Collybia butyracea* and *Amanita muscaria* from Arsenic Smelter Sites in Austria. Appl. Organomet. Chem., Vol. 11, 289 - 296.

Larsen, E. H., M. Hansen, and W. Gossler. 1998. Speciation and health risk considerations of arsenic in the edible mushroom *Laccaria amethystina* collected from contaminated and uncontaminated locations. Applied Organometallic Chemistry, Vol. 12, 285 - 291 (1998).

Liegel, L., D. Pilz, and T. Love. 1998a. The MAB Mushroom Study: backgrounds and concerns. AMBIO spec. rep. no. 9, Sept. 1998. Roy. Swedish Acad. of Science, Stockholm: 3 - 7.

Liegel, L., D. Pilz, T. Love, and E. Jones. 1998b. Integrating biological, socioeconomic, and managerial methods and results in the MAB Mushroom Study. AMBIO spec. rep. no. 9, Sept. 1998. Royal Swedish Academy of Science, Stockholm: 26 - 33.

Lincoff, G. H. 1981. The Audubon Society Field Guide to North American Mushrooms.

A. A. Knopf, New York. 926 pp.

Love, T., E. Jones, and L. Liegel. 1998. Valuing the temperate rainforest: wild mushrooming on the Olympic Peninsula Biosphere Reserve. AMBIO spec. rep. no. 9, Sept. 1998. Royal Swedish Academy of Science, Stockholm: 16 - 25.

Macdonald, C. 2004. Summary data report for metals and radionucleides in soils and plants at Port Radium, September 2003. Report prepared by Northern Environmental Consulting, Pinawa, Manitoba, for SENES Consulting and the Contaminants Division, Indian and Northern Affairs Canada, Yellowknife, NT. 70 pp.

Macdonald, C. 2003a. Summary report on the analysis of soil and plant samples collected at the Colomac Mine Site in September 2002. Draft report prepared by Northern Environmental Consulting, Pinawa, Manitoba, for the Contaminants Division, Indian and Northern Affairs Canada, Yellowknife, NT. 61 pp. plus appendices.

Macdonald, C. 2003b. Summary report on the chemical analysis of soil, plants and small mammals at the Colomac Mine Site, September 2003. Draft report prepared by Northern Environmental Consulting, Pinawa, Manitoba, for the Contaminants Division, Indian and Northern Affairs Canada, Yellowknife, NT. 122 pp.

McLain, R., E. Jones, and L. Liegel. 1998. The MAB Mushroom Study as a teaching case example of interdisciplinary and sustainable forestry research. AMBIO spec. rep. no. 9, Sept. 1998. Roy. Swedish Acad. of Sci., Stockholm: 34 - 35.

Melgar, M. J., J. Alonso, M. Perez-Lopez, and M. A. Garcia. 1998. Influence of some factors in toxicity and accumulation of cadmium from edible wild macrofungi in NW Spain. J. Environ. Sci. Health, B33(4), 439 - 455 (1998).

Minagawa, K., T. Sasaki, Y. Takizawa, R. Tamura, and T. Oshina. 1980. Accumulation route and chemical form of mercury in mushroom species. Bull. Environm. Contam. Toxicol. 25, 382 - 388 (1980).

Mitchell, M. and Associates. 1997. The Harvest, Market and Availability of Special Forest Products in the Manitoba Model Forest. Project: 95-4-09. 81 pp.

Mohammed, G. H. 1999. Non-Timber Forest Products in Ontario: An Overview. Ontario Forest Research Institute, Ministry of Natural Resources. Forest Research Information Paper No. 145. 64 pp.

Molina, R., T. O'Dell, D. Luoma, M. Amaranthus, M. Castellano, and K. Russell. 1993. Biology, ecology, and social aspects of wild edible mushrooms in the forests of the Pacific Northwest: a preface to managing commercial harvest. Tech. Rep. PNW-GTR-309, U.S. Dept. Agriculture, Portland, OR. 42 pp.

Molina, R., N. Vance, J. F. Weigand, D. Pilz, and M. Amaranthus. 1997. Special forest products: intergrating social, economic, and biological considerations into ecosystem management. In: Creating a forestry for the 21st century. The science of ecosystem management. Chapter 21, pp. 315 - 336. Island Press, Washington, D.C.

Nickerson, D. 1999. EXTECH III Biogeochemical Survey – Yellowknife area, 1999, NTS 85J/9; Northwest Territories Geology Division, Indian and Northern Affairs Canada, Open Report 1999-002.

Oatman, G. S. 1998. Medicinal mushrooms - I: an ancient alternative to synthetic drugs. Mycoinfo, Inc. Seattle, WA. 2 pp.

Obst, J. 2004. Colomac Mine Terrestrial Sample Collection Program in 2003. Unpublished report prepared by Arctic Ecology and Development Consulting for the Department of Indian and Northern Affairs Canada Contaminants Division, Yellowknife, NT. 23 pp.

Obst, J. 2003. Colomac Mine Plant and Soil Sample Collection Program in 2002. Unpublished report prepared by Arctic Ecology and Development Consulting for the Department of Indian and Northern Affairs Canada Contaminants Division, Yellowknife, NT. 29 pp.

Obst, J., W. Coedy, and R.G. Bromley. 2001. Heavy Metal Analyses of Wild Edible Mushrooms in the North Great Slave Lake Region, Northwest Territories, Canada. Unpublished report prepared for the Environment and Conservation Division, Indian and Northern Affairs Canada (INAC), Yellowknife, NT. 71 pp. [Note: the results of this preliminary report are included in this final paper].

Obst, J. and W. Brown. 2000. Feasibility of a Morel Mushroom Harvest in the Northwest Territories. Unpublished report prepared by Arctic Ecology and Development Consulting and Deton'çho Corporation for the Government of the Northwest Territories, Division of Economic Development, Trade and Investment Office, Dept. of Environment and Natural Resources, Yellowknife, NT. 42 pp.

Padgham, W.A. 1987. Yellowknife Guide Book: A guide to the geology of the Yellowknife Volcanic belt and its bordering rocks. The Yellowknife Geo-workshop Committee and Geological Association of Canada, Mineral Deposits Division. 209 pp.

Phillips, R. 1991. Mushrooms of North America. Little Brown & Company, Toronto. 319 pp.

Pilz, D., R. McLain, S. Alexander, L. Villarreal-Ruiz, S. Berch, T. L. Wurtz, C. G. Parks, E. McFarlane, B. Baker, R. Molina, and J. E. Smith. 2007. Ecology and Management of Morels Harvested from the Forests of Western North America. US Dept. of Agriculture, Forest Service, Pacific Northwest Research Station, USDA General Technical Report PNW-GTR-710, March 2007. 161 pp.

Pilz, D., S. Alexander, J. E. Smith, R. Schroeder, and J. Freed. 2006. Alaskan nontimber forest product opportunities. Gen. Tech. Rep. PNW-GTR-671. Portland, OR: US Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 79 pp.

Pilz, D., J. Smith, M. P. Amaranthus, S. Alexander, R. Molina, and D. Luoma. 1999. Mushrooms and Timber: Managing commercial harvesting in the Oregon Cascades. J. of Forestry, March 1999: 4 - 11.

Pilz, D., R. Molina, and L. Liegel. 1998a. Biological productivity of chanterelle mushrooms in and near the Olympic Peninsula Biosphere Reserve. AMBIO spec. rep. no. 9, Sept. 1998. Roy. Swedish Acad. of Science, Stockholm: 8 - 13.

Pilz, D., F. D. Brodie, S. Alexander, and R. Molina. 1998b. Relative value of chanterelles and timber as commercial forest products. AMBIO spec. rep. no. 9, Sept. 1998. Royal Swedish Academy of Science, Stockholm: 14 - 16.

Pilz, D. and R. Molina. 1996. Managing forest ecosystems to conserve fungus diversity and sustain wild mushroom harvests. Studies 1 - 13. Tech. Rep. PNW-GTR-371, U.S. Dept. Agriculture, Portland, OR. 104 pp.

Pop, A., and A. Nicoara. 1996. Heavy metals in three species of edible mushrooms. Studia Univ. Bares Bolyaj, Romania. Biologia XLI. 1 - 2 (1996): 93 - 96.

Receveur, O., M. Boulay, C. Mills, W. Carpenter, and H. Kuhnlein. 1996. Variance in food use in Dene/Metis communities. Centre for Indigenous Peoples' Nutrition and Environment (CINE); McGill University, Montreal. 198 pp.

Richardson, G.M. 2001. Human Health Risk Assessment of the intake of four heavy metals through the consumption of mushrooms from the North Great Slave Lake Region [based on preliminary results of this study provided in Obst et al. 2001]. Unpublished letter (July 9, 2001) from G. M. Richardson, Ph.D., risk assessment consultant; Risklogic Scientific Services Inc., Ottawa, Canada. 6 pp. (see original letter in Appendix 1).

SAF. 1997. Saskatchewan Agriculture and Food (SAF). Special forest products. Farmfacts, Government of Saskatchewan, Canada. 4 pp.

SAF. 1996. Saskatchewan Agriculture and Food (SAF). Commercial Harvesting of Wild Mushrooms in Saskatchewan. Farmfacts, Government of Saskatchewan, Canada. 4 pp.

Schlosser, W. E. and K. Blatner. 1997. Special forest products: An east-side perspective. USDA Pacific Northwest Research Station. PNW-GTR-380.

Skuterud, L., I. G. Travnikova, M. I. Balonov, P. Strand, and B. J. Howard. 1997. Contribution of fungi to radiocaesium intake by rural populations in Russia. The Science of the Total Environment, 193 (1997) 237 - 242.

Slejkovec, Z., A. R. Byrne, T. Stijve, W. Goessler, and K. J. Irgolic. 1997. Arsenic compounds in higher fungi. Applied Organometallic Chemistry, Vol. 11, 673 - 682 (1997).

Slekovec, M., and K. J. Irgolic. 1996. Uptake of arsenic by mushrooms from soil. Chemical Speciation and Bioavailability (1996), 8 (3/4): 67 - 73.

Tuzen, M., M. Ozdemir, and A. Demirbas. 1998. Heavy metal bioaccumulation by cultivated *Agaricus bisporus* from artificially enriched substrates. Z. Lebensm. Unters. Forsch. A. (1998) 206: 417 - 419.

USDA Forest Service. 1999. Commercially-harvested edible forest mushrooms productivity and sustainable harvest research in the Pacific Northwest. 12 pp.

USDA National Agriculture. 1998. Agricultural Statistics Board - Mushrooms. National Agricultural Statistics Service (NASS), Washington, DC. 13 pp.

USFDA. 1993. Guidance document for Cadmium in Shellfish, U.S. Food and Drug Administration 1993. Http://vm.cfsan.fda.gov/~frf/guid-cd.html

Van Elteren, J.T., U.D. Woroniecka, and K.J. Kroon. 1998. Accumulation and distribution of selenium and cesium in the cultivated mushroom *Agaricus bisporus* - a radiotracer-aided study. Chemosphere 36 (8): 1787 - 1798.

Van Hees, E.H., G.D. Kirkham, M-L. Sirbescu, K.L. Shelton, R.L. Hauser, and H. Falck. 2006. Large lithogeochemical alteration halos around Yellowknife gold deposits and implications for fluid pathways; Chapter 16 *in* Gold in the Yellowknife Greenstone Belt, Northwest Territories: Results of the EXTECH III Multidisciplinary Research Project, (ed.) C.D. Anglin, H. Falck, D.F. Wright, and E.J. Ambrose; Geological Association of Canada, Mineral Deposits Division, Special Publication No. 3, p. 232 – 248.

Varian. 1988. Analytical Methods for Graphite Tube Analyzer. Method manual, PTY Ltd., Australia.

Vetter, J., and E. Berta. 1997. Mercury contents of some wild edible mushrooms. Z. Lebensm. Unters. Forsch. A. (1997) 205: 316 - 320.

Weber, A., G. Lehrberger, and G. Morteani. 1997. Gold and arsenic in mushrooms, mosses, and needles: biochemical aspects of a Middle Ages geogenic dumping site in Oberviechtach, northern Oberpfaelzer Wald. Max-Planck-Institute, Germany; Geologica Bavarica, 0 (102): 229 - 250.

WHO 1995. Environmental Health Criteria 18: Inorganic lead. World Health Organization, Geneva.

WHO 1993a. Guidelines for drinking-water quality, *2nd ed. Vol.1.* Recommendations. World Health Organization, Geneva, 1993. 41 – 42 pp.

WHO 1993b. Evaluation on certain food additives and contaminants. Technical Report Series No. 837: 41st report of the Joint FAO/WHO Expert Committee on Food Additives. World Health Organization, Geneva, 1993. 57 pp.

WHO 1992. Environmental Health Criteria 134: Cadmium. World Health Organization, Geneva.

WHO 1989. Evaluation of certain food additives and contaminants. Technical Report Series No. 776: 33rd report of the Joint FAO/WHO Expert Committee on Food Additives. Geneva.

WHO 1981. Environmental Health Criteria 18: Arsenic. World Health Organization, Geneva.

WHO 1977. Environmental Health Criteria for Cadmium. Ambio 6, 287.

WHO 1976a. List of maximum levels recommended for contaminants by the Joint FAO/WHO Codex Alimentarius Commission. Second Series, CAC/FAL, Rome, 3 (1976) 1 - 8.

WHO 1976b. Environmental Health Criteria 1: Mercury. World Health Organization, Geneva.

Willeford, L. M. 1996. Mushrooms as medicine. New Age Journal, Jan/Feb 96. 4 pp.

Wurtz, T.L., A.L. Wiita, and N.S. Weber. 2005. Harvesting morels after wildfire in Alaska. Res. Note PNW-RN-546. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific NorthwestResearch Station. 31 pp.

Yalcin, S., and X. C.Le. 2001. Speciation of arsenic using solid phase extraction cartridges. Journal of Environmental Monitoring, 3, 81-85.

Zrodlowski, Z. 1995. The influence of washing and peeling of mushrooms Agaricus bisporus on the level of heavy metal contamination. Pol. J. Food Nutr. Sci., Vol. 4/45, No. 1, 26 - 33.

Zurera, G., F. Rincon, F. Argos, and R. Pozo-Lora. 1998. Mercury content in mushroom species in the Cordova area. Bull. Environ. Contam. Toxicol., Vol. 36, No. 5: 662 - 666.

APPENDICES

Appendix 1. Human Health Risk Assessments of Heavy Metal Intake through the Consumption of Edible Wild Mushrooms

1) In 2001, the author of this paper requested a human health risk assessment on the intakes of arsenic, lead, cadmium and mercury through the consumption of edible wild mushrooms by residents of the Yellowknife area.

The request was forwarded to Health Canada through the Health Protection Unit, Population Health Division, Department of Health and Social Services (HSS), Government of the Northwest Territories (GNWT).

Consequently, a human health risk assessment on the intake of all four heavy metals through local mushrooms was received from Health Canada, Chemical Health Hazard Assessment Division, Bureau of Chemical Safety, Food Directorate, Health Products and Food Branch (Health Canada 2002).

A second health risk assessment was received from an independent health risk consultant (Richardson 2001) appointed by HSS, GNWT.

Both health risk assessments were based on preliminary data and results from the first set of 45 mushroom samples (as indicated in Table 1) from this study (Obst *et al.* 2001).

The final results of all 124 fungi samples presented in this paper reported even higher levels of total arsenic, inorganic arsenic and lead in edible wild mushrooms than the first set of data. Therefore, the author of this paper initiated a new human health risk assessment in early 2012. An assessment on lead in fungi was received in November 2012 through HSS (GNWT) from the Bureau of Chemical Safety, Food Directorate of Health Canada. An assessment of arsenic concentrations in fungi is still pending.

The following assessments are the original human health risk assessments received from Health Canada (2012 and 2002) and Richardson (2001).

2) Assessment of lead (Pb) in wild mushrooms by Health Canada in 2012 (original text in *Italic*; edits in Arial font and brackets).

Health Canada (2012): "*Of all the samples that reported results (n=123), the mean was 57.8 ppm* [of lead (Pb)] *but the median only 0.3 ppm* [Pb] *(very large range; < 0.1-1010 ppm* [Pb]*). As these are on a dry weight basis, you would divide by 10 to get an approximate wet weight concentration. Even at 5.78 ppm* [Pb]*, this would be considered somewhat elevated while the mean* [median] *value (0.03 ppm) would be considered as* *consistent with other surveys. When I looked at the subset where there was both soil and mushroom data, I didn't see a strong correlation between the two, which is also somewhat consistent with the available data (mushrooms usually don't bioconcentrate Pb from surrounding soils).*

Depending on the species consumed and location collected, there could be the possibility that regular or frequent consumers could be ingesting Pb in significantly higher amounts than compared to the daily diet. There currently isn't a numerical toxicology Pb value on which to compare intakes to but, on average, the usual daily intake (diet) is considered to be about 0.1 ug/kg bw/day. For an adult, they would only have to consume a few grams of mushrooms/day at the mean concentration (5.78 ppm) in order to exceed this value. If the median value were used, there really wouldn't be too much of a concern (almost half a pound/day). We've developed a process whereby the estimated increase in blood Pb at steady state can be derived from dietary intakes in order to provide a value of what amount of a food might result in a significant increase in blood Pb. I can always run the mean and median mushroom Pb values through that process to give you a better idea if this might represent an issue."

3) Health Risk Assessment and Recommendations by Health Canada in 2002

1) Arsenic

Health Canada (2002): "*Inorganic arsenic, on which the Health Canada and WHO pTDIs* [provisional Tolerable Daily Intake] *are based, is considered to be more toxic than organic forms. As the report* [Obst *et al.* 2001] *states, up to 99.75% of the total arsenic found in these mushrooms is organic. Even if the highest concentration of arsenic found in any of the tested species is considered (49.4 µg total arsenic/g wet weight or approximately 123.5 ng inorganic arsenic/g wet weight), an adult would have to consume greater than 1 kg of mushrooms/day before exceeding the pTDI. We would consider that the arsenic levels would not pose any concern for either harvesters or general consumers*".

2) Lead

Health Canada (2002): "*Based on an overall mushroom lead concentration of 120.3 µg/g dry weight (12.03 µg/g wet weight), an adult consumer would only be able to ingest approximately 18 g of mushrooms/day before exceeding the pTDI, taking into consideration the estimated dietary intake of lead from other foods. Consumption advice for lead would only be necessary for less than 3.0% of the survey population* [in Table 5] *who reported consumption of greater than 5 kg of mushrooms per year. This figure would increase to approximately 5 – 6% of the survey population when considering the higher average lead concentration found in Morchella*".

3) Cadmium

Health Canada (2002): "*Based on the mean cadmium concentration for all mushroom species of 0.24 µg/g wet weight and taking into consideration an estimated contribution of 20 µg cadmium/day from diet, the average consumer could still ingest up to 180g mushrooms per day before exceeding the pTDI. As this estimate is even greater than the 15 kg value cited in the survey for serious gourmet harvesters, we would consider that the cadmium levels would not pose any concern for either harvesters or general consumers*".

4) Mercury

Health Canada (2002): "*Considering analytical values given for mercury are total mercury, and based on an average mushroom mercury concentration of 0.055 µg/g wet weight, an adult would have to consume greater than 760g of mushroom/day before exceeding the pTDI. As this estimate is even greater than the 15 kg/year or 41g/day value cited in the survey for serious gourmet harvesters, we would consider that the mercury level would not pose any risk to the general population, women of child bearing age or children*".

References cited by Health Canada (2002) for the above metals: WHO (1993a), WHO (1993b), Dabeka and McKenzie (1995), and USFDA (1993).

4) Health Risk Assessment and Recommendations by an Independent Expert in 2001

a) Richardson (2001): "*Consistent with the approach of Obst et al.* [2001], *I focused mainly on four metals – arsenic, cadmium, lead and mercury – as the data suggest that these are of greatest concern. I examined exposures from the perspective of chronic exposure duration. There is little or no reliable data on acceptable or tolerable sub-chronic or acute intake levels for these metals* [As, Pb, Cd, and Hg]. *However, Obst et al.* [2001] *indicated that the harvesting season is about 2 months (60 days) long. It is likely that most consumers would eat wild mushrooms only when in season. Therefore, my use of chronic pTDIs is being conservative. My approach was to reverse the exposure equation such that I derived the rate of mushroom consumption that would not result in exceeding available reference doses for the four metals, assuming that mushrooms were contaminated at the average concentration value. The results were as follows (on a fresh weight basis):*

arsenic: acceptable or tolerable consumption rate = 40 g/day assuming all arsenic is inorganic;

cadmium: acceptable or tolerable consumption rate = 290 g/day;

lead: acceptable or tolerable consumption rate = 20 g/day;

mercury: acceptable or tolerable consumption rate = 900 g/day".

b) Richardson (2001): "*Obst et al.* [2001] *defined 6 categories of mushroom consumers. These were:*

category 1 (very low) - 0.07 – 0.5 kg/yr, which is equivalent to 0.2 – 1.4 g/day assuming consumption throughout the year, or assuming that the exposures occur over a shorter time period but are amortized (averaged) over an entire 365 days;

category 2 (low): 1.4 – 2.7 g/day;

category 3 (low): 2.7 – 5.5 g/day;

category 4 (moderate): 5.5 – 13.7 g/day;

category 5 (high): 13.7 – 27.4 g/day;

category 6 (very high): 27.4 – 41.1 g/day".

c) Richardson (2001): *"Based on the tolerable consumption rates indicated above, there is no concern related to either cadmium or mercury exposure. Based on arsenic contents, the tolerable consumption rate was estimated to be 40 g/day, which is within the range for category 6 (27.4 – 41.1 g/day). Given the broad assumptions and data quality involved in arriving at both the tolerable consumption rates and the estimated intakes defined by Obst et al.* [2001] *in their intake categories, I would not be concerned about arsenic intake either. It should also be noted that the toxic concern for arsenic relates to its inorganic forms and Obst et al.* [2001] *reported that the majority of arsenic in the two mushrooms tested was organic, and also literature sources indicate at least 50% of arsenic in mushrooms appears to be organic. Organic arsenic species have lower toxicity relative to inorganic forms. Therefore, mushroom intake with respect to arsenic is also not a concern, from my perspective".*

d) Richardson (2001): *"The greatest concern in my view relates to lead exposure. The tolerable mushroom consumption rate for lead was calculated as 20g of mushrooms per day. This suggests that persons with high or very high consumption (Obst et al.'s* [2001] *category 1 and 2* [in Table 5] *may be ingesting relatively large amounts of lead. There appear to be only two mushroom species that are highly contaminated with lead – Agaricus and Morchella. Only 3 samples of Agaricus were collected. These were from YK River Park, YK Old Town and YK Treminco Mine. I would suspect that lead levels in* *the soil of Old Town and the Treminco Mine would be higher than elsewhere in the region, but 3 specimens is not enough to determine if accumulation from soil is an issue. You must also keep in mind that this study was conducted when the roaster at the Giant Mine was still operating. Mushrooms and other fungi do tend to absorb contaminants from the air and, therefore, contamination in these species (and all species in the area) may have dropped now that the roaster is closed down".*

e) Richardson (2001): *"Only 4 samples of Morchella were collected, all from Tibbitt Lake. Soil samples were not analyzed for lead, so the influence of soil contamination on lead accumulation in this species can not be determined. The site is far enough from Giant Mine that the roaster emissions would not be an issue. Therefore, this species may preferentially accumulate lead".*

f) Richardson (2001): *"Recommendations: Based on the data that are available, only lead intake is a concern. Two species of mushrooms have very high lead contamination – Agaricus and Morchella. I would recommend that consumers of these two species of mushrooms be advised to maintain a low intake rate, or reduce their intake of these species to a low level. A small helping once per week, in my view would not be intolerable. By a small helping I mean about 140 g or 5 oz fresh weight (i.e., prior to cooking). This could be increased if consumption only occurs during the harvesting season (not year round). In that case, doubling or tripling the suggested intake would not be cause for concern".*

Appendix 2.

Figures 1 – 12..101-112

Tables 1, 1a – c, and Tables 2 – 5..113-128

Tables A, A1 – A4, and Tables B to J...129-178

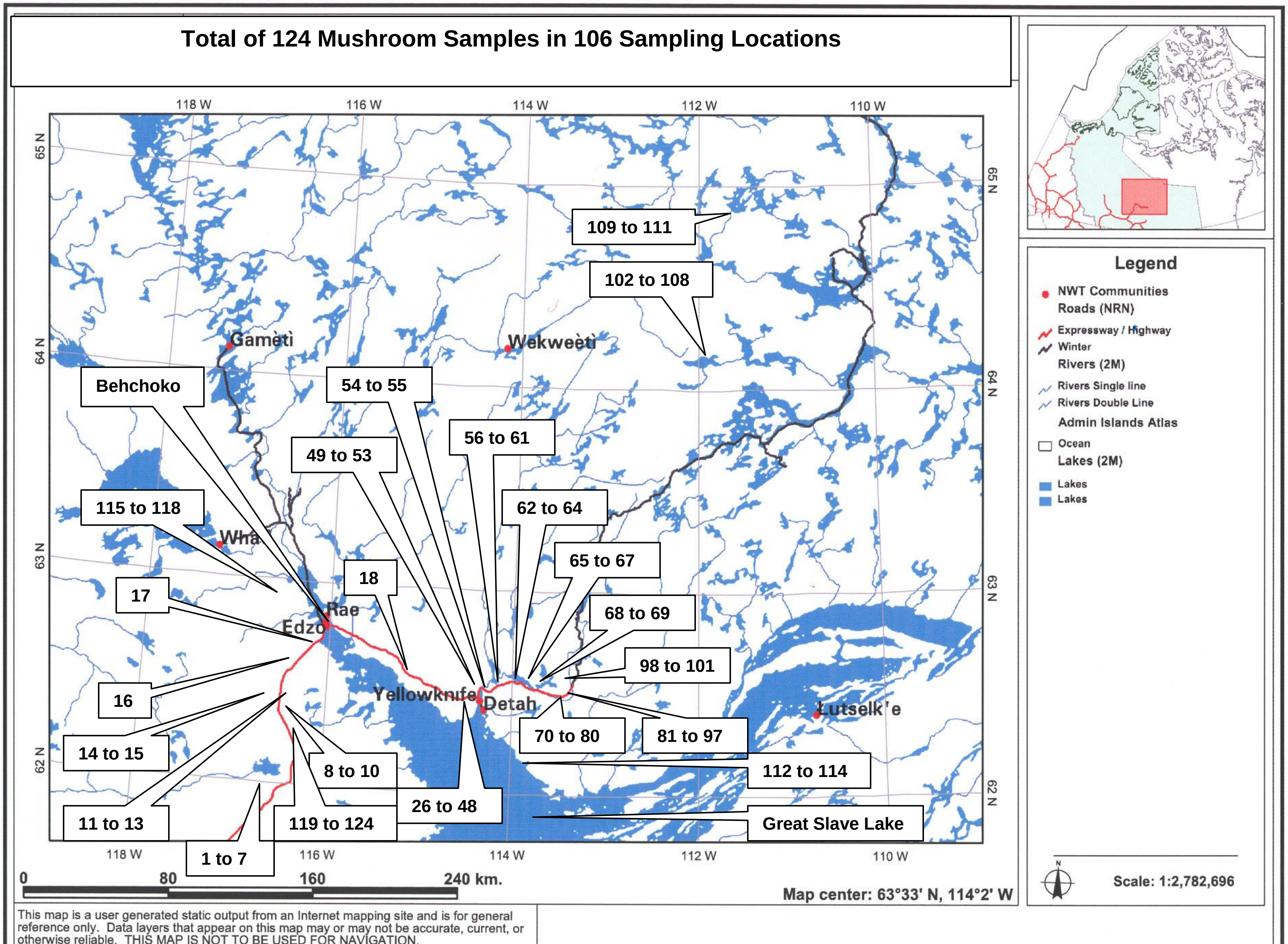


Figure 1. Sampling locations of Soil and Mushrooms in the North Slave Region, NWT.

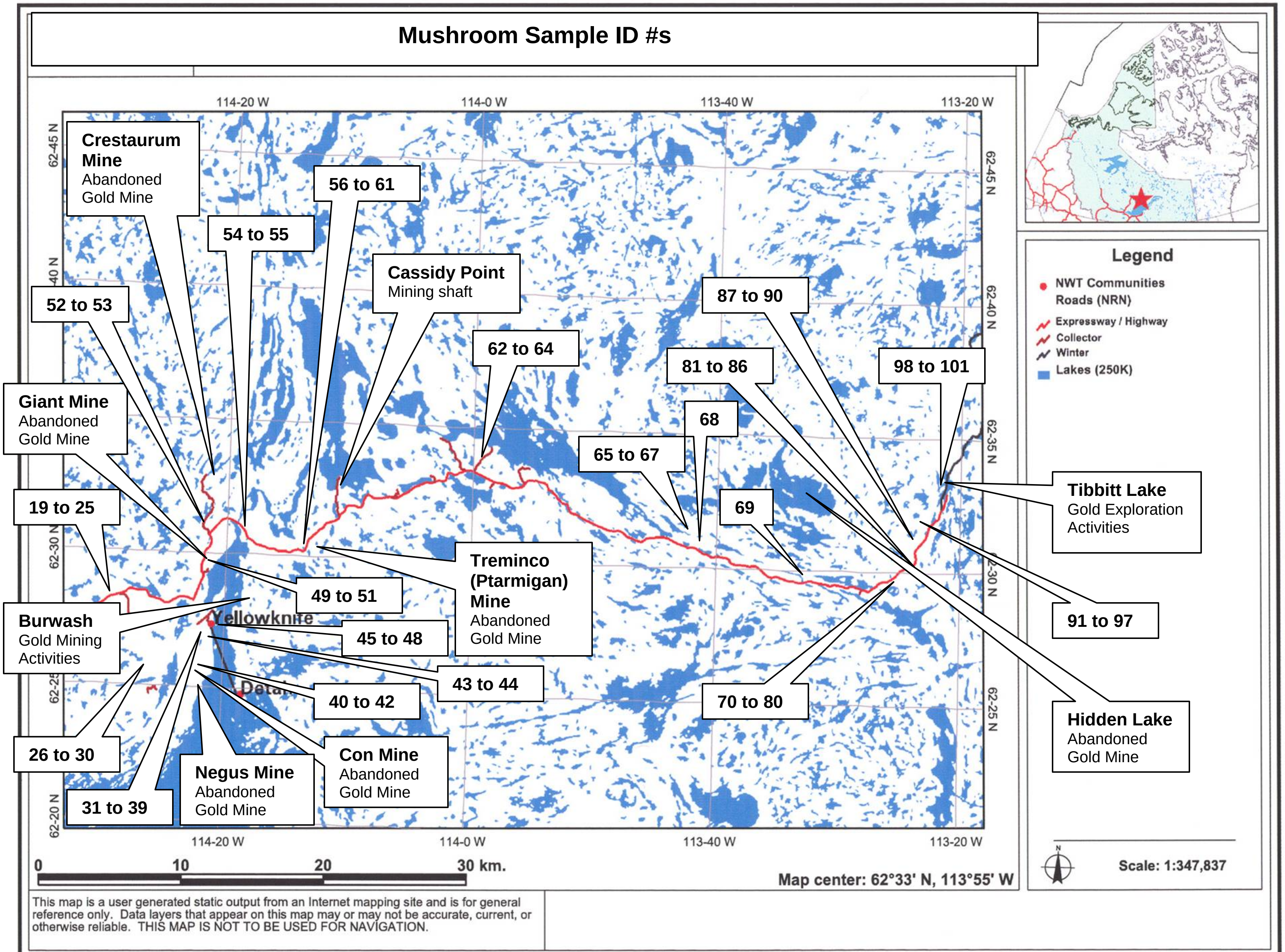


Figure 2. Sampling locations of Soil and Mushrooms along the Ingraham road corridor, North Slave Region, NWT.

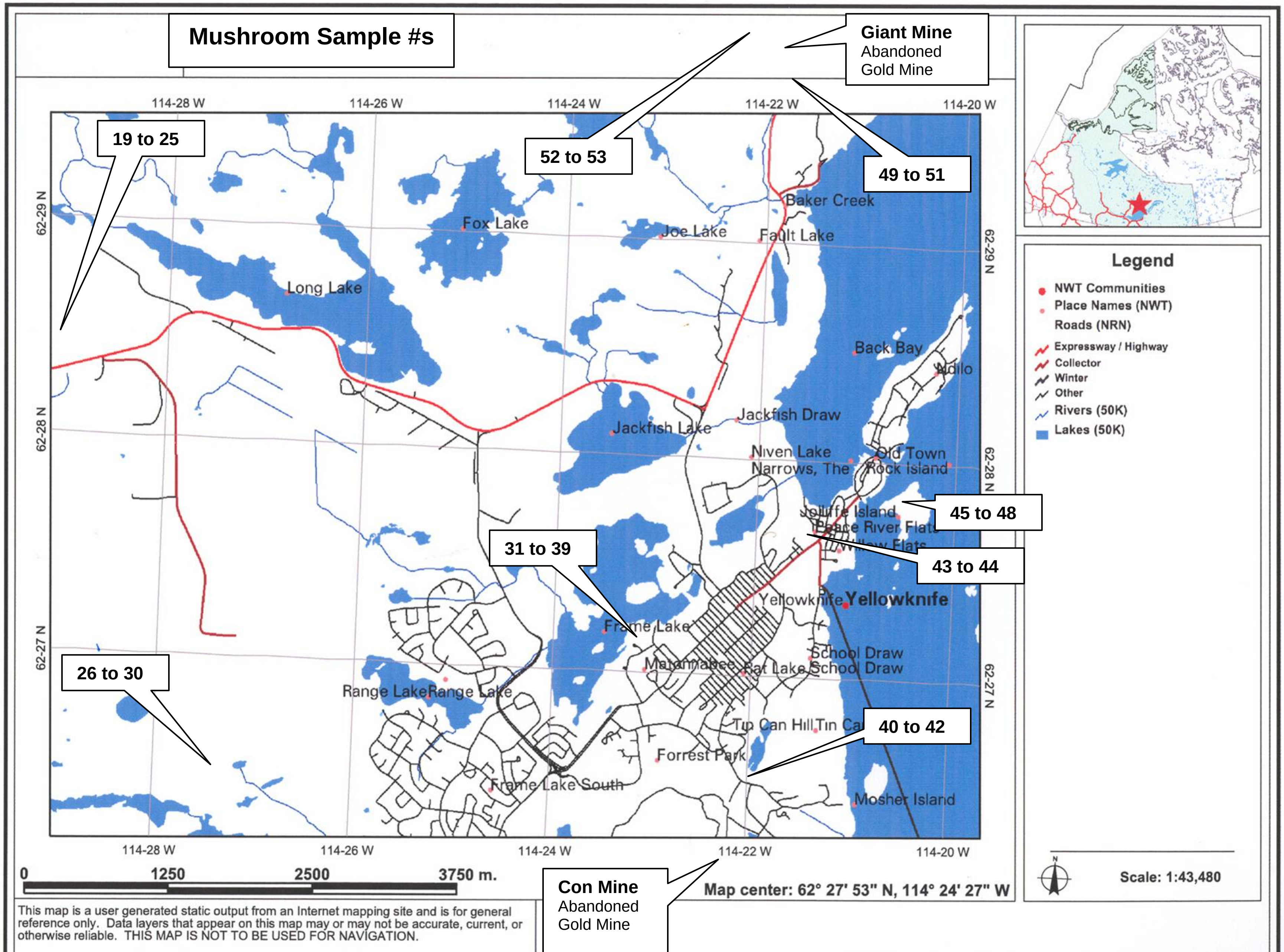


Figure 3. Sampling locations of Soil and Mushrooms within the City of Yellowknife, North Slave Region, NWT.

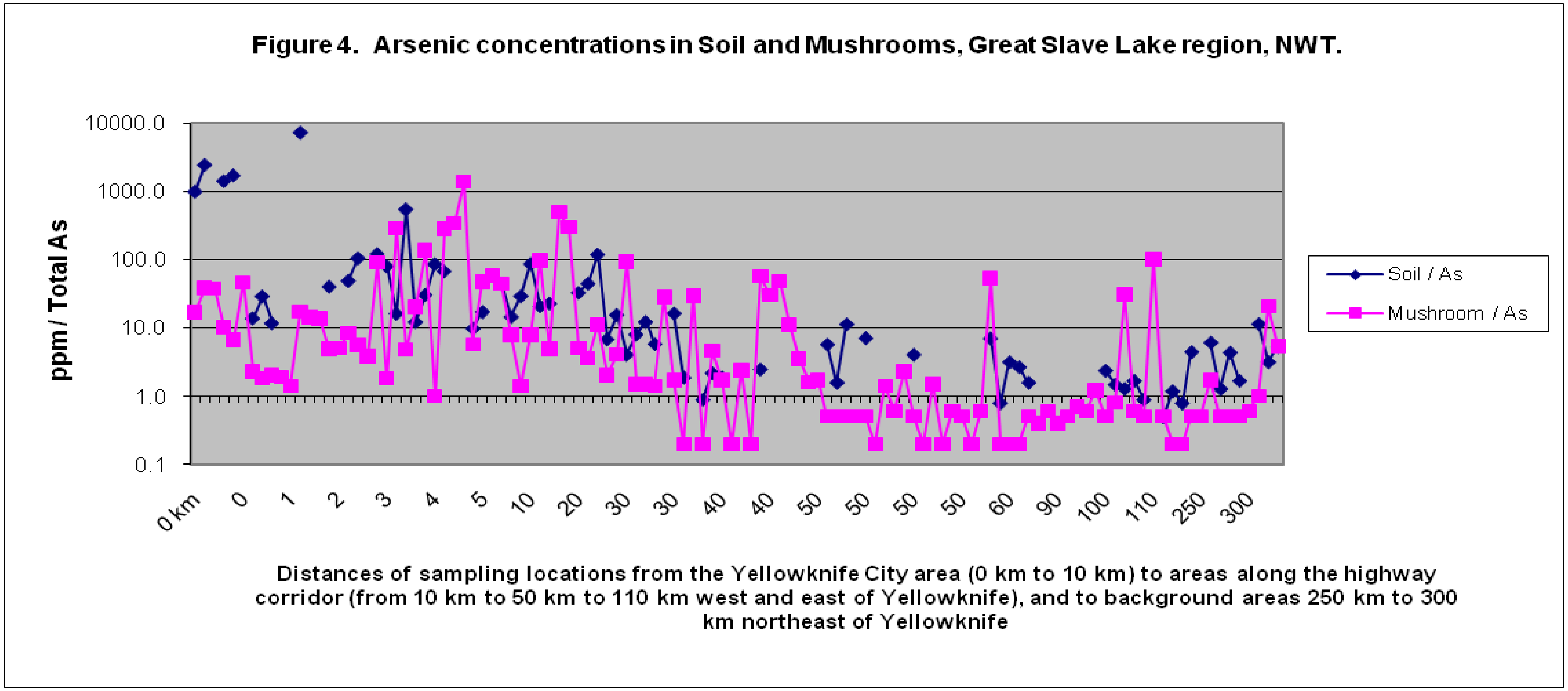
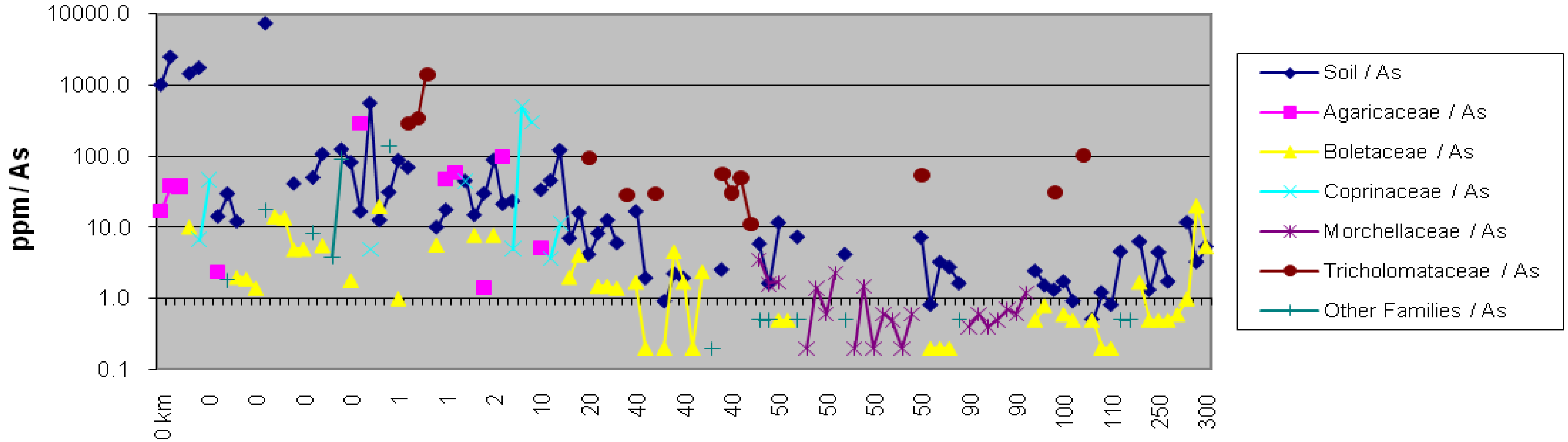


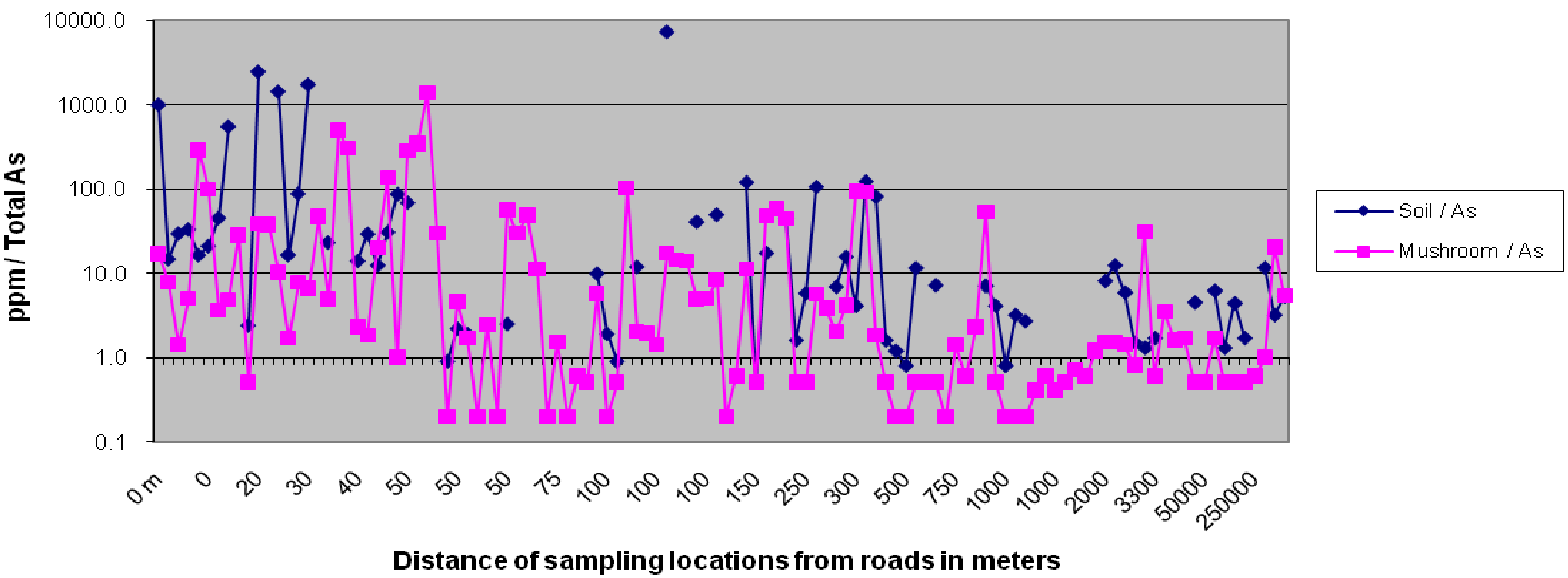
Figure 4. Arsenic concentrations in Soil and Mushrooms, Great Slave Lake region, NWT.
ppm / Total As
10000.0
1000.0
100.0
10.0
1.0
0.1
0 km
0
1
2
3
4
5
10
20
30
30
40
40
50
50
50
50
60
90
100
110
250
300
Soil / As
Mushroom / As
Distances of sampling locations from the Yellowknife City area (0 km to 10 km) to areas along the highway corridor (from 10 km to 50 km to 110 km west and east of Yellowknife), and to background areas 250 km to 300 km northeast of Yellowknife

Figure 5. Arsenic concentrations in Soil and Mushroom Families, Great Slave Lake region, NWT.



Distances of sampling locations from Yellowknife City (0 km to 10 km) to areas along the highway corridor (10 km to 110 km west and east of Yellowknife), and to background areas 240 km to 300 km northeast of Yellowknife

Figure 6. Arsenic concentrations in Soil and Mushrooms near Roads, Yellowknife region, NWT.



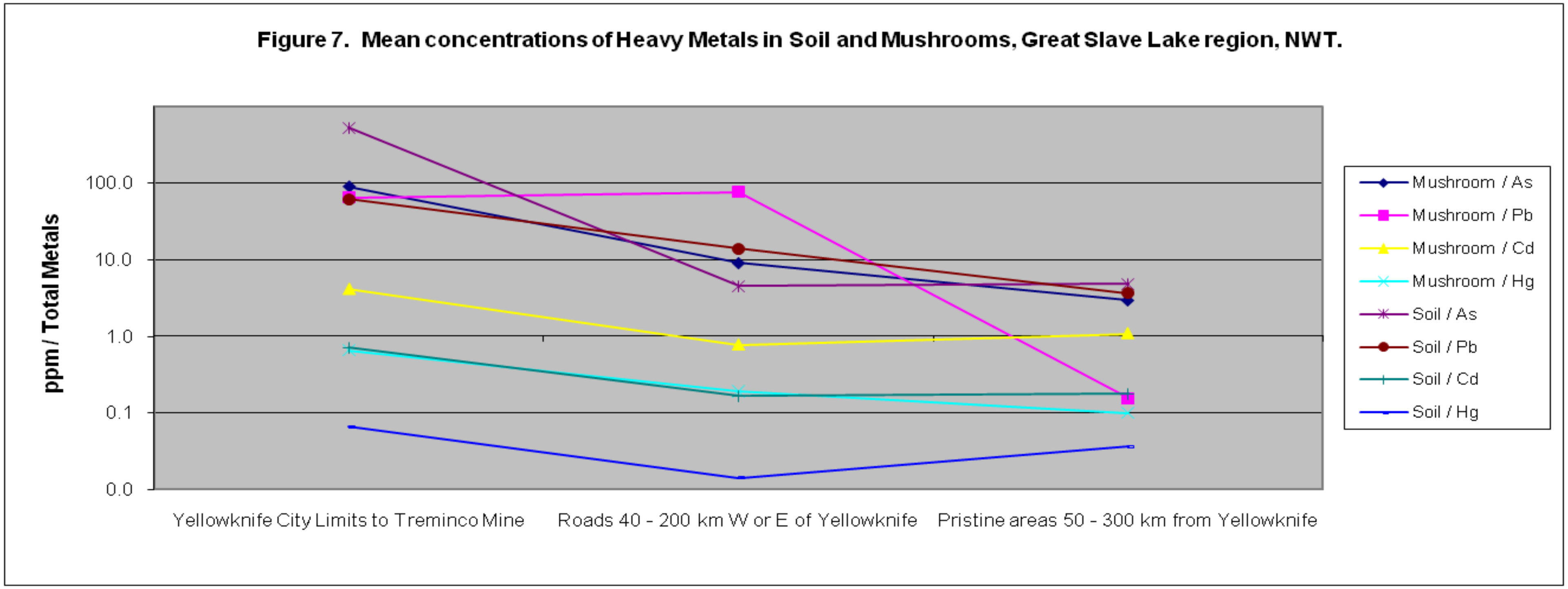
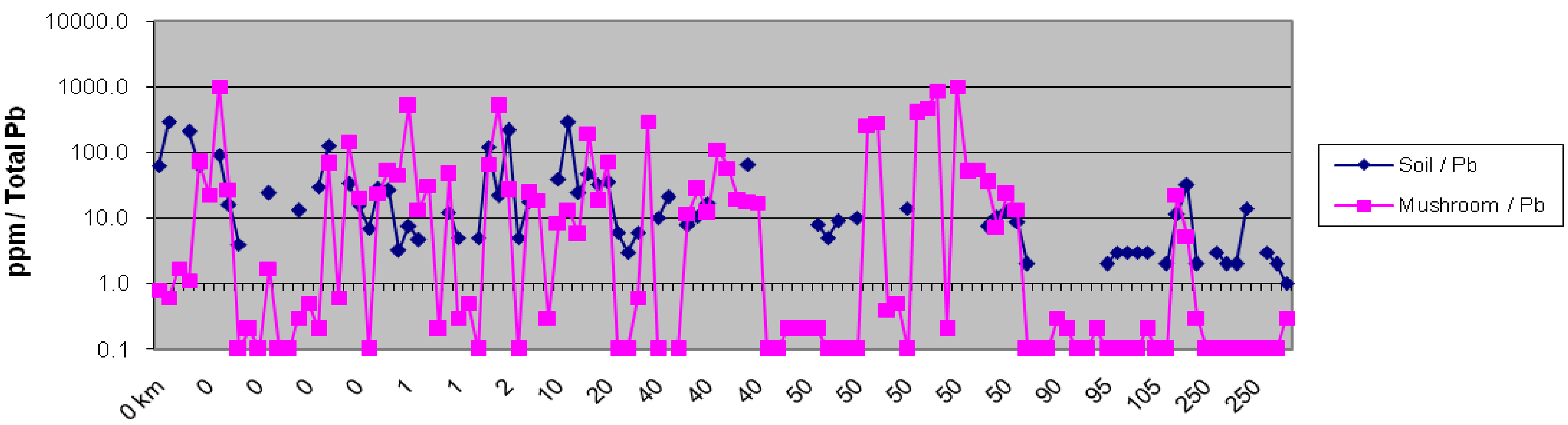


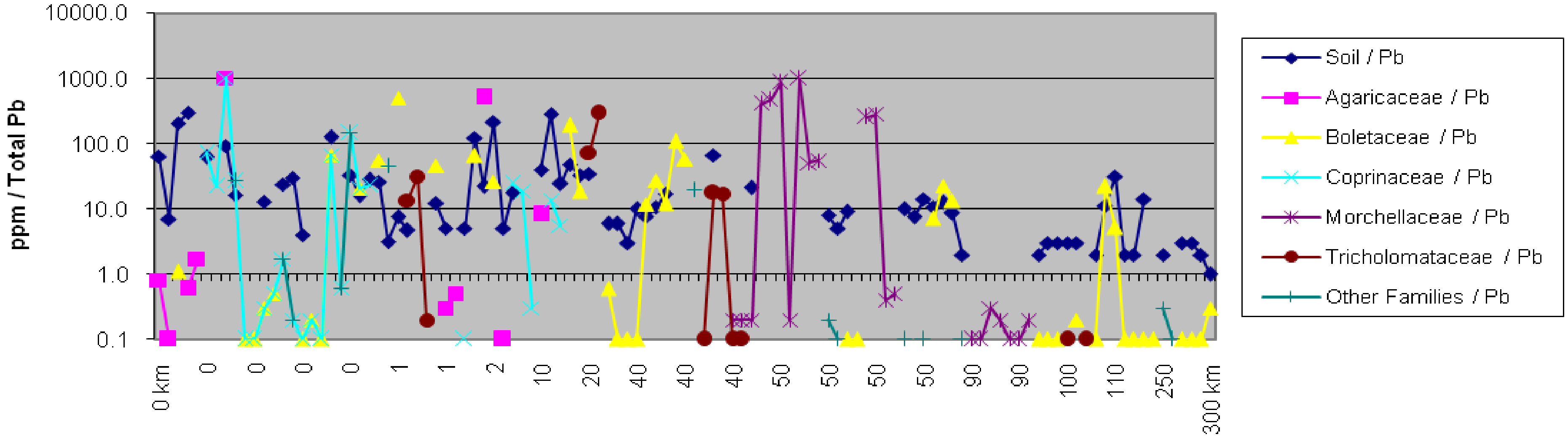
Figure 7. Mean concentrations of Heavy Metals in Soil and Mushrooms, Great Slave Lake region, NWT.
ppm / Total Metals
100.0
10.0
1.0
0.1
0.0
Yellowknife City Limits to Treminco Mine
Roads 40 - 200 km W or E of Yellowknife
Pristine areas 50 - 300 km from Yellowknife
Mushroom / As
Mushroom / Pb
Mushroom / Cd
Mushroom / Hg
Soil / As
Soil / Pb
Soil / Cd
Soil / Hg

Figure 8. Lead concentrations in Soil and Mushrooms, Great Slave Lake region, NWT.



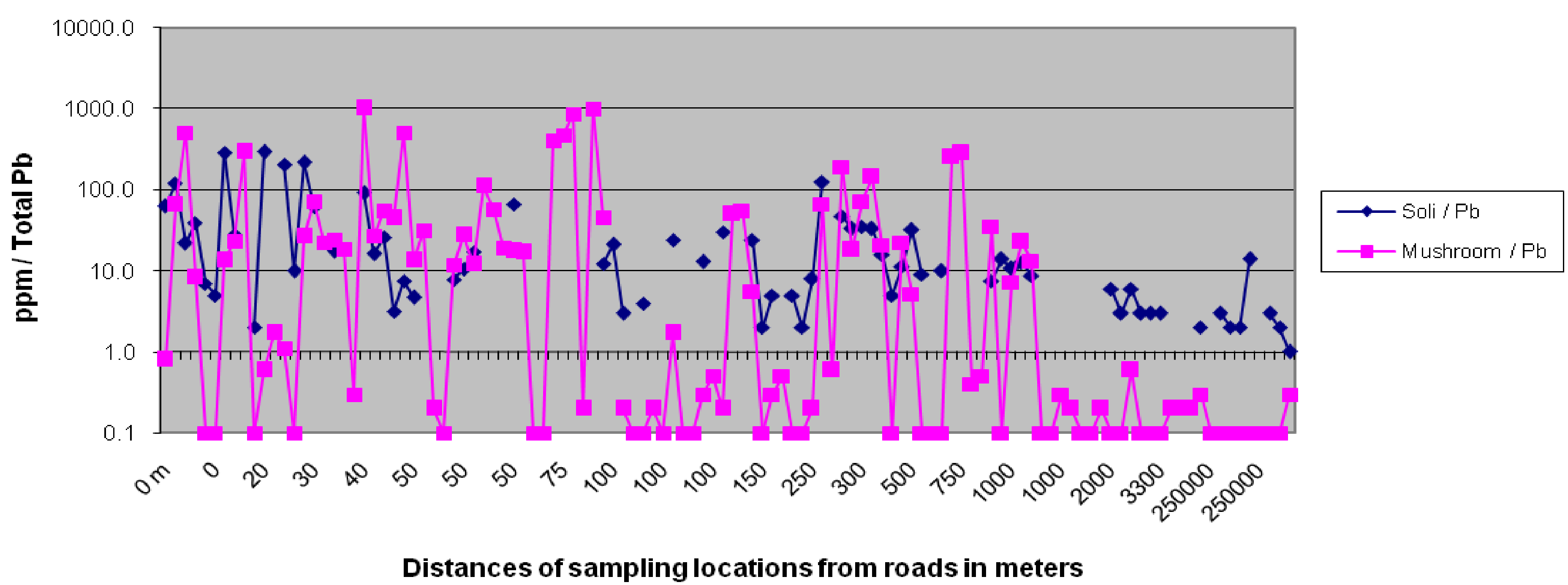
Distances of sampling locations from the Yellowknife City area (0 km to 10 km) to areas along the highway corridor (from 10 km to 50 km to 110 km west and east of Yellowknife), and to background areas 240 km to 300 km northeast of Yellowknife

Figure 9. Lead concentrations in Soil and Mushroom Families, Great Slave Lake region, NWT.



Distances of sampling locations from Yellowknife City (0 km to 10 km) to areas along the highway corridor (from 10 km to 50 km to 110 km west and east of Yellowknife), and to background areas 240 km to 300 km northeast of Yellowknife

Figure 10. Lead concentrations in Soil and Mushrooms near Roads, Yellowknife region, NWT.



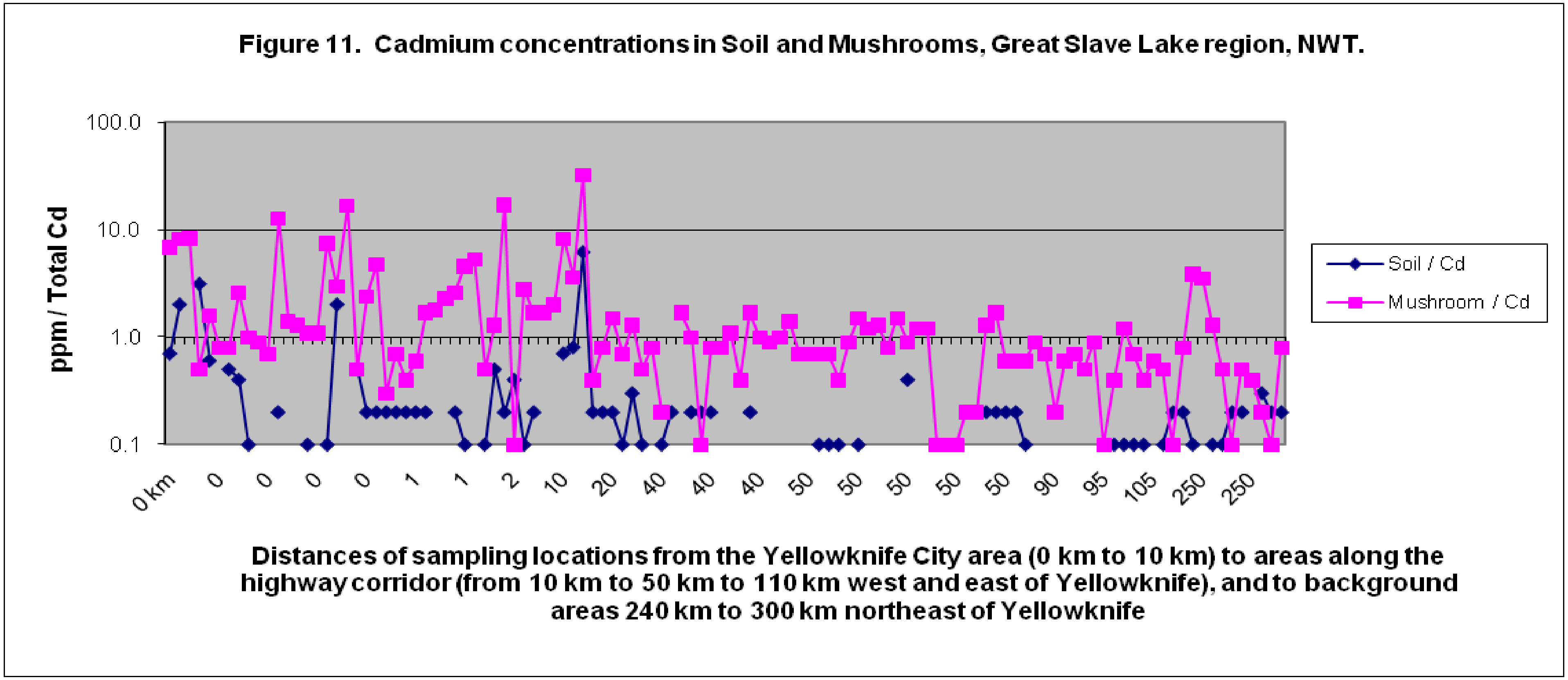
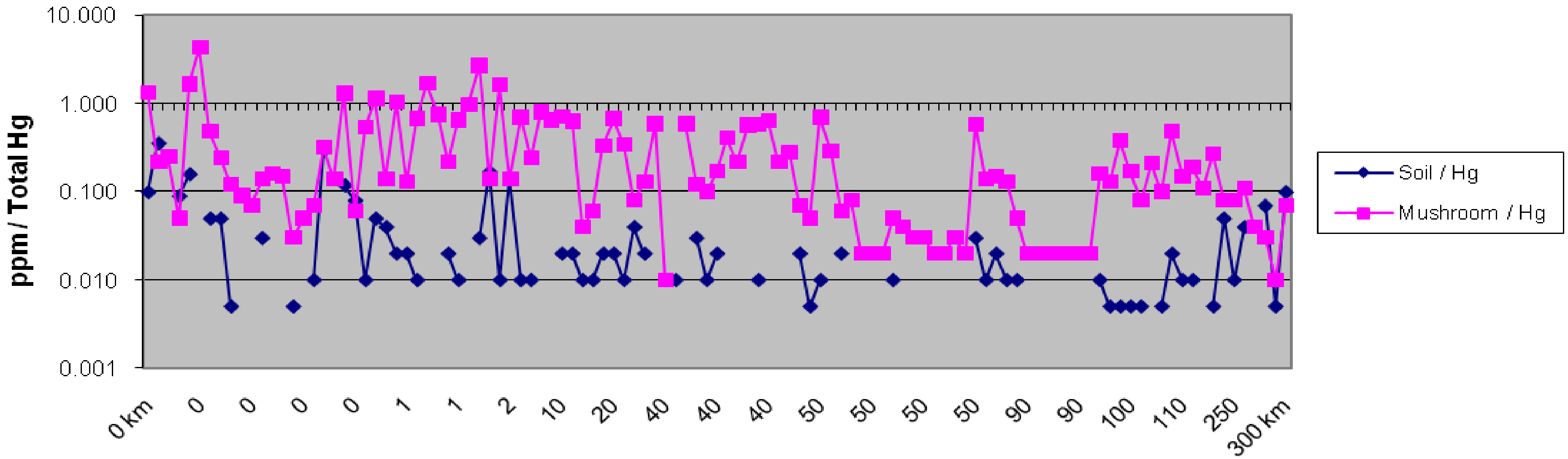


Figure 11. Cadmium concentrations in Soil and Mushrooms, Great Slave Lake region, NWT.
ppm / Total Cd
100.0
10.0
1.0
0.1
Soil / Cd
Mushroom / Cd
0 km
0
0
0
0
1
1
2
10
20
40
40
40
50
50
50
50
50
90
95
105
250
250
Distances of sampling locations from the Yellowknife City area (0 km to 10 km) to areas along the highway corridor (from 10 km to 50 km to 110 km west and east of Yellowknife), and to background areas 240 km to 300 km northeast of Yellowknife

Figure 12. Mercury concentrations in Soil and Mushrooms, Great Slave Lake region, NWT.



Distances of sampling locations from the Yellowknife City area (0 km to 10 km) to areas along the highway corridor (10 km to 110 km west and east of Yellowknife), and to background areas 240 km to 300 km northeast of Yellowknife

Table 1. Concentrations of Arsenic, Lead, Cadmium and Mercury in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 - 2009.

purple = samples in Obst *et al*. 2001	light blue = known unspoiled background area	dark blue = fungi washed with tap water	yg. = young fungi
yellow = backup samples from 1997 - 1999	green = assumed undisturbed background area	grey = debris on fungi only brushed off	ad. = adult fungi
bold ID #s = shared soil sample from same spot	orange = known impacted area	no color = fungi rinsed with distilled, deionised water	YK = Yellowknife

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location North Slave Region	Total Arsenic: Soil	Total Arsenic: Fungi	Total Lead: Soil	Total Lead: Fungi	Total Cadmium: Soil	Total Cadmium: Fungi	Total Mercury: Soil	Total Mercury: Fungi	Distance in km from: YK City	Giant Mine	Other Mine	Hwy Road
				Total Metal Concentrations in µg/g dry weight (bold data = elevated levels)											
1	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	0.4	N/A	< 0.1	N/A	0.9	N/A	< 0.02	140	140	140	2.0
2	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	0.6	N/A	0.1	N/A	0.7	N/A	< 0.02	140	140	140	2.0
3	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	0.4	N/A	0.3	N/A	0.2	N/A	< 0.02	140	140	140	2.0
4	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	0.5	N/A	0.2	N/A	0.6	N/A	< 0.02	140	140	140	2.0
5	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	0.7	N/A	0.1	N/A	0.7	N/A	< 0.02	140	140	140	2.0
6	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	0.6	N/A	0.1	N/A	0.5	N/A	< 0.02	140	140	140	2.0
7	Burn-site Morel	Morchellaceae	100 km S of Edzo	N/A	1.2	N/A	0.2	N/A	0.9	N/A	< 0.02	140	140	140	2.0
8	Sand Bolete	Boletaceae	46 km SW of Edzo	1.7	0.6	3.0	< 0.1	< 0.1	0.7	< 0.005	0.17	113	113	103	3.55
9	Sand Bolete	Boletaceae	46 km SW of Edzo	1.5	0.8	3.0	< 0.1	0.1	0.4	< 0.005	0.13	113	113	103	3.30
10	White Matsutake	Tricholomataceae	46 km SW of Edzo	1.3	**30.8**	3.0	< 0.1	< 0.1	**1.2**	< 0.005	0.38	113	113	103	3.30
11	Sand Bolete	Boletaceae	46 km SW of Edzo	0.9	< 0.5	3.0	0.2	0.1	0.4	< 0.005	0.08	113	113	106	0.10
12	Sand Bolete	Boletaceae	46 km SW of Edzo	< 0.5	< 0.5	2.0	< 0.1	< 0.1	0.5	< 0.005	0.10	113	113	106	0.15
13	White Matsutake	Tricholomataceae	46 km SW of Edzo	same	**101.0**	same	< 0.1	same	0.6	same	0.21	113	113	106	0.10
14	Red-capped Bolete	Boletaceae	43 km SW of Edzo	1.2	< 0.2	**11.3**	**22.2**	0.2	0.1	0.020	0.48	110	110	113	6.00
15	Sand Bolete	Boletaceae	43 km SW of Edzo	0.8	< 0.2	**31.8**	5.2	0.2	0.8	0.010	0.15	110	110	113	6.00
16	Sand Bolete	Boletaceae	17 km SW of Edzo	2.4	< 0.5	2.0	< 0.1	0.1	< 0.1	0.010	0.16	95	95	95	0.015
17	Hooded False Morel	Helvellaceae	2 km SW of Edzo	1.6	< 0.5	2.0	< 0.1	< 0.1	0.6	0.010	0.05	90	90	90	0.65
18	Yellow Bolete	Boletaceae	40 km W of YK	**16.5**	1.7	**10.0**	< 0.1	0.1	0.2	0.010	0.01	40	40	40	0.02
19	Hollow-stem Bolete	Boletaceae	YK Golf Course	**12.4**	**19.9**	**26.2**	**55.0**	0.2	0.7	0.040	0.14	0	6.5	6.5	0.05
20	Puffball	Lycoperdaceae	YK Golf Course	**30.7**	**135.0**	3.2	**44.9**	0.2	0.4	0.020	**1.05**	0	6.5	6.5	0.05
21	Red-capped Bolete	Boletaceae	YK Golf Course	**9.9**	5.7	**12.2**	**46.0**	0.2	**2.6**	0.020	0.22	0	6.5	6.5	0.10
22	Sand Bolete	Boletaceae	YK Golf Course	**86.9**	1.0	7.6	**509.0**	0.2	0.6	0.020	0.13	0	6.5	6.5	0.05
23	White Matsutake	Tricholomataceae	YK Golf Course	**68.5**	**280.0**	4.7	**13.5**	0.2	**1.7**	0.010	**0.67**	0	6.5	6.5	0.05
24	White Matsutake	Tricholomataceae	YK Golf Course	same	**340.0**	same	**31.4**	same	**1.8**	same	**1.70**	0	6.5	6.5	0.05
25	White Matsutake	Tricholomataceae	YK Golf Course	same	**1370.0**	same	0.2	same	**2.3**	same	0.75	0	6.5	6.5	0.05
26	Meadow Mushroom yg.	Agaricaceae	YK Sewage Road	**21.0**	**97.2**	5.0	< 0.1	0.1	**2.8**	0.010	**0.70**	0	9.2	7.8	0.00
27	Meadow Mushroom ad.	Agaricaceae	YK Sewage Road	**17.4**	**47.1**	5.0	0.3	0.1	**4.6**	0.010	**0.65**	0	8	5.5	0.15
28	Meadow Mushroom	Agaricaceae	YK Sewage Road	same	**58.2**	same	0.5	same	**5.3**	same	**0.97**	0	8	5.5	0.15
29	Shaggy Mane	Coprinaceae	YK Sewage Road	**44.5**	**44.0**	5.0	< 0.1	0.1	0.5	0.030	**2.69**	0	8	5.5	0.15
30	Meadow Mushroom	Agaricaceae	YK Sewage Road	**16.4**	**286.0**	7.0	0.1	0.2	**4.8**	0.010	**0.54**	0	8	4.5	0.00

(Table1. continued on next page)

(Table1. continued)

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location North Slave Region	Total Arsenic: Soil	Total Arsenic: Fungi	Total Lead: Soil	Total Lead: Fungi	Total Cadmium: Soil	Total Cadmium: Fungi	Total Mercury: Soil	Total Mercury: Fungi	YK City	Giant Mine	Other Mine	Hwy Road
31	Red-capped Bolete yg.	Boletaceae	YK Frame Lake	11.9	2.0	4.0	< 0.1	< 0.1	1.0	< 0.005	0.12	0	5	2.8	0.15
32	Red-capped Bolete	Boletaceae	YK Frame Lake	same	1.9	same	0.2	same	0.9	same	0.09	0	5	2.8	0.15
33	Red-capped Bolete ad.	Boletaceae	YK Frame Lake	same	1.4	same	< 0.1	same	0.7	same	0.07	0	5	2.8	0.15
34	Fly Agaric	Amanitaceae	YK Frame Lake	7310.0	17.2	24.0	1.7	0.2	12.9	0.030	0.14	0	5	2.8	0.15
35	Birch Bolete yg.	Boletaceae	YK Frame Lake	same	14.3	same	< 0.1	same	1.4	same	0.16	0	5	2.8	0.15
36	Birch Bolete yg.	Boletaceae	YK Frame Lake	same	13.7	same	< 0.1	same	1.3	same	0.15	0	5	2.8	0.15
37	Birch Bolete ad.	Boletaceae	YK Frame Lake	40.6	4.9	13.0	0.3	0.1	1.1	< 0.005	0.03	0	5	2.9	0.15
38	Birch Bolete ad.	Boletaceae	YK Frame Lake	same	5.0	same	0.5	same	1.1	same	0.05	0	5	2.9	0.15
39	Fly Agaric	Amanitaceae	YK Frame Lake	49.4	8.3	30.0	0.2	0.1	7.5	0.010	0.07	0	5	2.9	0.15
40	Meadow Mushroom yg.	Agaricaceae	YK Con Mine	2460.0	38.2	296.0	0.6	2.0	8.2	0.360	0.22	0	6.5	0.5	0.02
41	Meadow Mushroom ad.	Agaricaceae	YK Con Mine	same	37.5	same	1.7	same	8.4	same	0.25	0	6.5	0.5	0.02
42	Birch Bolete	Boletaceae	YK Con Mine	1430.0	10.2	207.0	1.1	3.1	0.5	0.090	0.05	0	6.5	0.5	0.02
43	Meadow Mushroom	Agaricaceae	YK Old Town	14.0	2.3	92.1	1010.0	0.5	0.8	0.050	0.48	0	4.7	2.5	0.04
44	Puffball	Lycoperdaceae	YK Old Town	29.3	1.8	16.3	26.8	0.4	2.6	0.050	0.24	0	4.7	2.5	0.04
45	Birch Bolete	Boletaceae	YK Jolliffe Island	106.0	5.6	126.0	67.0	2.0	3.0	0.300	0.32	0	4.5	3	0.30
46	Fly Agaric	Amanitaceae	YK Jolliffe Island	same	3.8	same	0.6	same	16.9	same	0.14	0	4.5	3	0.30
47	Puffball	Lycoperdaceae	YK Jolliffe Island	123.0	90.7	33.1	145.0	0.5	0.5	0.120	1.31	0	4.5	3	0.40
48	Red-capped Bolete	Boletaceae	YK Jolliffe Island	81.1	1.8	15.9	20.6	0.2	2.4	0.080	0.06	0	4.5	3	0.40
49	Shaggy Mane	Coprinaceae	YK Giant Mine	1730.0	6.6	62.4	71.3	0.6	1.6	0.160	1.67	0	2	2	0.03
50	Shaggy Mane	Coprinaceae	YK Giant Mine	same	46.3	same	22.3	same	0.8	same	4.29	0	2	2	0.03
51	Meadow Mushroom	Agaricaceae	YK Giant Mine	999.0	16.9	63.0	0.8	0.7	6.9	0.100	1.33	0	0.5	0.5	0.04
52	Shaggy Mane	Coprinaceae	YK Giant/Vee L.	550.0	4.8	27.9	23.5	0.2	0.3	0.050	1.13	0	1	1	0.07
53	Birch Bolete	Boletaceae	YK Vee Lake Rd.	87.6	7.8	217.0	26.4	0.4	0.1	0.140	0.14	0	2.5	2.5	1.20
54	Hollow-stem Bolete	Boletaceae	YK River Park	14.7	7.8	122.0	65.7	0.5	1.3	0.170	0.14	0	2.5	2.5	0.10
55	Spring Agaricus	Agaricaceae	YK River Park	29.5	1.4	22.1	511.0	0.2	17.1	0.010	1.65	0	2.5	2.5	0.10
56	Shaggy Mane	Coprinaceae	Yk Treminco Mine	23.1	4.9	17.5	24.2	0.2	1.7	0.010	0.24	5.5	5.5	3.4	0.03
57	Shaggy Mane	Coprinaceae	Yk Treminco Mine	same	494.0	same	18.6	same	1.7	same	0.80	5.5	5.5	3.4	0.03
58	Shaggy Mane	Coprinaceae	Yk Treminco Mine	same	298.0	same	0.3	same	2.0	same	0.65	5.5	5.5	3.4	0.03
59	Shaggy Mane	Coprinaceae	Yk Treminco Mine	45.0	3.6	288.0	13.5	0.8	3.6	0.020	0.63	7.2	7.2	1	0.005
60	Forest Mushroom	Agaricaceae	Yk Treminco Mine	33.1	5.0	39.8	8.3	0.7	8.2	0.020	0.71	7.2	7.2	0.9	0.10
61	Tippler's Bane	Coprinaceae	Yk Treminco Mine	120.0	11.1	24.4	5.6	6.1	32.4	0.010	0.04	7.2	7.2	0.8	0.15
62	Red-capped Bolete	Boletaceae	Prelude Lake Trail	6.9	2.0	47.7	192.0	0.2	0.4	0.010	0.06	20	20	13	1.50
63	Sand Bolete	Boletaceae	Prelude Lake Trail	15.7	4.1	33.0	18.3	0.2	0.8	0.020	0.33	20	20	13	1.50
64	White Matsutake	Tricholomataceae	Prelude Lake Trail	4.1	92.3	35.0	72.4	0.2	1.5	0.020	0.67	20	20	13	1.50
65	Sand Bolete	Boletaceae	Cameron Fall Trail	8.1	1.5	6.0	< 0.1	0.1	0.7	0.010	0.34	33	33	26	2.00
66	Slippery Jack	Boletaceae	Cameron Fall Trail	12.4	1.5	3.0	< 0.1	0.3	1.3	0.040	0.08	33	33	26	2.00
67	Birch Bolete	Boletaceae	Cameron Fall Trail	5.9	1.4	6.0	0.6	0.1	0.5	0.020	0.13	33	33	26	2.00
68	White Matsutake	Tricholomataceae	Ingraham Trail	N/A	28.1	N/A	294.0	N/A	0.8	N/A	0.59	35	35	28	0.01
69	Red-capped Bolete	Boletaceae	Cameron River Pk.	1.9	< 0.2	21.1	N/A	0.2	N/A	0.010	N/A	42	42	35	0.10

(Table1. continued on next page)

(Table1. continued)

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location North Slave Region	Total Arsenic: Soil		Total Arsenic: Fungi	Total Lead: Soil		Total Lead: Fungi	Total Cadmium: Soil		Total Cadmium: Fungi	Total Mercury: Soil		Total Mercury: Fungi	YK City	Giant Mine	Other Mine	Hwy Road
70	White Matsutake	Tricholomataceae	Ingraham/C. Antler	N/A		**29.4**	N/A	<	0.1	N/A		**1.7**	N/A		**0.59**	47	47	40	0.05
71	Birch Bolete	Boletaceae	Ingraham/C. Antler	0.9	<	0.2	7.8		**11.7**	0.2		**1.0**	0.030		0.12	47	47	40	0.05
72	Larch Bolete	Boletaceae	Ingraham/C. Antler	2.2		4.6	**10.6**		**27.7**	0.2		0.1	0.010		0.10	47	47	40	0.05
73	Red-capped Bolete	Boletaceae	Ingraham/C. Antler	1.9		1.7	**17.1**		**12.0**	0.2		0.8	0.020		0.17	47	47	40	0.05
74	Red-capped Bolete	Boletaceae	Ingraham/C. Antler	same	<	0.2	same		**110.0**	same		0.8	same		0.41	47	47	40	0.05
75	Sand Bolete	Boletaceae	Ingraham/C. Antler	same		2.4	same		**57.9**	same		**1.1**	same		0.22	47	47	40	0.05
76	Sarcodon	Hydnaceae	Ingraham/C. Antler	same	<	0.2	same		**19.3**	same		0.4	same		**0.57**	47	47	40	0.05
77	White Matsutake	Tricholomataceae	Ingraham/C. Antler	2.5		**56.2**	**66.5**		**17.6**	0.2		**1.7**	0.010		**0.58**	47	47	40	0.05
78	White Matsutake	Tricholomataceae	Ingraham/C. Antler	same		**29.8**	same		**16.9**	same		**1.0**	same		**0.64**	47	47	40	0.05
79	White Matsutake	Tricholomataceae	Ingraham/C. Antler	N/A		**48.4**	N/A	<	0.1	N/A		0.9	N/A		0.22	47	47	40	0.05
80	White Matsutake	Tricholomataceae	Ingraham/C. Antler	N/A		**11.0**	N/A		0.1	N/A		**1.0**	N/A		0.28	47	47	40	0.05
81	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt L.	5.8	<	0.5	8.0		0.2	< 0.1		0.7	0.020		0.07	49	49	42	0.25
82	Birch Bolete	Boletaceae	Ingraham/Tibbitt L.	**11.5**	<	0.5	9.0	<	0.1	0.1		0.4	0.010		**0.70**	49	49	42	0.75
83	Birch Bolete	Boletaceae	Ingraham/Tibbitt L.	same	<	0.5	same	<	0.1	same		0.9	same		0.29	49	49	42	0.75
84	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt L.	7.2	<	0.5	**10.0**	<	0.1	0.1		**1.5**	0.020		0.06	49	49	42	0.75
85	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt L.	1.6	<	0.5	5.0	<	0.1	0.1		0.7	< 0.005		0.05	49	49	42	0.50
86	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt L.	4.1	<	0.5	**14.0**	<	0.1	0.4		0.9	0.010		0.05	49	49	42	1.00
87	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A	<	0.2	N/A		**255.0**	N/A		**1.2**	N/A		0.08	49	49	42	0.75
88	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		1.4	N/A		**283.0**	N/A		1.3	N/A		0.02	49	49	42	0.75
89	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		0.6	N/A		0.4	N/A		0.8	N/A	<	0.02	49	49	42	0.75
90	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		2.3	N/A		0.5	N/A		1.5	N/A	<	0.02	49	49	42	0.75
91	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A	<	0.2	N/A		**405.0**	N/A		**1.2**	N/A		0.04	50	50	43	0.075
92	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		1.5	N/A		**469.0**	N/A		1.2	N/A		0.03	50	50	43	0.075
93	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A	<	0.2	N/A		**867.0**	N/A		0.1	N/A		0.03	50	50	43	0.075
94	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		0.6	N/A		0.2	N/A	<	0.1	N/A	<	0.02	50	50	43	0.075
95	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		0.5	N/A		**993.0**	N/A		0.1	N/A	<	0.02	50	50	43	0.075
96	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A	<	0.2	N/A		**50.5**	N/A		0.2	N/A		0.03	50	50	43	0.125
97	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt L.	N/A		0.6	N/A		**55.2**	N/A		0.2	N/A	<	0.02	50	50	43	0.125
98	Sand Bolete	Boletaceae	Tibbitt Lake	0.8	<	0.2	**10.7**		7.2	0.2		**1.7**	0.010		0.14	52	52	45	1.0
99	Suillus	Boletaceae	Tibbitt Lake	3.2	<	0.2	**12.7**		**23.0**	0.2		0.6	0.020		0.15	52	52	45	1.0
100	Yellow Bolete	Boletaceae	Tibbitt Lake	2.7	<	0.2	8.7		**13.3**	0.2		0.6	0.010		0.13	52	52	45	1.0
101	White Matsutake	Tricholomataceae	Tibbitt Lake	7.1		**53.1**	7.5		**35.1**	0.2		**1.3**	0.030		**0.58**	52	52	45	0.9
102	Fly Agaric	Amanitaceae	Tundra Jolly Lake	4.5	<	0.5	2.0		0.3	< 0.1		**3.9**	0.010		0.19	240	240	233	240
103	Fly Agaric	Amanitaceae	Tundra Jolly Lake	same	<	0.5	same	<	0.1	same		**3.5**	same		0.11	240	240	233	240
104	Red-capped Bolete	Boletaceae	Tundra Jolly Lake	6.2		1.7	3.0	<	0.1	0.1		**1.3**	< 0.005		0.27	240	240	233	240
105	Birch Bolete	Boletaceae	Tundra Jolly Lake	1.3	<	0.5	2.0	<	0.1	0.1		0.5	0.050		0.08	240	240	233	240
106	Birch Bolete	Boletaceae	Tundra Jolly Lake	4.4	<	0.5	2.0	<	0.1	0.2	<	0.1	0.010		0.08	240	240	233	240
107	Birch Bolete	Boletaceae	Tundra Jolly Lake	1.7	<	0.5	**14.0**		0.1	0.2		0.5	0.040		0.11	240	240	233	240
108	Birch Bolete	Boletaceae	Tundra Jolly Lake	same		0.6	same		0.1	same		0.4	same		0.04	240	240	233	240

(Table1. continued on next page)

(Table1. continued)

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location North Slave Region	Total Arsenic: Soil	Fungi	Total Lead: Soil	Fungi	Total Cadmium: Soil	Fungi	Total Mercury: Soil	Fungi	YK City	Giant Mine	Other Mine	Hwy Road
109	Birch Bolete	Boletaceae	Tundra Daring Lake	**11.6**	< 1.0	3.0	< 0.1	0.3	0.2	0.070	0.03	300	300	293	300
110	Birch Bolete	Boletaceae	Tundra Daring Lake	3.2	**20.3**	2.0	0.1	0.2	0.1	< 0.005	0.01	300	300	293	300
111	Birch Bolete	Boletaceae	Tundra Daring Lake	5.3	5.4	1.0	0.3	< 0.2	0.8	**0.100**	0.07	300	300	293	300
112	Burn-site Morel	Morchellaceae	Drybones Bay	N/A	3.5	N/A	< 0.2	N/A	1.4	N/A	N/A	50	50	50	50
113	Burn-site Morel	Morchellaceae	Drybones Bay	N/A	1.6	N/A	< 0.2	N/A	0.7	N/A	N/A	50	50	50	50
114	Burn-site Morel	Morchellaceae	Drybones Bay	N/A	1.7	N/A	< 0.2	N/A	0.7	N/A	N/A	50	50	50	50
115	Burn-site Morel	Morchellaceae	N of YK/S of Whati	N/A	1.1	N/A	0.5	N/A	2.5	N/A	0.02	100	100	100	100
116	Burn-site Morel	Morchellaceae	N of YK/S of Whati	N/A	1.1	N/A	0.2	N/A	1.0	N/A	0.02	100	100	100	100
117	Burn-site Morel	Morchellaceae	N of YK/S of Whati	N/A	0.8	N/A	0.2	N/A	0.6	N/A	0.01	100	100	100	100
118	Burn-site Morel	Morchellaceae	N of YK/S of Whati	N/A	0.9	N/A	< 0.1	N/A	0.6	N/A	0.01	100	100	100	100
119	Burn-site Morel	Morchellaceae	50 km SW of Edzo	N/A	1.7	N/A	0.1	N/A	1.0	N/A	0.04	120	120	130	1.0
120	Burn-site Morel	Morchellaceae	50 km SW of Edzo	N/A	0.9	N/A	0.1	N/A	0.6	N/A	0.01	120	120	130	1.0
121	Burn-site Morel	Morchellaceae	50 km SW of Edzo	N/A	1.4	N/A	0.1	N/A	1.5	N/A	0.01	120	120	130	1.0
122	Burn-site Morel	Morchellaceae	50 km SW of Edzo	N/A	0.6	N/A	0.2	N/A	1.1	N/A	0.05	120	120	130	1.0
123	Burn-site Morel	Morchellaceae	50 km SW of Edzo	N/A	1.3	N/A	0.3	N/A	0.5	N/A	0.01	120	120	130	1.0
124	Burn-site Morel	Morchellaceae	50 km SW of Edzo	N/A	1.2	N/A	0.1	N/A	1.2	N/A	0.01	120	120	130	1.0
			Samples from other regions and imports:												
125	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	3.8	N/A	1.6	N/A	**2.1**	N/A	0.04	28	N/A	N/A	11.3
126	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	1.3	N/A	0.1	N/A	**2.2**	N/A	0.01	28	N/A	N/A	11.3
127	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	1.9	N/A	0.4	N/A	**1.2**	N/A	< 0.01	28	N/A	N/A	11.3
128	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	7.2	N/A	0.4	N/A	**1.1**	N/A	< 0.13	28	N/A	N/A	11.3
129	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	4.0	N/A	0.1	N/A	**1.5**	N/A	0.01	28	N/A	N/A	11.3
130	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	**11.1**	N/A	0.2	N/A	0.6	N/A	< 0.01	28	N/A	N/A	11.3
131	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	1.3	N/A	0.5	N/A	0.4	N/A	< 0.01	28	N/A	N/A	11.3
132	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	6.3	N/A	0.5	N/A	0.2	N/A	< 0.01	28	N/A	N/A	11.3
133	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	3.4	N/A	0.4	N/A	0.2	N/A	< 0.01	28	N/A	N/A	11.3
134	Morel Mushroom	Morchellaceae	Alaska / Fairbanks	N/A	< 1.0	N/A	0.4	N/A	0.2	N/A	< 0.01	28	N/A	N/A	11.3
135	Oyster Mushroom	Tricholomataceae	BC import	N/A	< 0.5	N/A	1.9	N/A	0.4	N/A	0.02	N/A	N/A	N/A	N/A
136	Wood Ear	Auriculariaceae	BC import	N/A	< 0.5	N/A	0.3	N/A	< 0.1	N/A	0.07	N/A	N/A	N/A	N/A
137	Wood Ear	Auriculariaceae	BC import	N/A	< 0.5	N/A	0.3	N/A	< 0.1	N/A	0.06	N/A	N/A	N/A	N/A
138	Morel Mushroom	Morchellaceae	BC / US import	N/A	< 0.5	N/A	0.2	N/A	0.6	N/A	0.05	N/A	N/A	N/A	N/A
139	Morel Mushroom	Morchellaceae	BC / US import	N/A	< 0.5	N/A	0.2	N/A	0.6	N/A	0.08	N/A	N/A	N/A	N/A
140	Chinese Shiitake	Tricholomataceae	Chinese import	N/A	0.5	N/A	0.3	N/A	0.3	N/A	0.06	N/A	N/A	N/A	N/A
141	Chinese Shiitake	Tricholomataceae	Chinese import	N/A	< 0.5	N/A	0.3	N/A	0.5	N/A	0.06	N/A	N/A	N/A	N/A

Table 1a. Concentrations of Arsenic and Lead in Soil and Mushrooms from Popular Harvest Areas in the North Slave Region, Northwest Territories, 1997 - 2009.

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location North Slave Region & Yellowknife (YK)	Popularity of Harvest Area (grey = harvest after forest fire; red = fungi avoided by people)	Total Arsenic: µg/g dry weight Soil	Total Arsenic: µg/g dry weight Fungi	Total Lead: µg/g dry weight Soil	Total Lead: µg/g dry weight Fungi	Description of Sampling Area (**bold data** = elevated levels; blank field = shared soil, see Table 1.)
1	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	0.4	N/A	< 0.1	less impacted background 140 km SW of YK
2	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	0.6	N/A	0.1	less impacted background 140 km SW of YK
3	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	0.4	N/A	0.3	less impacted background 140 km SW of YK
4	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	0.5	N/A	0.2	less impacted background 140 km SW of YK
5	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	0.7	N/A	0.1	less impacted background 140 km SW of YK
6	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	0.6	N/A	0.1	less impacted background 140 km SW of YK
7	Burn-site Morel	Morchellaceae	100 km S of Edzo	unpopular area; only 2006-harvest	N/A	1.2	N/A	0.2	less impacted background 140 km SW of YK
8	Sand Bolete	Boletaceae	46 km SW of Edzo	unpopular area; few harvests	1.7	0.6	3.0	< 0.1	less impacted background 113 km W of YK
9	Sand Bolete	Boletaceae	46 km SW of Edzo	unpopular area; few harvests	1.5	0.8	3.0	< 0.1	less impacted background 113 km W of YK
10	White Matsutake	Tricholomataceae	46 km SW of Edzo	unpopular area; few harvests	1.3	**30.8**	3.0	< 0.1	less impacted background 113 km W of YK
11	Sand Bolete	Boletaceae	46 km SW of Edzo	unpopular area; few harvests	0.9	< 0.5	3.0	0.2	less impacted background 113 km W of YK
12	Sand Bolete	Boletaceae	46 km SW of Edzo	unpopular area; few harvests	0.5	< 0.5	2.0	< 0.1	less impacted background 113 km W of YK
13	White Matsutake	Tricholomataceae	46 km SW of Edzo	unpopular area; few harvests		**101.0**		< 0.1	less impacted background 113 km W of YK
14	Red-capped Bolete	Boletaceae	43 km SW of Edzo	unpopular area; few harvests	1.2	< 0.2	**11.3**	**22.2**	less impacted background 110 km W of YK
15	Sand Bolete	Boletaceae	43 km SW of Edzo	unpopular area; few harvests	0.8	< 0.2	**31.8**	5.2	less impacted background 110 km W of YK
16	Sand Bolete	Boletaceae	17 km SW of Edzo	unpopular area; few harvests	2.4	< 0.5	2.0	< 0.1	less impacted background 95 km W of YK
17	Hooded False Morel	Helvellaceae	2 km SW of Edzo	unpopular area; poisonous fungi !	1.6	< 0.5	2.0	< 0.1	less impacted background 90 km W of YK
18	Yellow Bolete	Boletaceae	40 km W of YK	unpopular area; few harvests	**16.5**	1.7	**10.0**	< 0.1	less impacted background 40 km W of YK
19	Hollow-stem Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**12.4**	**19.9**	**26.2**	**55.0**	impacted core study area in and around YK
20	Puffball	Lycoperdaceae	YK Golf Course	very popular area; many harvests	**30.7**	**135.0**	3.2	**44.9**	impacted core study area in and around YK
21	Red-capped Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**9.9**	5.7	**12.2**	**46.0**	impacted core study area in and around YK
22	Sand Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**86.9**	1.0	7.6	**509.0**	impacted core study area in and around YK
23	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests	**68.5**	**280.0**	4.7	**13.5**	impacted core study area in and around YK
24	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests		**340.0**		**31.4**	impacted core study area in and around YK
25	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests		**1370.0**		0.2	impacted core study area in and around YK
26	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**21.0**	**97.2**	5.0	< 0.1	impacted core study area in and around YK
27	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**17.4**	**47.1**	5.0	0.3	impacted core study area in and around YK
28	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests		**58.2**		0.5	impacted core study area in and around YK
29	Shaggy Mane	Coprinaceae	YK Sewage Road	popular area; many harvests	**44.5**	**44.0**	5.0	< 0.1	impacted core study area in and around YK
30	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**16.4**	**286.0**	7.0	0.1	impacted core study area in and around YK
31	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests	**11.9**	2.0	4.0	< 0.1	impacted core study area in and around YK
32	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		1.9		0.2	impacted core study area in and around YK

(Table1a. continued on next page)

(Table1a. continued)

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location North Slave Region & Yellowknife (YK)	Popularity of Harvest Area	Total Arsenic: µg/g dry weight		Total Lead: µg/g dry weight		**bold data** = elevated levels
				grey = harvest after forest fire					**blank field** = shared soil, see Table 1.
				red = fungi avoided by people	Soil	Fungi	Soil	Fungi	Description of Sampling Area
33	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		1.4		< 0.1	impacted core study area in and around YK
34	Fly Agaric	Amanitaceae	YK Frame Lake	popular area; poisonous fungi !	**7310.0**	**17.2**	**24.0**	1.7	impacted core study area in and around YK
35	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		**14.3**		< 0.1	impacted core study area in and around YK
36	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		**13.7**		< 0.1	impacted core study area in and around YK
37	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests	**40.6**	4.9	**13.0**	0.3	impacted core study area in and around YK
38	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		5.0		0.5	impacted core study area in and around YK
39	Fly Agaric	Amanitaceae	YK Frame Lake	popular area; poisonous fungi !	**49.4**	8.3	**30.0**	0.2	impacted core study area in and around YK
40	Meadow Mushroom	Agaricaceae	YK Con Mine/Rat L	popular area; many harvests	**2460.0**	**38.2**	**296.0**	0.6	impacted core study area in and around YK
41	Meadow Mushroom	Agaricaceae	YK Con Mine/Rat L	popular area; many harvests		**37.5**		1.7	impacted core study area in and around YK
42	Birch Bolete	Boletaceae	YK Con Mine/Rat L	popular area; many harvests	**1430.0**	**10.2**	**207.0**	1.1	impacted core study area in and around YK
43	Meadow Mushroom	Agaricaceae	YK Old Town lawn	popular area; many harvests	**14.0**	2.3	**92.1**	**1010.0**	impacted core study area in and around YK
44	Puffball	Lycoperdaceae	YK Old Town lawn	popular area; many harvests	**29.3**	1.8	**16.3**	**26.8**	impacted core study area in and around YK
45	Birch Bolete	Boletaceae	YK Jolliffe Island	popular area; many harvests	**106.0**	5.6	**126.0**	**67.0**	impacted core study area in and around YK
46	Fly Agaric	Amanitaceae	YK Jolliffe Island	popular area; poisonous fungi !		3.8		0.6	impacted core study area in and around YK
47	Puffball	Lycoperdaceae	YK Jolliffe Island	popular area; many harvests	**123.0**	**90.7**	**33.1**	**145.0**	impacted core study area in and around YK
48	Red-capped Bolete	Boletaceae	YK Jolliffe Island	popular area; many harvests	**81.1**	1.8	**15.9**	**20.6**	impacted core study area in and around YK
49	Shaggy Mane	Coprinaceae	YK Giant Mine	popular patch; many harvests	**1730.0**	6.6	**62.4**	**71.3**	impacted core study area in and around YK
50	Shaggy Mane	Coprinaceae	YK Giant Mine	popular patch; many harvests		**46.3**		**22.3**	impacted core study area in and around YK
51	Meadow Mushroom	Agaricaceae	YK Giant Mine	popular patch; many harvests	**999.0**	**16.9**	**63.0**	0.8	impacted core study area in and around YK
52	Shaggy Mane	Coprinaceae	YK Giant/Vee Lk.	popular patch; many harvests	**550.0**	4.8	**27.9**	**23.5**	impacted core study area in and around YK
53	Birch Bolete	Boletaceae	YK Vee Lake Rd.	popular area; many harvests	**87.6**	7.8	**217.0**	**26.4**	impacted core study area in and around YK
54	Hollow-stem Bolete	Boletaceae	YK River Park	popular area; many harvests	**14.7**	7.8	**122.0**	**65.7**	impacted core study area in and around YK
55	Spring Agaricus	Agaricaceae	YK River Park	popular area; many harvests	**29.5**	1.4	**22.1**	**511.0**	impacted core study area in and around YK
56	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests	**23.1**	4.9	**17.5**	**24.2**	impacted core study area in and around YK
57	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests		**494.0**		**18.6**	impacted core study area in and around YK
58	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests		**298.0**		0.3	impacted core study area in and around YK
59	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests	**45.0**	3.6	**288.0**	**13.5**	impacted core study area in and around YK
60	Forest Mushroom	Agaricaceae	YK Treminco Mine	popular area; many harvests	**33.1**	5.0	**39.8**	8.3	impacted core study area in and around YK
61	Tippler's Bane	Coprinaceae	YK Treminco Mine	popular area; fungi avoided !	**120.0**	**11.1**	**24.4**	5.6	impacted core study area in and around YK
62	Red-capped Bolete	Boletaceae	Prelude Lake Trail	popular area; many harvests	6.9	2.0	**47.7**	**192.0**	less impacted background 20 km ENE of YK
63	Sand Bolete	Boletaceae	Prelude Lake Trail	popular area; many harvests	**15.7**	4.1	**33.0**	**18.3**	less impacted background 20 km ENE of YK
64	White Matsutake	Tricholomataceae	Prelude Lake Trail	popular area; many harvests	4.1	**92.3**	**35.0**	**72.4**	less impacted background 20 km ENE of YK
65	Sand Bolete	Boletaceae	Cameron Fall Trail	unpopular area; few harvests	8.1	1.5	6.0	< 0.1	less impacted background 33 km E of YK

(Table1a. continued on next page)

(Table1a. continued)

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location	Popularity of Harvest Area	Total Arsenic: µg/g dry weight		Total Lead: µg/g dry weight		**bold data** = elevated levels; **blank field** = shared soil, see Table 1.
			North Slave Region & Yellowknife (YK)	grey = harvest after forest fire; red = fungi avoided by people	Soil	Fungi	Soil	Fungi	Description of Sampling Area
66	Slippery Jack	Boletaceae	Cameron Fall Trail	unpopular area; few harvests	**12.4**	1.5	3.0	< 0.1	less impacted background 33 km E of YK
67	Birch Bolete	Boletaceae	Cameron Fall Trail	unpopular area; few harvests	5.9	1.4	6.0	0.6	less impacted background 33 km E of YK
68	White Matsutake	Tricholomataceae	Ingraham Trail	very popular area; many harvests	N/A	**28.1**	N/A	**294.0**	less impacted background 35 km E of YK
69	Red-capped Bolete	Boletaceae	Cameron River Park	very popular area; many harvests	1.9	< 0.2	**21.1**	N/A	less impacted background 42 km E of YK
70	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**29.4**	N/A	< 0.1	less impacted background 47 km E of YK
71	Birch Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	0.9	< 0.2	7.8	**11.7**	less impacted background 47 km E of YK
72	Larch Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	2.2	4.6	**10.6**	**27.7**	less impacted background 47 km E of YK
73	Red-capped Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	1.9	1.7	**17.1**	**12.0**	less impacted background 47 km E of YK
74	Red-capped Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests		< 0.2		**110.0**	less impacted background 47 km E of YK
75	Sand Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests		2.4		**57.9**	less impacted background 47 km E of YK
76	Sarcodon	Hydnaceae	Ingraham/Camp Ant.	very popular area; fungi avoided !		< 0.2		**19.3**	less impacted background 47 km E of YK
77	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	2.5	**56.2**	**66.5**	**17.6**	less impacted background 47 km E of YK
78	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests		**29.8**		**16.9**	less impacted background 47 km E of YK
79	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**48.4**	N/A	< 0.1	less impacted background 47 km E of YK
80	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**11.0**	N/A	0.1	less impacted background 47 km E of YK
81	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt Lk	popular area; poisonous fungi !	5.8	< 0.5	8.0	0.2	less impacted background 49 km E of YK
82	Birch Bolete	Boletaceae	Ingraham/Tibbitt Lk	popular area; many harvests	**11.5**	< 0.5	9.0	< 0.1	less impacted background 49 km E of YK
83	Birch Bolete	Boletaceae	Ingraham/Tibbitt Lk	popular area; many harvests		< 0.5		< 0.1	less impacted background 49 km E of YK
84	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt Lk	popular area; poisonous fungi !	7.2	< 0.5	**10.0**	< 0.1	less impacted background 49 km E of YK
85	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt Lk	popular area; poisonous fungi !	1.6	< 0.5	5.0	< 0.1	less impacted background 49 km E of YK
86	Hooded False Morel	Helvellaceae	Ingraham/Tibbitt Lk	popular area; poisonous fungi !	4.1	< 0.5	**14.0**	< 0.1	less impacted background 49 km E of YK
87	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**255.0**	less impacted background 49 km E of YK
88	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	1.4	N/A	**283.0**	less impacted background 49 km E of YK
89	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	0.4	less impacted background 49 km E of YK
90	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	2.3	N/A	0.5	less impacted background 49 km E of YK
91	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**405.0**	less impacted background 50 km E of YK
92	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	1.5	N/A	**469.0**	less impacted background 50 km E of YK
93	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**867.0**	less impacted background 50 km E of YK
94	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	0.2	less impacted background 50 km E of YK
95	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.5	N/A	**993.0**	less impacted background 50 km E of YK
96	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**50.5**	less impacted background 50 km E of YK
97	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	**55.2**	less impacted background 50 km E of YK
98	Sand Bolete	Boletaceae	Tibbitt Lake North	unpopular area; few harvests	0.8	< 0.2	**10.7**	7.2	less impacted background 52 km E of YK

(Table1a. continued on next page)

(Table1a. continued)

Fungi ID #	Mushroom/Fungi Species	Mushroom Family	Location	Popularity of Harvest Area	Total Arsenic:			Total Lead:			**bold data** = elevated levels
			North Slave Region	grey = harvest after forest fire	µg/g dry weight			µg/g dry weight			**blank field** = shared soil, see Table 1.
			& Yellowknife (YK)	red = fungi avoided by people	Soil		Fungi	Soil		Fungi	Description of Sampling Area
99	Suillus	Boletaceae	Tibbitt Lake North	unpopular area; few harvests	3.2	<	0.2	**12.7**		**23.0**	less impacted background 52 km E of YK
100	Yellow Bolete	Boletaceae	Tibbitt Lake North	unpopular area; few harvests	2.7	<	0.2	8.7		**13.3**	less impacted background 52 km E of YK
101	White Matsutake	Tricholomataceae	Tibbitt Lake North	unpopular area; few harvests	7.1		**53.1**	7.5		**35.1**	less impacted background 52 km E of YK
102	Fly Agaric	Amanitaceae	Tundra Jolly Lake	inaccessible; poisonous fungi !	4.5	<	0.5	2.0		0.3	unspoiled background 240 km NE of YK
103	Fly Agaric	Amanitaceae	Tundra Jolly Lake	inaccessible; poisonous fungi !		<	0.5		<	0.1	unspoiled background 240 km NE of YK
104	Red-capped Bolete	Boletaceae	Tundra Jolly Lake	inaccessible area; no harvest	6.2		1.7	3.0	<	0.1	unspoiled background 240 km NE of YK
105	Birch Bolete	Boletaceae	Tundra Jolly Lake	inaccessible area; no harvest	1.3	<	0.5	2.0	<	0.1	unspoiled background 240 km NE of YK
106	Birch Bolete	Boletaceae	Tundra Jolly Lake	inaccessible area; no harvest	4.4	<	0.5	2.0	<	0.1	unspoiled background 240 km NE of YK
107	Birch Bolete	Boletaceae	Tundra Jolly Lake	inaccessible area; no harvest	1.7	<	0.5	**14.0**		0.1	unspoiled background 240 km NE of YK
108	Birch Bolete	Boletaceae	Tundra Jolly Lake	inaccessible area; no harvest			0.6			0.1	unspoiled background 240 km NE of YK
109	Birch Bolete	Boletaceae	Tundra Daring Lake	inaccessible area; no harvest	**11.6**	<	1.0	3.0	<	0.1	unspoiled background 300 km NE of YK
110	Birch Bolete	Boletaceae	Tundra Daring Lake	inaccessible area; no harvest	3.2		**20.3**	2.0		0.1	unspoiled background 300 km NE of YK
111	Birch Bolete	Boletaceae	Tundra Daring Lake	inaccessible area; no harvest	5.3		5.4	1.0		0.3	unspoiled background 300 km NE of YK
112	Burn-site Morel	Morchellaceae	Drybones Bay area	inaccessible; only 2008-harvest	N/A		3.5	N/A	<	0.2	unspoiled background 50 km SE of YK
113	Burn-site Morel	Morchellaceae	Drybones Bay area	inaccessible; only 2008-harvest	N/A		1.6	N/A	<	0.2	unspoiled background 50 km SE of YK
114	Burn-site Morel	Morchellaceae	Drybones Bay area	inaccessible; only 2008-harvest	N/A		1.7	N/A	<	0.2	unspoiled background 50 km SE of YK
115	Burn-site Morel	Morchellaceae	N of YK/S of Whati	inaccessible; only 2009-harvest	N/A		1.1	N/A		0.5	unspoiled background 100 km NW of YK
116	Burn-site Morel	Morchellaceae	N of YK/S of Whati	inaccessible; only 2009-harvest	N/A		1.1	N/A		0.2	unspoiled background 100 km NW of YK
117	Burn-site Morel	Morchellaceae	N of YK/S of Whati	inaccessible; only 2009-harvest	N/A		0.8	N/A		0.2	unspoiled background 100 km NW of YK
118	Burn-site Morel	Morchellaceae	N of YK/S of Whati	inaccessible; only 2009-harvest	N/A		0.9	N/A	<	0.1	unspoiled background 100 km NW of YK
119	Burn-site Morel	Morchellaceae	50 km SSW of Edzo	inaccessible; only 2009-harvest	N/A		1.7	N/A		0.1	unspoiled background 120 km WSW of YK
120	Burn-site Morel	Morchellaceae	50 km SSW of Edzo	inaccessible; only 2009-harvest	N/A		0.9	N/A		0.1	unspoiled background 120 km WSW of YK
121	Burn-site Morel	Morchellaceae	50 km SSW of Edzo	inaccessible; only 2009-harvest	N/A		1.4	N/A		0.1	unspoiled background 120 km WSW of YK
122	Burn-site Morel	Morchellaceae	50 km SSW of Edzo	inaccessible; only 2009-harvest	N/A		0.6	N/A		0.2	unspoiled background 120 km WSW of YK
123	Burn-site Morel	Morchellaceae	50 km SSW of Edzo	inaccessible; only 2009-harvest	N/A		1.3	N/A		0.3	unspoiled background 120 km WSW of YK
124	Burn-site Morel	Morchellaceae	50 km SSW of Edzo	inaccessible; only 2009-harvest	N/A		1.2	N/A		0.1	unspoiled background 120 km WSW of YK

Table 1b. Arsenic and Lead concentrations in Mushrooms and Soil from Accessible and Popular Harvest Areas in and around Yellowknife, North Slave Region, Northwest Territories, 1997 - 2009.

Fungi ID #	Mushroom Species	Mushroom Family	Location Yellowknife (YK) & Ingraham Trail	Popularity of Harvest Area	Total Arsenic: (µg/g dry weight) Soil	Total Arsenic: (µg/g dry weight) Fungi	Total Lead: (µg/g dry weight) Soil	Total Lead: (µg/g dry weight) Fungi
Samples from all other areas and poisonous mushrooms excluded				orange = impacted core study area; olive = less impacted background	**bold data** = elevated levels			
19	Hollow-stem Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**12.4**	**19.9**	**26.2**	**55.0**
20	Puffball	Lycoperdaceae	YK Golf Course	very popular area; many harvests	**30.7**	**135.0**	3.2	**44.9**
21	Red-capped Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**9.9**	5.7	**12.2**	**46.0**
22	Sand Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**86.9**	1.0	7.6	**509.0**
23	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests	**68.5**	**280.0**	4.7	**13.5**
24	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests		**340.0**		**31.4**
25	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests		**1370.0**		0.2
26	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**21.0**	**97.2**	5.0	< 0.1
27	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**17.4**	**47.1**	5.0	0.3
28	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests		**58.2**		0.5
29	Shaggy Mane	Coprinaceae	YK Sewage Road	popular area; many harvests	**44.5**	**44.0**	5.0	< 0.1
30	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**16.4**	**286.0**	7.0	0.1
31	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests	**11.9**	2.0	4.0	< 0.1
32	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		1.9		0.2
33	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		1.4		< 0.1
35	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		**14.3**		< 0.1
36	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		**13.7**		< 0.1
37	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests	**40.6**	4.9	**13.0**	0.3
38	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		5.0		0.5
40	Meadow Mushroom	Agaricaceae	YK Con Mine/Rat L	popular area; many harvests	**2460.0**	**38.2**	**296.0**	0.6
41	Meadow Mushroom	Agaricaceae	YK Con Mine/Rat L	popular area; many harvests		**37.5**		1.7
42	Birch Bolete	Boletaceae	YK Con Mine/Rat L	popular area; many harvests	**1430.0**	**10.2**	**207.0**	1.1
43	Meadow Mushroom	Agaricaceae	YK Old Town lawn	popular area; many harvests	**14.0**	2.3	**92.1**	**1010.0**
44	Puffball	Lycoperdaceae	YK Old Town lawn	popular area; many harvests	**29.3**	1.8	**16.3**	**26.8**
45	Birch Bolete	Boletaceae	YK Jolliffe Island	popular area; many harvests	**106.0**	5.6	**126.0**	**67.0**
47	Puffball	Lycoperdaceae	YK Jolliffe Island	popular area; many harvests	**123.0**	**90.7**	**33.1**	**145.0**
48	Red-capped Bolete	Boletaceae	YK Jolliffe Island	popular area; many harvests	**81.1**	1.8	**15.9**	**20.6**
49	Shaggy Mane	Coprinaceae	YK Giant Mine	popular area; many harvests	**1730.0**	6.6	**62.4**	**71.3**
50	Shaggy Mane	Coprinaceae	YK Giant Mine	popular area; many harvests		**46.3**		**22.3**
51	Meadow Mushroom	Agaricaceae	YK Giant Mine	popular area; many harvests	**999.0**	**16.9**	**63.0**	0.8
52	Shaggy Mane	Coprinaceae	YK Giant/Vee Lk.	popular area; many harvests	**550.0**	4.8	**27.9**	**23.5**
53	Birch Bolete	Boletaceae	YK Vee Lake Rd.	popular area; many harvests	**87.6**	7.8	**217.0**	**26.4**
54	Hollow-stem Bolete	Boletaceae	YK River Park	popular area; many harvests	**14.7**	7.8	**122.0**	**65.7**
55	Spring Agaricus	Agaricaceae	YK River Park	popular area; many harvests	**29.5**	1.4	**22.1**	**511.0**
56	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests	**23.1**	4.9	**17.5**	**24.2**
57	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests		**494.0**		**18.6**
58	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests		**298.0**		0.3
59	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests	**45.0**	3.6	**288.0**	**13.5**
60	Forest Mushroom	Agaricaceae	YK Treminco Mine	popular area; many harvests	**33.1**	5.0	**39.8**	8.3
		Mean values for all popular harvest areas in or around Yellowknife:			**300.6**	**97.8**	**64.4**	**70.8**
		Mushrooms: (N = 39) for As and Pb; Soil: (N = 27) for As and Pb						
62	Red-capped Bolete	Boletaceae	Prelude Lake Trail	popular area; many harvests	6.9	2.0	**47.7**	**192.0**
63	Sand Bolete	Boletaceae	Prelude Lake Trail	popular area; many harvests	**15.7**	4.1	**33.0**	**18.3**
64	White Matsutake	Tricholomataceae	Prelude Lake Trail	popular area; many harvests	4.1	**92.3**	**35.0**	**72.4**
68	White Matsutake	Tricholomataceae	Ingraham Trail	very popular area; many harvests	N/A	**28.1**	N/A	**294.0**
69	Red-capped Bolete	Boletaceae	Cameron River Park	very popular area; many harvests	1.9	< 0.2	**21.1**	N/A
70	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**29.4**	N/A	< 0.1
71	Birch Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	0.9	< 0.2	7.8	**11.7**
72	Larch Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	2.2	4.6	**10.6**	**27.7**
73	Red-capped Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	1.9	1.7	**17.1**	**12.0**

(Table1b. continued on next page)

(Table1b. continued)

Samples from all other areas and poisonous mushrooms excluded				orange = impacted core study area	**bold data** = elevated levels			
Fungi ID #	**Mushroom Species**	**Mushroom Family**	**Location** Yellowknife (YK) & Ingraham Trail	olive = less impacted background **Popularity of Harvest Area**	**Total Arsenic:** (µg/g dry weight)		**Total Lead:** (µg/g dry weight)	
					Soil	**Fungi**	**Soil**	**Fungi**
74	Red-capped Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests		< 0.2		**110.0**
75	Sand Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests		2.4		**57.9**
77	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	2.5	**56.2**	**66.5**	**17.6**
78	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests		**29.8**		**16.9**
79	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**48.4**	N/A	< 0.1
80	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**11.0**	N/A	0.1
82	Birch Bolete	Boletaceae	Ingraham/Tibbitt Lk	popular area; many harvests	**11.5**	< 0.5	9.0	< 0.1
83	Birch Bolete	Boletaceae	Ingraham/Tibbitt Lk	popular area; many harvests		< 0.5		< 0.1
		Mean values for all popular harvest areas, excluding Morels:			**226.8**	**73.6**	**55.2**	**65.3**
		Mushrooms: (N = 56) for As; (N = 55) for Pb; Soil: (N = 36) for As and Pb						
87	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**255.0**
88	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	1.4	N/A	**283.0**
89	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	0.4
90	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	2.3	N/A	0.5
91	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**405.0**
92	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	1.5	N/A	**469.0**
93	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**867.0**
94	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	0.2
95	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.5	N/A	**993.0**
96	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**50.5**
97	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	**55.2**
		Mean values for Morels in popular harvest areas:			N/A	**0.8**	N/A	**307.2**
		Morel Mushrooms: (N = 11) for As and Pb						
		Mean values for all popular harvest areas, including Morels:			N/A	**61.7**	N/A	**105.6**
		Mushrooms: (N = 67) for As; (N = 66) for Pb						

Table 1c. Arsenic and Lead concentrations in Mushrooms and Soil from Specific Popular Harvest Areas in and around Yellowknife, North Slave Region, Northwest Territories, 1997 - 2009.

Samples from all other areas and poisonous mushrooms are excluded				orange = impacted core study area	**bold data** = elevated levels			
Fungi ID #	**Mushroom Species**	**Mushroom Family**	**Location** Yellowknife (YK) & Ingraham Trail	olive = less impacted background **Popularity of Harvest Area**	**Total Arsenic:** (µg/g dry weight)		**Total Lead:** (µg/g dry weight)	
					Soil	**Fungi**	**Soil**	**Fungi**
19	Hollow-stem Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**12.4**	**19.9**	**26.2**	**55.0**
20	Puffball	Lycoperdaceae	YK Golf Course	very popular area; many harvests	**30.7**	**135.0**	3.2	**44.9**
21	Red-capped Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**9.9**	5.7	**12.2**	**46.0**
22	Sand Bolete	Boletaceae	YK Golf Course	very popular area; many harvests	**86.9**	1.0	7.6	**509.0**
23	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests	**68.5**	**280.0**	4.7	**13.5**
24	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests		**340.0**		**31.4**
25	White Matsutake	Tricholomataceae	YK Golf Course	very popular area; many harvests		**1370.0**		0.2
	Mean values for YK Golf Course area: Mushroom (*N* = 7) for As & Pb; Soil (*N* = 5) for As & Pb				**41.7**	**307.4**	**10.8**	**100.0**
26	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**21.0**	**97.2**	5.0	< 0.1
27	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**17.4**	**47.1**	5.0	0.3
28	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests		**58.2**		0.5
29	Shaggy Mane	Coprinaceae	YK Sewage Road	popular area; many harvests	**44.5**	**44.0**	5.0	< 0.1
30	Meadow Mushroom	Agaricaceae	YK Sewage Road	popular area; many harvests	**16.4**	**286.0**	7.0	0.1
31	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests	**11.9**	2.0	4.0	< 0.1
32	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		1.9		0.2
33	Red-capped Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		1.4		< 0.1
35	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		**14.3**		< 0.1
36	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		**13.7**		< 0.1
37	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests	**40.6**	4.9	**13.0**	0.3
38	Birch Bolete	Boletaceae	YK Frame Lake	popular area; many harvests		5.0		0.5
40	Meadow Mushroom	Agaricaceae	YK Con Mine/Rat L	popular area; many harvests	**2460.0**	**38.2**	**296.0**	0.6
41	Meadow Mushroom	Agaricaceae	YK Con Mine/Rat L	popular area; many harvests		**37.5**		1.7
42	Birch Bolete	Boletaceae	YK Con Mine/Rat L	popular area; many harvests	**1430.0**	**10.2**	**207.0**	1.1
	Mean values for Sewage/Frame/Con: Mushroom (*N* = 15) for As & Pb; Soil (*N* = 8) for As & Pb				**505.2**	**44.1**	**67.8**	**0.4**
43	Meadow Mushroom	Agaricaceae	YK Old Town lawn	popular area; many harvests	**14.0**	2.3	**92.1**	**1010.0**
44	Puffball	Lycoperdaceae	YK Old Town lawn	popular area; many harvests	**29.3**	1.8	**16.3**	**26.8**
45	Birch Bolete	Boletaceae	YK Jolliffe Island	popular area; many harvests	**106.0**	5.6	**126.0**	**67.0**
47	Puffball	Lycoperdaceae	YK Jolliffe Island	popular area; many harvests	**123.0**	**90.7**	**33.1**	**145.0**
48	Red-capped Bolete	Boletaceae	YK Jolliffe Island	popular area; many harvests	**81.1**	1.8	**15.9**	**20.6**
49	Shaggy Mane	Coprinaceae	YK Giant Mine	popular area; many harvests	**1730.0**	6.6	**62.4**	**71.3**
50	Shaggy Mane	Coprinaceae	YK Giant Mine	popular area; many harvests		**46.3**		**22.3**
51	Meadow Mushroom	Agaricaceae	YK Giant Mine	popular area; many harvests	**999.0**	**16.9**	**63.0**	0.8
52	Shaggy Mane	Coprinaceae	YK Giant/Vee Lk.	popular area; many harvests	**550.0**	4.8	**27.9**	**23.5**
53	Birch Bolete	Boletaceae	YK Vee Lake Rd.	popular area; many harvests	**87.6**	7.8	**217.0**	**26.4**
54	Hollow-stem Bolete	Boletaceae	YK River Park	popular area; many harvests	**14.7**	7.8	**122.0**	**65.7**
55	Spring Agaricus	Agaricaceae	YK River Park	popular area; many harvests	**29.5**	1.4	**22.1**	**511.0**
	Mean values for Old Town/Giant: Mushroom (*N* = 12) for As & Pb; Soil (*N* = 11) for As & Pb				**342.2**	**16.2**	**72.5**	**165.9**
56	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests	**23.1**	4.9	**17.5**	**24.2**
57	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests		**494.0**		**18.6**
58	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests		**298.0**		0.3
59	Shaggy Mane	Coprinaceae	YK Treminco Mine	popular area; many harvests	**45.0**	3.6	**288.0**	**13.5**
60	Forest Mushroom	Agaricaceae	YK Treminco Mine	popular area; many harvests	**33.1**	5.0	**39.8**	8.3
	Mean values for Treminco Mine area: Mushroom (*N* = 5) for As & Pb; Soil (*N* = 3) for As & Pb				**33.7**	**161.1**	**115.1**	**13.0**
62	Red-capped Bolete	Boletaceae	Prelude Lake Trail	popular area; many harvests	6.9	2.0	**47.7**	**192.0**
63	Sand Bolete	Boletaceae	Prelude Lake Trail	popular area; many harvests	**15.7**	4.1	**33.0**	**18.3**
64	White Matsutake	Tricholomataceae	Prelude Lake Trail	popular area; many harvests	4.1	**92.3**	**35.0**	**72.4**
	Mean values for Prelude Nature Trail: Mushroom (*N* = 3) for As & Pb; Soil (*N* = 3) for As & Pb				**8.9**	**32.8**	**38.6**	**94.2**
68	White Matsutake	Tricholomataceae	Ingraham Trail	very popular area; many harvests	N/A	**28.1**	N/A	**294.0**
69	Red-capped Bolete	Boletaceae	Cameron River Park	very popular area; many harvests	1.9	< 0.2	**[21.1]**	**N/A**
70	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**29.4**	N/A	< 0.1

(Table1c. continued on next page)

(Table1c. continued)

Samples from all other areas and poisonous mushrooms are excluded				orange = impacted core study area	**bold data** = elevated levels			
Fungi ID #	**Mushroom Species**	**Mushroom Family**	**Location** Yellowknife (YK) & Ingraham Trail	olive = less impacted background **Popularity of Harvest Area**	**Total Arsenic:** (µg/g dry weight)		**Total Lead:** (µg/g dry weight)	
					Soil	**Fungi**	**Soil**	**Fungi**
71	Birch Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	0.9	< 0.2	7.8	**11.7**
72	Larch Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	2.2	4.6	**10.6**	**27.7**
73	Red-capped Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests	1.9	1.7	**17.1**	**12.0**
74	Red-capped Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests		< 0.2		**110.0**
75	Sand Bolete	Boletaceae	Ingraham/Camp Ant.	very popular area; many harvests		2.4		**57.9**
77	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	2.5	**56.2**	**66.5**	**17.6**
78	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests		**29.8**		**16.9**
79	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**48.4**	N/A	< 0.1
80	White Matsutake	Tricholomataceae	Ingraham/Camp Ant.	very popular area; many harvests	N/A	**11.0**	N/A	0.1
82	Birch Bolete	Boletaceae	Ingraham/Tibbitt Lk	popular area; many harvests	**11.5**	< 0.5	9.0	< 0.1
83	Birch Bolete	Boletaceae	Ingraham/Tibbitt Lk	popular area; many harvests		< 0.5		< 0.1
	Mean values for Ingraham: Mushroom (*N* = 14) for As, (*N* = 13) Pb; Soil (*N* = 6) As, (*N* = 5) Pb				**3.5**	**15.2**	**22.2**	**42.2**
87	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**255.0**
88	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	1.4	N/A	**283.0**
89	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	0.4
90	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	2.3	N/A	0.5
91	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**405.0**
92	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	1.5	N/A	**469.0**
93	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**867.0**
94	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	0.2
95	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.5	N/A	**993.0**
96	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	< 0.2	N/A	**50.5**
97	Burn-site Morel	Morchellaceae	Ingraham/Tibbitt Lk	popular area; only 1999-harvest	N/A	0.6	N/A	**55.2**
	Mean values for Morels: Mushroom (*N* = 11) for As & Pb				N/A	**0.76**	N/A	**307.2**

Table 2. Concentrations of Arsenic, Lead, Cadmium and Mercury in Mushrooms, Soil and Wood from Forest Fire Sites in the North Slave Region, Northwest Territories, 1998 - 2000.

ID #	Metals analyzed	Fungi Species from same location as wood sample (for locations see ID#s in Table A)	Fungi Family	Fungi Metal µg/g d.w.	Soil µg/g	Wood Coal complete burned wood µg/g	Tree Age yrs	Wood outside burned, inside unburned µg/g	Tree Age yrs	Wood charred live tree inside unburned µg/g	Tree Age yrs	Mean accumu-lation factor from soil to burned wood/coal	Tree Species jack pine, white or black spruce	Year of forest fire
16	Arsenic	Sand Bolete	Boletaceae	< 0.5	2.4	1.3	22	< 0.5	20	< 0.5	19		jack pine	1979
17	Arsenic	Hooded False Morel	Helvellaceae	< 0.5	1.6	0.5	25	< 0.5	25				spruce	1999
81	Arsenic	Hooded False Morel	Helvellaceae	< 0.5	5.8	< 0.5	30	< 0.5	16				jack pine	1998
82	Arsenic	Birch Bolete	Boletaceae	< 0.5	11.5	4.5	30	< 0.5	30				jack pine	1998
82	Arsenic	2nd wood sample/same location						< 0.5	40				spruce	1998
84	Arsenic	Hooded False Morel	Helvellaceae	< 0.5	7.2	< 0.5	25	< 0.5	25				jack pine	1998
85	Arsenic	Hooded False Morel	Helvellaceae	< 0.5	1.6	< 0.5	40	< 0.5	40				jack pine	1998
86	Arsenic	Hooded False Morel	Helvellaceae	< 0.5	4.1	1.2	21	0.5	21				jack pine	1998
	mean values for Arsenic:			**0.5**	**5.7**	**1.3**		**0.5**		**0.5**		**0.23 X**		
16	Lead	Sand Bolete	Boletaceae	< 0.1	2.0	1.3	22	0.5	20	0.1	19		jack pine	1979
17	Lead	Hooded False Morel	Helvellaceae	< 0.1	**10.0**	0.1	25	1.1	25				spruce	1999
81	Lead	Hooded False Morel	Helvellaceae	0.2	8.0	0.1	30	< 0.1	16				jack pine	1998
82	Lead	Birch Bolete	Boletaceae	< 0.1	9.0	2.7	30	1.0	30				spruce	1998
82	Lead	2nd wood sample/same location						0.3	40				spruce	1998
84	Lead	Hooded False Morel	Helvellaceae	< 0.1	**10.0**	0.5	25	0.2	25				jack pine	1998
85	Lead	Hooded False Morel	Helvellaceae	< 0.1	5.0	< 0.1	40	0.5	40				jack pine	1998
86	Lead	Hooded False Morel	Helvellaceae	< 0.1	**14.0**	0.9	21	0.2	21				jack pine	1998
	mean values for Lead:			**0.1**	**8.4**	**0.8**		**0.5**		**0.1**		**0.1 X**		
16	Cadmium	Sand Bolete	Boletaceae	< 0.1	0.1	0.1	22	0.1	20	0.1	19		jack pine	1979
17	Cadmium	Hooded False Morel	Helvellaceae	0.6	< 0.1	0.1	25	0.1	25				spruce	1999
81	Cadmium	Hooded False Morel	Helvellaceae	0.7	< 0.1	0.1	30	0.1	16				jack pine	1998
82	Cadmium	Birch Bolete	Boletaceae	0.4	0.1	< 0.1	30	0.1	30				spruce	1998
82	Cadmium	2nd wood sample/same location						< 0.1	40				spruce	1998
84	Cadmium	Hooded False Morel	Helvellaceae	**1.5**	0.1	0.1	25	0.1	25				jack pine	1998
85	Cadmium	Hooded False Morel	Helvellaceae	0.7	0.1	0.1	40	0.1	40				jack pine	1998
86	Cadmium	Hooded False Morel	Helvellaceae	0.9	0.4	0.1	21	0.1	21				jack pine	1998
	mean values for Cadmium:			**0.7**	**0.1**	**0.1**		**0.1**		**0.1**		**1 X**		
16	Mercury	Sand Bolete	Boletaceae	0.16	0.010	< 0.01	22	0.02	20	0.01	19		jack pine	1979
17	Mercury	Hooded False Morel	Helvellaceae	0.05	0.010	0.04	25	< 0.01	25				spruce	1999
81	Mercury	Hooded False Morel	Helvellaceae	0.07	0.020	0.03	30	< 0.01	16				jack pine	1998
82	Mercury	Birch Bolete	Boletaceae	0.70	0.010	0.08	30	0.03	30				spruce	1998
82	Mercury	2nd wood sample/same location						< 0.01	40				spruce	1998
84	Mercury	Hooded False Morel	Helvellaceae	0.06	0.020	0.03	25	< 0.01	25				jack pine	1998
85	Mercury	Hooded False Morel	Helvellaceae	0.05	< 0.005	0.01	40	0.01	40				jack pine	1998
86	Mercury	Hooded False Morel	Helvellaceae	0.05	0.010	0.09	21	0.01	21				jack pine	1998
	mean values for Mercury:			**0.23**	**0.012**	**0.04**		**0.01**		**0.01**		**3.33 X**		

Table 3. Accumulations of four Heavy Metals from Soil to Mushrooms in the North Slave Region, Northwest Territories, 1997 - 2009.

Mushroom Species	Mushroom Family	Total Arsenic Soil µg/g	Fungi µg/g	Accumulation Factor of As Soil to Fungi	Total Lead Soil µg/g	Fungi µg/g	Accumulation Factor of Pb Soil to Fungi	Total Cadmium Soil µg/g	Fungi µg/g	Accumulation Factor of Cd Soil to Fungi	Total Mercury Soil µg/g	Fungi µg/g	Accumulation Factor of Hg Soil to Fungi	No. of samples soil	fungi
White Matsutake	Tricholomataceae	24.8	190.0	**7.661**	17.1	37.0	2.16	0.2	1.3	**6.5**	0.013	0.60	**46.2**	9	13
Puffball	Lycoperdaceae	61.0	75.8	**1.243**	17.5	72.2	**4.13**	0.4	1.2	3.0	0.063	0.87	**13.8**	3	3
Meadow Mushroom (3 species; Table B)	Agaricaceae	606.8	59.0	0.097	83.1	153.3	1.84	0.7	6.7	**9.6**	0.094	0.75	**8.0**	10	10
Fly Agaric	Amanitaceae	1494.9	6.1	0.004	36.8	0.6	0.02	0.5	8.9	**17.8**	0.072	0.13	1.8	5	5
Bolete (8 species; Table B)	Boletaceae	46.3	3.4	0.073	24.6	27.6	1.12	0.3	0.8	2.7	0.033	0.15	4.5	47	47
Shaggy Mane (2 species; Table B)	Coprinaceae	476.5	101.5	0.213	58.1	19.9	0.34	1.0	5.0	**5.0**	0.051	1.35	**26.5**	9	9
Sarcodon	Hydnaceae	1.9	0.2	0.105	25.5	19.3	0.76	0.2	0.4	2.0	0.017	0.57	**33.5**	1	1
Burn-site Morel (100 km S of Edzo)	Morchellaceae	1.2	0.6	0.500	2.8	0.2	0.07	0.1	0.6	**6.0**	0.005	0.02	4.0	5	7
Burn-site Morel (Tibbitt Lake)	Morchellaceae	6.0	0.8	0.133	9.2	307.2	**33.39**	0.2	0.7	3.5	0.013	0.03	2.3	5	11
Hooded False Morel	Helvellaceae	4.1	0.5	0.122	7.8	0.1	0.01	0.2	0.9	4.5	0.013	0.06	4.6	5	5

Note: blue highlight = mean concentrations of heavy metals in soil samples from nearby sampling locations (for shared soil samples see Table 1);
µg/g = dry weight; bold numbers = highest accumulation factors.

Table 4. Speciation of Arsenic in Mushrooms from Yellowknife, North Slave Region, Northwest Territories, 1997 - 2008.

Fungi ID #	Mushroom Species (1st & 2nd laboratory run and test)	Location Yellowknife (YK)	Total Arsenic	Test Method of Speciation	Organic Arsenic: 1. Test DMA	2. Test DMA	1. Test MMA	2. Test MMA	Inorganic Arsenic: 1. Test As^3	2. Test As^3	1. Test As^5	2. Test As^5
			ug/g d.w.		ug/g d.w.	ug/g d.w.	ug/g d.w.	ug/g d.w.	ug/g d.w.	ug/g d.w.	ug/g d.w.	ug/g d.w.
13	White Matsutake	46 km SW of Edzo	101.0	SM3113:B	1.4	N/A	0.4	N/A	76.1	N/A	0.7	
23 (a)	White Matsutake (1st run)	YK Golf Course	280.0	Water	240.0	253.0	0.2	0.1	0.3	N/A	0.1	< 0.1
23 (b)	White Matsutake (2nd run)	YK Golf Course	280.0	Methanol	456.0	N/A	0.1	0.1		N/A	0.1	< 0.1
24 (a)	White Matsutake (1st run)	YK Golf Course	340.0	Water	178.0	345.0	0.1	0.1	0.2	N/A	0.1	< 0.1
24 (b)	White Matsutake (2nd run)	YK Golf Course	340.0	Methanol	242.0	300.0	0.1	0.1	0.3	N/A	0.1	< 0.1
26	Meadow Mushroom	YK Sewage Road	97.2	SM3113:B	0.1	N/A	2.0	N/A	4.7	N/A	0.9	N/A
29	Shaggy Mane	YK Sewage Road	44.0	SM3113:B	0.5	N/A	0.6	N/A	0.4	N/A	1.1	N/A
30	Meadow Mushroom	YK Sewage Road	286.0	SM3113:B	0.4	N/A	2.6	N/A	256.0	N/A	0.8	N/A
34	Fly Agaric	YK Frame Lake	17.2	SM3113:B	2.1	N/A	0.3	N/A	1.3	N/A	0.6	N/A
35	Birch Bolete	YK Frame Lake	14.3	SM3113:B	0.3	N/A	0.4	N/A	0.5	N/A	0.5	N/A
40	Meadow Mushroom	YK Con Mine	38.2	SM3113:B	0.5	N/A	0.4	N/A	2.9	N/A	0.7	N/A
51	Meadow Mushroom	YK Giant Mine	16.9	SM3113:B	1.5	N/A	0.5	N/A	2.9	N/A	0.8	N/A

Arsenic Speciation Parameters:

DMA	Dimethylarsinic acid	organic arsenic
MMA	Monomethylarsonic acid	organic arsenic
As^3	Arsenite	inorganic arsenic
As^5	Arsenate	inorganic arsenic

Note: blue highlight = two original samples and two duplicates of the same samples.

Table 5. Estimated Annual Intake of four Heavy Metals through the consumption of Mushrooms by Harvesters and Residents of Yellowknife, Northwest Territories, 1998 - 1999.

Harvester/ Interviewee ID #	**Total annual consumption of fresh mushrooms (kg)**	**Total Arsenic** Intake per year in **mg** per person	**Total Lead** Intake per year in **mg** per person	**Total Cadmium** Intake per year in **mg** per person	**Total Mercury** Intake per year in **mg** per person
# 1 (category **1**)	15	43.49	342.57	1.08	0.37
# 2 (category **1**)	15	73.63	349.77	1.17	0.49
# 3 (category **1**)	11	73.84	205.42	1.70	0.59
# 4 (category **1**)	9.5	12.97	472.02	0.77	0.22
# 5 (category **1**)	9.5	12.97	472.02	0.77	0.22
# 6 (category **1**)	9	73.72	114.05	1.58	0.57
# 7 (category **2**)	8	0.13	262.92	0.45	0.02
# 8 (category **2**)	7	0.12	230.05	0.39	0.02
# 9 (category **2**)	7	15.47	176.38	0.52	0.12
# 10 (category **3**)	5	0.08	164.32	0.27	0.02
# 11 (category **3**)	5	0.08	164.32	0.27	0.02
# 12 (category **3**)	5	0.08	164.32	0.27	0.02
# 13 (category **3**)	5	0.08	164.32	0.27	0.02
# 14 (category **3**)	5	33.24	102.76	0.43	0.19
# 15 (category **3**)	5	0.54	135.29	0.44	0.03
# 16 (category **3**)	4	7.74	104.62	0.29	0.07
# 17 (category **3**)	3.5	15.41	61.36	0.33	0.12
# 18 (category **3**)	3	15.40	44.93	0.31	0.12
# 19 (category **4**)	2	12.27	35.38	0.33	0.10
# 20 (category **4**)	2	12.45	33.37	0.32	0.12
# 21 (category **4**)	2	12.45	33.37	0.32	0.12
# 22 (category **5**)	1	0.02	32.87	0.06	0.01
# 23 (category **5**)	1	0.02	32.87	0.06	0.01
# 24 (category **5**)	1	0.02	32.87	0.06	0.01
# 25 (category **5**)	1	0.02	32.87	0.06	0.01
# 26 (category **6**)	0.25	<0.008	8.22	0.02	0.01

Table A. Sampling Locations of Mushrooms, Soil and Wood from the North Slave Region, NWT, and from Other Regions, 1997 - 2009.

purple = samples in Obst *et al*. 2001
yellow = backup samples 1997 - 1999
bold **ID #s** = shared soil from same spot
blue = known unspoiled background area
green = assumed undisturbed background area
orange = known impacted core study area

Fungi ID #	Collection Date (D/M/Y)	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Soil ID #	Wood ID # (Table 2)	Latitude North	Longitude West	Distances in km from: YK City	Giant Mine	Other Mine	Hwy Road	Surficial Sediments at Sampling Locations of Fungi, Soil and Wood: Pleistocene and Recent; including Organic Material and Anthropogenic Fill	General Regional Bedrock Geology
1	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
2	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
3	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
4	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
5	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
6	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
7	30-06-2006	Burn-site Morel	100 km S of Edzo	N/A	N/A	61.584500	116.295300	140	140	140	2.000	sand, silt, clay, forest fire site	Archean Mixed rocks
8	18-09-2001	Sand Bolete	46 km SW of Edzo	8	N/A	62.416011	116.422828	113	113	103	3.550	sand, mud, silt, clay, humus	Archean Mixed rocks
9	18-09-2001	Sand Bolete	46 km SW of Edzo	9	N/A	62.415897	116.429745	113	113	103	3.300	sand, mud, silt, clay, humus	Archean Mixed rocks
10	18-09-2001	White Matsutake	46 km SW of Edzo	10	N/A	62.417323	116.429871	113	113	103	3.300	sand, mud, silt, clay, humus	Archean Mixed rocks
11	18-09-2001	Sand Bolete	46 km SW of Edzo	11	N/A	62.420905	116.490047	113	113	106	0.100	sand, mud, silt, clay, humus	Archean Mixed rocks
12	18-09-2001	Sand Bolete	46 km SW of Edzo	**12**	N/A	62.420688	116.489129	113	113	106	0.150	sand, mud, silt, clay, humus	Archean Mixed rocks
13	18-09-2001	White Matsutake	46 km SW of Edzo	**13**	N/A	62.421903	116.490030	113	113	106	0.100	sand, mud, silt, clay, humus	Archean Mixed rocks
14	20-09-1998	Red-capped Bolete	43 km SW of Edzo	14	N/A	62.481197	116.603700	110	110	113	6.000	sand, mud, silt, clay, humus	Archean Mixed rocks
15	20-09-1998	Sand Bolete	43 km SW of Edzo	15	N/A	62.481201	116.605086	110	110	113	6.000	sand, mud, silt, clay, humus	Archean Mixed rocks
16	18-09-2001	Sand Bolete	17 km SW of Edzo	16	16 (1,2,4)	62.638999	116.257446	95	95	95	0.015	sand, mud, silt, clay, humus	Archean Mixed rocks
17	18-09-2001	Hooded False Morel	2 km SW of Edzo	17	17 (1,2)	62.769613	116.067084	90	90	90	0.650	sand, mud, silt, clay, humus	Archean Granitoid rocks
18	18-09-2001	Yellow Bolete	40 km W of YK	18	N/A	62.560954	115.046776	40	40	40	0.020	sand, mud, silt, clay, humus	Archean Granitoid rocks
19	17-09-1998	Hollow-stem Bolete	YK Golf Course	19	N/A	62.473476	114.475478	0	6.5	6.5	0.050	sand, mud, silt, clay, humus	Archean Granitoid rocks
20	17-09-1998	Puffball	YK Golf Course	20	N/A	62.473460	114.477029	0	6.5	6.5	0.050	sand, mud, silt, clay, humus	Archean Granitoid rocks
21	01-09-1998	Red-capped Bolete	YK Golf Course	21	N/A	62.473980	114.478801	0	6.5	6.5	0.100	sand, mud, silt, clay, humus	Archean Granitoid rocks
22	17-09-1998	Sand Bolete	YK Golf Course	22	N/A	62.473672	114.473935	0	6.5	6.5	0.050	sand, mud, silt, clay, humus	Archean Granitoid rocks
23	17-09-1998	White Matsutake	YK Golf Course	**23**	N/A	62.473688	114.472384	0	6.5	6.5	0.050	sand, mud, silt, clay, humus	Archean Granitoid rocks
24	29-09-1997	White Matsutake	YK Golf Course	**23**	N/A	62.473884	114.470841	0	6.5	6.5	0.050	sand, mud, silt, clay, humus	Archean Granitoid rocks
25	29-09-1997	White Matsutake	YK Golf Course	**23**	N/A	62.473884	114.470841	0	6.5	6.5	0.050	sand, mud, silt, clay, humus	Archean Granitoid rocks
26	28-08-2001	Meadow Mushroom	YK Sewage Road	26	N/A	62.449202	114.497744	0	9.2	7.8	0.000	road fill, sand, mud, humus	Archean Granitoid rocks
27	28-08-2001	Meadow Mushroom	YK Sewage Road	**27**	N/A	62.443976	114.448830	0	8	5.5	0.150	road fill, sand, mud, humus	Archean Granitoid rocks
28	28-08-2001	Meadow Mushroom	YK Sewage Road	**27**	N/A	62.443959	114.450380	0	8	5.5	0.150	road fill, sand, mud, humus	Archean Granitoid rocks
29	28-08-2001	Shaggy Mane	YK Sewage Road	29	N/A	62.443992	114.447280	0	8	5.5	0.150	road fill, sand, mud, humus	Archean Granitoid rocks
30	28-08-2001	Meadow Mushroom	YK Sewage Road	30	N/A	62.436927	114.436476	0	8	4.5	0.000	road fill, sand, mud, humus	Archean Granitoid rocks
31	14-09-2001	Red-capped Bolete	YK Frame Lake	**31**	N/A	62.447612	114.390849	0	5	2.8	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
32	14-09-2001	Red-capped Bolete	YK Frame Lake	**31**	N/A	62.447623	114.389687	0	5	2.8	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
33	14-09-2001	Red-capped Bolete	YK Frame Lake	**31**	N/A	62.447169	114.390247	0	5	2.8	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
34	14-09-2001	Fly Agaric	YK Frame Lake	34	N/A	62.448691	114.390512	0	5	2.8	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
35	14-09-2001	Birch Bolete	YK Frame Lake	**37**	N/A	62.448041	114.392808	0	5	2.8	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks

(Table A. continued on next page)

(Table A. continued)

purple = samples in Obst *et al*. 2001	blue = known unspoiled background area	Surficial Sediments at Sampling Locations of Fungi, Soil and Wood:
yellow = backup samples 1997 - 1999	green = assumed undisturbed background area	
bold **ID #s** = shared soil from same spot	orange = known impacted core study area	

Fungi ID #	Collection Date (D/M/Y)	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Soil ID #	Wood ID # (Table 2)	Latitude North	Longitude West	Distances in km from: YK City	Giant Mine	Other Mine	Hwy Road	Pleistocene and Recent; including Organic Material and Anthropogenic Fill	General Regional Bedrock Geology
36	14-09-2001	Birch Bolete	YK Frame Lake	**37**	N/A	62.448497	114.392053	0	5	2.8	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
37	14-09-2001	Birch Bolete	YK Frame Lake	**37**	N/A	62.449763	114.390949	0	5	2.9	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
38	14-09-2001	Birch Bolete	YK Frame Lake	**37**	N/A	62.450132	114.389997	0	5	2.9	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
39	14-09-2001	Fly Agaric	YK Frame Lake	39	N/A	62.450500	114.389044	0	5	2.9	0.150	anthropogenic fill, sand, silt	Archean Volcanic rocks
40	14-09-2001	Meadow Mushroom	YK Con Mine	**40**	N/A	62.442288	114.366763	0	6.5	0.5	0.020	tailings spill, sand, mud, silt	Archean Volcanic rocks
41	14-09-2001	Meadow Mushroom	YK Con Mine	**40**	N/A	62.442297	114.365794	0	6.5	0.5	0.020	tailings spill, sand, mud, silt	Archean Volcanic rocks
42	14-09-2001	Birch Bolete	YK Con Mine	42	N/A	62.442129	114.364624	0	6.5	0.5	0.020	tailings spill, sand, mud, silt	Archean Volcanic rocks
43	19-09-1998	Meadow Mushroom	YK Old Town	43	N/A	62.460482	114.358864	0	4.7	2.5	0.040	meadow over old landfill	Archean Volcanic rocks
44	19-09-1998	Puffball	YK Old Town	44	N/A	62.460852	114.357717	0	4.7	2.5	0.040	meadow over old landfill	Archean Volcanic rocks
45	17-09-1998	Birch Bolete	YK Jolliffe Island	**45**	N/A	62.463142	114.343469	0	4.5	3	0.300	impacted silt, clay, humus	Archean Volcanic rocks
46	30-08-2002	Fly Agaric	YK Jolliffe Island	**45**	N/A	62.462970	114.342685	0	4.5	3	0.300	impacted silt, clay, humus	Archean Volcanic rocks
47	17-09-1998	Puffball	YK Jolliffe Island	47	N/A	62.463885	114.340786	0	4.5	3	0.400	impacted silt, clay, humus	Archean Volcanic rocks
48	17-09-1998	Red-capped Bolete	YK Jolliffe Island	48	N/A	62.463171	114.340367	0	4.5	3	0.400	impacted silt, clay, humus	Archean Volcanic rocks
49	17-09-1998	Shaggy Mane	YK Giant Mine	**49**	N/A	62.484837	114.363073	0	2	2	0.030	road side fill, some humus	Archean Volcanic rocks
50	24-09-1997	Shaggy Mane	YK Giant Mine	**49**	N/A	62.484938	114.361913	0	2	2	0.030	road side fill, some humus	Archean Volcanic rocks
51	26-08-2001	Meadow Mushroom	YK Giant Mine	51	N/A	62.489652	114.366009	0	0.5	0.5	0.040	road side fill, some humus	Archean Volcanic rocks
52	17-09-1998	Shaggy Mane	YK Giant/Vee L.	52	N/A	62.510894	114.358236	0	1	1	0.070	road side fill, some humus	Archean Volcanic rocks
53	17-09-1998	Birch Bolete	YK Vee Lake Rd.	53	N/A	62.523877	114.360573	0	2.5	2.5	1.200	road side fill, some humus	Archean Volcanic rocks
54	17-09-1998	Hollow-stem Bolete	YK River Park	54	N/A	62.517040	114.315574	0	2.5	2.5	0.100	road side fill, some humus	Archean Sedimentary rocks
55	17-09-1998	Spring Agaricus	YK River Park	55	N/A	62.516676	114.316141	0	2.5	2.5	0.100	road side fill, some humus	Archean Sedimentary rocks
56	17-09-1998	Shaggy Mane	Yk Treminco Mine	**56**	N/A	62.501377	114.253133	5.5	5.5	3.4	0.030	road side fill, some humus	Archean Sedimentary rocks
57	29-09-1997	Shaggy Mane	Yk Treminco Mine	**56**	N/A	62.501301	114.251577	5.5	5.5	3.4	0.030	road side fill, some humus	Archean Sedimentary rocks
58	29-09-1997	Shaggy Mane	Yk Treminco Mine	**56**	N/A	62.501301	114.251577	5.5	5.5	3.4	0.030	road side fill, some humus	Archean Sedimentary rocks
59	18-09-1998	Shaggy Mane	Yk Treminco Mine	59	N/A	62.513997	114.215195	7.2	7.2	1	0.005	road side fill, some humus	Archean Sedimentary rocks
60	18-09-1998	Forest Mushroom	Yk Treminco Mine	60	N/A	62.515257	114.214663	7.2	7.2	0.9	0.100	road side fill, some humus	Archean Sedimentary rocks
61	18-09-1998	Tippler's Bane	Yk Treminco Mine	61	N/A	62.516871	114.214729	7.2	7.2	0.8	0.150	tailings, sand, silt, clay	Archean Sedimentary rocks
62	17-09-1998	Red-capped Bolete	Prelude Lake Trail	62	N/A	62.565657	113.987733	20	20	13	1.500	sand, silt, clay, humus	Archean Granitoid rocks
63	17-09-1998	Sand Bolete	Prelude Lake Trail	63	N/A	62.566061	113.988856	20	20	13	1.500	sand, silt, clay, humus	Archean Granitoid rocks
64	17-09-1998	White Matsutake	Prelude Lake Trail	64	N/A	62.566675	113.990154	20	20	13	1.500	sand, silt, clay, humus	Archean Granitoid rocks
65	24-08-2001	Sand Bolete	Cameron Fall Trail	65	N/A	62.518844	113.690988	33	33	26	2.000	sand, silt, clay, humus	Archean Granitoid rocks
66	24-08-2001	Slippery Jack	Cameron Fall Trail	66	N/A	62.518827	113.691377	33	33	26	2.000	sand, silt, clay, humus	Archean Granitoid rocks
67	24-08-2001	Birch Bolete	Cameron Fall Trail	67	N/A	62.518882	113.691881	33	33	26	2.000	sand, silt, clay, humus	Archean Granitoid rocks
68	17-09-1998	White Matsutake	Ingraham Trail	N/A	N/A	62.508580	113.683292	35	35	28	0.010	sand, silt, clay, humus	Archean Sedimentary rocks
69	01-09-1998	Red-capped Bolete	Cameron River Pk.	69	N/A	62.493048	113.549018	42	42	35	0.100	sand, silt, clay, humus	Archean Sedimentary rocks
70	06-10-2001	White Matsutake	Ingraham/C. Antler	N/A	N/A	62.492271	113.520552	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks

(Table A. continued on next page)

(Table A. continued)

purple = samples in Obst *et al*. 2001
yellow = backup samples 1997 - 1999
bold **ID #s** = shared soil from same spot
blue = known unspoiled background area
green = assumed undisturbed background area
orange = known impacted core study area

Fungi ID #	Collection Date (D/M/Y)	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Soil ID #	Wood ID # (Table 2)	Latitude North	Longitude West	Distances in km from: YK City	Giant Mine	Other Mine	Hwy Road	Surficial Sediments at Sampling Locations of Fungi, Soil and Wood: Pleistocene and Recent; including Organic Material and Anthropogenic Fill	General Regional Bedrock Geology
71	17-09-1998	Birch Bolete	Ingraham/C. Antler	**71**	N/A	62.490493	113.509872	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
72	17-09-1998	Larch Bolete	Ingraham/C. Antler	**72**	N/A	62.490491	113.509291	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
73	17-09-1998	Red-capped Bolete	Ingraham/C. Antler	**73**	N/A	62.490186	113.509257	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
74	07-09-1998	Red-capped Bolete	Ingraham/C. Antler	**71-73,77**	N/A	62.492128	113.515627	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
75	07-09-1998	Sand Bolete	Ingraham/C. Antler	**71-73,77**	N/A	62.492036	113.514891	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
76	07-09-1998	Sarcodon	Ingraham/C. Antler	**71-73,77**	N/A	62.491890	113.514234	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
77	17-09-1998	White Matsutake	Ingraham/C. Antler	**77**	N/A	62.490536	113.511928	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
78	01-10-1997	White Matsutake	Ingraham/C. Antler	**71-73,77**	N/A	62.490358	113.512319	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
79	01-09-1998	White Matsutake	Ingraham/C. Antler	N/A	N/A	62.490355	113.511349	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
80	01-09-1998	White Matsutake	Ingraham/C. Antler	N/A	N/A	62.490406	113.510650	47	47	40	0.050	sand, silt, clay, humus	Archean Sedimentary rocks
81	13-09-2001	Hooded False Morel	Ingraham/Tibbitt L.	81	81 (1,2)	62.505389	113.403817	49	49	42	0.250	sand, silt, clay, forest fire site	Archean Sedimentary rocks
82	13-09-2001	Birch Bolete	Ingraham/Tibbitt L.	**82**	82 (1-3)	62.509127	113.409371	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
83	13-09-2001	Birch Bolete	Ingraham/Tibbitt L.	**82**	N/A	62.509124	113.408672	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
84	13-09-2001	Hooded False Morel	Ingraham/Tibbitt L.	84	84 (1,2)	62.509801	113.407378	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
85	13-09-2001	Hooded False Morel	Ingraham/Tibbitt L.	85	85 (1,2)	62.507285	113.406690	49	49	42	0.500	sand, silt, clay, forest fire site	Archean Sedimentary rocks
86	13-09-2001	Hooded False Morel	Ingraham/Tibbitt L.	86	86 (1,2)	62.511549	113.409168	49	49	42	1.000	sand, silt, clay, forest fire site	Archean Sedimentary rocks
87	12-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.509800	113.407380	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
88	12-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.509800	113.407380	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
89	12-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.509800	113.407380	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
90	12-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.509800	113.407380	49	49	42	0.750	sand, silt, clay, forest fire site	Archean Sedimentary rocks
91	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520309	113.384800	50	50	43	0.075	sand, silt, clay, forest fire site	Archean Sedimentary rocks
92	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520309	113.384800	50	50	43	0.075	sand, silt, clay, forest fire site	Archean Sedimentary rocks
93	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520736	113.384053	50	50	43	0.075	sand, silt, clay, forest fire site	Archean Sedimentary rocks
94	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520736	113.384053	50	50	43	0.075	sand, silt, clay, forest fire site	Archean Sedimentary rocks
95	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520736	113.384053	50	50	43	0.075	sand, silt, clay, forest fire site	Archean Sedimentary rocks
96	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520904	113.385487	50	50	43	0.125	sand, silt, clay, forest fire site	Archean Sedimentary rocks
97	02-06-1999	Burn-site Morel	Ingraham/Tibbitt L.	N/A	N/A	62.520904	113.385487	50	50	43	0.125	sand, silt, clay, forest fire site	Archean Sedimentary rocks
98	18-09-1998	Sand Bolete	Tibbitt Lake	98	N/A	62.550890	113.368930	52	52	45	1.000	sand, silt, clay, humus	Archean Sedimentary rocks
99	18-09-1998	Suillus	Tibbitt Lake	99	N/A	62.551049	113.368344	52	52	45	1.000	sand, silt, clay, humus	Archean Sedimentary rocks
100	18-09-1998	Yellow Bolete	Tibbitt Lake	100	N/A	62.551494	113.367634	52	52	45	1.000	sand, silt, clay, humus	Archean Sedimentary rocks
101	18-09-1998	White Matsutake	Tibbitt Lake	101	N/A	62.552041	113.361636	52	52	45	0.900	sand, silt, clay, humus	Archean Sedimentary rocks
102	10-09-2001	Fly Agaric	Tundra Jolly Lake	**102**	N/A	64.267391	111.922108	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks
103	10-09-2001	Fly Agaric	Tundra Jolly Lake	**102**	N/A	64.267728	111.927069	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks
104	10-09-2001	Red-capped Bolete	Tundra Jolly Lake	104	N/A	64.267728	111.933682	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks
105	10-09-2001	Birch Bolete	Tundra Jolly Lake	105	N/A	64.266380	111.939469	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks

(Table A. continued on next page)

(Table A. continued)

bold **ID #s** = shared soil from same spot; blue = known unspoiled background area

Fungi ID #	Collection Date (D/M/Y)	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Soil ID #	Wood ID # (Table 2)	Latitude North	Longitude West	Distances in km from: YK City	Giant Mine	Other Mine	Hwy Road	Surficial Sediments at Sampling Locations including Organic Material and Anthropogenic Fill	General Regional Bedrock Geology
106	10-09-2001	Birch Bolete	Tundra Jolly Lake	106	N/A	64.265032	111.935336	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks
107	10-09-2001	Birch Bolete	Tundra Jolly Lake	**107**	N/A	64.265369	111.928722	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks
108	10-09-2001	Birch Bolete	Tundra Jolly Lake	**107**	N/A	64.265369	111.923762	240	240	233	240.000	sand on Esker, some humus	Archean Metamorphic rocks
109	22-08-2002	Birch Bolete	Tundra Daring L.	109	N/A	64.866663	111.596427	300	300	293	300.000	sand on Esker, some humus	Archean Granitoid rocks
110	22-08-2002	Birch Bolete	Tundra Daring L.	110	N/A	64.866297	111.598107	300	300	293	300.000	sand on Esker, some humus	Archean Granitoid rocks
111	22-08-2002	Birch Bolete	Tundra Daring L.	111	N/A	64.865932	111.599787	300	300	293	300.000	sand on Esker, some humus	Archean Granitoid rocks
112	22-06-2008	Burn-site Morel	Drybones Bay	N/A	N/A	62.085440	113.473280	50	50	50	50.000	sand, silt, clay, forest fire site	Archean Granitoid rocks
113	22-06-2008	Burn-site Morel	Drybones Bay	N/A	N/A	62.085440	113.473280	50	50	50	50.000	sand, silt, clay, forest fire site	Archean Granitoid rocks
114	22-06-2008	Burn-site Morel	Drybones Bay	N/A	N/A	62.085440	113.473280	50	50	50	50.000	sand, silt, clay, forest fire site	Archean Granitoid rocks
115	20-06-2009	Burn-site Morel	NW of YK/SE of Wha	N/A	N/A	63.000000	112.000000	100	100	100	100.000	sand, silt, clay, forest fire site	Archean Mixed rocks
116	20-06-2009	Burn-site Morel	NW of YK/SE of Wha	N/A	N/A	63.000000	112.000000	100	100	100	100.000	sand, silt, clay, forest fire site	Archean Mixed rocks
117	20-06-2009	Burn-site Morel	NW of YK/SE of Wha	N/A	N/A	63.000000	112.000000	100	100	100	100.000	sand, silt, clay, forest fire site	Archean Mixed rocks
118	20-06-2009	Burn-site Morel	NW of YK/SE of Wha	N/A	N/A	63.000000	112.000000	100	100	100	100.000	sand, silt, clay, forest fire site	Archean Mixed rocks
119	20-06-2009	Burn-site Morel	50 km SW of Edzo	N/A	N/A	62.390000	116.350000	120	120	130	1.000	sand, silt, clay, forest fire site	Archean Mixed rocks
120	20-06-2009	Burn-site Morel	50 km SW of Edzo	N/A	N/A	62.390000	116.350000	120	120	130	1.000	sand, silt, clay, forest fire site	Archean Mixed rocks
121	20-06-2009	Burn-site Morel	50 km SW of Edzo	N/A	N/A	62.390000	116.350000	120	120	130	1.000	sand, silt, clay, forest fire site	Archean Mixed rocks
122	20-06-2009	Burn-site Morel	50 km SW of Edzo	N/A	N/A	62.390000	116.350000	120	120	130	1.000	sand, silt, clay, forest fire site	Archean Mixed rocks
123	20-06-2009	Burn-site Morel	50 km SW of Edzo	N/A	N/A	62.390000	116.350000	120	120	130	1.000	sand, silt, clay, forest fire site	Archean Mixed rocks
124	20-06-2009	Burn-site Morel	50 km SW of Edzo	N/A	N/A	62.390000	116.350000	120	120	130	1.000	sand, silt, clay, forest fire site	Archean Mixed rocks
			Samples from other regions and imports										
125	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	115 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
126	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	116 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
127	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	117 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
128	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	118 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
129	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	119 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
130	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	120 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
131	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	121 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
132	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	122 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
133	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	123 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
134	30-06-2002	Morel Mushroom	Alaska / Fairbanks	N/A	124 (1)	28 km SW	of Fairbanks	28	N/A	N/A	11.300	forest fire site	
135	01-10-2002	Oyster Mushroom	BC import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	farm soil/substrate	
136	01-10-2002	Wood Ear	BC import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	farm soil/substrate	
137	01-10-2002	Wood Ear	BC import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	farm soil/substrate	
138	01-10-2002	Morel Mushroom	BC / US import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	forest fire site	
139	01-10-2002	Morel Mushroom	BC / US import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	forest fire site	
140	01-10-2002	Chinese Shiitake	Hongkong import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	farm soil/substrate	
141	01-10-2002	Chinese Shiitake	Hongkong import	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	farm soil/substrate	

Table A1. Concentrations of Arsenic in Soil, Wood, Fungi, Bedrock and Till in the North Slave Region, Northwest Territories, 1997 - 2009.

purple = samples in Obst *et al*. 2001 | blue = known unspoiled background area | **Arsenic in rocks from Giant Mine** | **Arsenic over Bedrock**

yellow = backup samples 1997 - 1999 | olive green = assumed undisturbed background area | green = intermediate to mafic volcanics in the Yellowknife greenstone belt

bold **ID #s** = shared soil from same spot | orange = known impacted core study area | (source: van Hees *et al*. 2006) | (source: Kerr 2006)

bold data = elevated levels | blank fields = no data

Fungi ID #	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Total Arsenic (ppm) dry weight Soil	Wood	Fungi	General Regional Bedrock Geology	Least-altered rocks As (ppm)	Most-altered rocks As (ppm)	Most-altered rocks/gold ore As (ppm)	regional till As (ppm)	till & re-worked till As (ppm)	soil, silt & clay As (ppm)
1	Burn-site Morel	100 km S of Edzo	N/A		0.4	Archean Mixed rocks						
2	Burn-site Morel	100 km S of Edzo	N/A		0.6	Archean Mixed rocks						
3	Burn-site Morel	100 km S of Edzo	N/A		0.4	Archean Mixed rocks						
4	Burn-site Morel	100 km S of Edzo	N/A		0.5	Archean Mixed rocks						
5	Burn-site Morel	100 km S of Edzo	N/A		0.7	Archean Mixed rocks						
6	Burn-site Morel	100 km S of Edzo	N/A		0.6	Archean Mixed rocks						
7	Burn-site Morel	100 km S of Edzo	N/A		1.2	Archean Mixed rocks						
8	Sand Bolete	46 km SW of Edzo	1.7		0.6	Archean Mixed rocks						
9	Sand Bolete	46 km SW of Edzo	1.5		0.8	Archean Mixed rocks						
10	White Matsutake	46 km SW of Edzo	1.3		**30.8**	Archean Mixed rocks						
11	Sand Bolete	46 km SW of Edzo	0.9		< 0.5	Archean Mixed rocks						
12	Sand Bolete	46 km SW of Edzo	0.5		< 0.5	Archean Mixed rocks						
13	White Matsutake	46 km SW of Edzo			**101.0**	Archean Mixed rocks						
14	Red-capped Bolete	43 km SW of Edzo	1.2		< 0.2	Archean Mixed rocks						
15	Sand Bolete	43 km SW of Edzo	0.8		< 0.2	Archean Mixed rocks						
16	Sand Bolete	17 km SW of Edzo	2.4	< 0.5 to 1.3	< 0.5	Archean Mixed rocks						
17	Hooded False Morel	2 km SW of Edzo	1.6	< 0.5 to 0.5	< 0.5	Archean Granitoid rocks				0 to 1		
18	Yellow Bolete	40 km W of YK	**16.5**		1.7	Archean Granitoid rocks				0 to 1		
19	Hollow-stem Bolete	YK Golf Course	**12.4**		**19.9**	Archean Granitoid rocks				0 to 1		
20	Puffball	YK Golf Course	**30.7**		**135.0**	Archean Granitoid rocks				0 to 1		
21	Red-capped Bolete	YK Golf Course	**9.9**		5.7	Archean Granitoid rocks				0 to 1		
22	Sand Bolete	YK Golf Course	**86.9**		1.0	Archean Granitoid rocks				0 to 1		
23	White Matsutake	YK Golf Course	**68.5**		**280.0**	Archean Granitoid rocks				0 to 1		
24	White Matsutake	YK Golf Course			**340.0**	Archean Granitoid rocks				0 to 1		
25	White Matsutake	YK Golf Course			**1370.0**	Archean Granitoid rocks				0 to 1		
26	Meadow Mushroom	YK Sewage Road	**21.0**		**97.2**	Archean Granitoid rocks				0 to 1		
27	Meadow Mushroom	YK Sewage Road	**17.4**		**47.1**	Archean Granitoid rocks				0 to 1		
28	Meadow Mushroom	YK Sewage Road			**58.2**	Archean Granitoid rocks				0 to 1		
29	Shaggy Mane	YK Sewage Road	**44.5**		**44.0**	Archean Granitoid rocks				0 to 1		
30	Meadow Mushroom	YK Sewage Road	**16.4**		**286.0**	Archean Granitoid rocks				0 to 1		

(Table A1. continued on next page)

(Table A1. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area				**Arsenic in rocks from Giant Mine**			**Arsenic over Bedrock**		
yellow = backup samples 1997 - 1999			olive green = assumed undisturbed background area				green = intermediate to mafic volcanics in the Yellowknife greenstone belt					
bold **ID #s** = shared soil from same spot			orange = known impacted core study area				(source: van Hees *et al*. 2006)			(source: Kerr 2006)		
			bold data = elevated levels			blank fields = no data						
Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**Total Arsenic** (ppm) dry weight **Soil**	**Wood**	**Fungi**	**General Regional Bedrock Geology**	Least-altered rocks **As** (ppm)	Most-altered rocks **As** (ppm)	Most-altered rocks/gold ore **As** (ppm)	regional till **As** (ppm)	till & re-worked till **As** (ppm)	soil, silt & clay **As** (ppm)
31	Red-capped Bolete	YK Frame Lake	**11.9**		2.0	Archean Volcanic rocks				10 to 30		5 to 1560
32	Red-capped Bolete	YK Frame Lake			1.9	Archean Volcanic rocks				10 to 30		5 to 1560
33	Red-capped Bolete	YK Frame Lake			1.4	Archean Volcanic rocks				10 to 30		5 to 1560
34	Fly Agaric	YK Frame Lake	**7310.0**		**17.2**	Archean Volcanic rocks				10 to 30		5 to 1560
35	Birch Bolete	YK Frame Lake			**14.3**	Archean Volcanic rocks				10 to 30		5 to 1560
36	Birch Bolete	YK Frame Lake			**13.7**	Archean Volcanic rocks				10 to 30		5 to 1560
37	Birch Bolete	YK Frame Lake	**40.6**		4.9	Archean Volcanic rocks				10 to 30		5 to 1560
38	Birch Bolete	YK Frame Lake			5.0	Archean Volcanic rocks				10 to 30		5 to 1560
39	Fly Agaric	YK Frame Lake	**49.4**		8.3	Archean Volcanic rocks				10 to 30		5 to 1560
40	Meadow Mushroom	YK Con Mine	**2460.0**		**38.2**	Archean Volcanic rocks				10 to 30	813	5 to 1560
41	Meadow Mushroom	YK Con Mine			**37.5**	Archean Volcanic rocks				10 to 30	813	5 to 1560
42	Birch Bolete	YK Con Mine	**1430.0**		**10.2**	Archean Volcanic rocks				10 to 30	813	5 to 1560
43	Meadow Mushroom	YK Old Town	**14.0**		2.3	Archean Volcanic rocks				10 to 30		5 to 1560
44	Puffball	YK Old Town	**29.3**		1.8	Archean Volcanic rocks				10 to 30		5 to 1560
45	Birch Bolete	YK Jolliffe Island	**106.0**		5.6	Archean Volcanic rocks				10 to 30		5 to 1560
46	Fly Agaric	YK Jolliffe Island			3.8	Archean Volcanic rocks				10 to 30		5 to 1560
47	Puffball	YK Jolliffe Island	**123.0**		**90.7**	Archean Volcanic rocks				10 to 30		5 to 1560
48	Red-capped Bolete	YK Jolliffe Island	**81.1**		1.8	Archean Volcanic rocks				10 to 30		5 to 1560
49	Shaggy Mane	YK Giant Mine	**1730.0**		6.6	Archean Volcanic rocks	<2 to 6	52 to >10000	>10000	10 to 30		5 to 1560
50	Shaggy Mane	YK Giant Mine			**46.3**	Archean Volcanic rocks	<2 to 6	52 to >10000	>10000	10 to 30		5 to 1560
51	Meadow Mushroom	YK Giant Mine	**999.0**		**16.9**	Archean Volcanic rocks	<2 to 6	52 to >10000	>10000	10 to 30		5 to 1560
52	Shaggy Mane	YK Giant/Vee L.	**550.0**		4.8	Archean Volcanic rocks	<2 to 6	52 to >10000	>10000	10 to 30	320	5 to 1560
53	Birch Bolete	YK Vee Lake Rd.	**87.6**		7.8	Archean Volcanic rocks	<2 to 6	52 to >10000	>10000	10 to 30	320	5 to 1560
54	Hollow-stem Bolete	YK River Park	**14.7**		7.8	Archean Sedimentary rocks				5 to 10		
55	Spring Agaricus	YK River Park	**29.5**		1.4	Archean Sedimentary rocks				5 to 10		
56	Shaggy Mane	Yk Treminco Mine	**23.1**		4.9	Archean Sedimentary rocks				5 to 10	18 to 46	
57	Shaggy Mane	Yk Treminco Mine			**494.0**	Archean Sedimentary rocks				5 to 10	18 to 46	
58	Shaggy Mane	Yk Treminco Mine			**298.0**	Archean Sedimentary rocks				5 to 10	18 to 46	
59	Shaggy Mane	Yk Treminco Mine	**45.0**		3.6	Archean Sedimentary rocks				5 to 10	18 to 46	
60	Forest Mushroom	Yk Treminco Mine	**33.1**		5.0	Archean Sedimentary rocks				5 to 10	18 to 46	
61	Tippler's Bane	Yk Treminco Mine	**120.0**		**11.1**	Archean Sedimentary rocks				5 to 10	18 to 46	

(Table A1. continued on next page)

(Table A1. continued)

purple = samples in Obst *et al*. 2001	blue = known unspoiled background area	**Arsenic in rocks from Giant Mine**	**Arsenic over Bedrock**
yellow = backup samples 1997 - 1999	olive green = assumed undisturbed background area	green = intermediate to mafic volcanics in the Yellowknife greenstone belt	
bold **ID #s** = shared soil from same spot	orange = known impacted core study area	(source: van Hees *et al*. 2006)	(source: Kerr 2006)

Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**bold data** = elevated levels; **Total Arsenic** (ppm) dry weight: **Soil**	**Wood**	**Fungi**	blank fields = no data; **General Regional Bedrock Geology**	Least-altered rocks **As** (ppm)	Most-altered rocks **As** (ppm)	Most-altered rocks/gold ore **As** (ppm)	regional till **As** (ppm)	till & re-worked till **As** (ppm)	soil, silt & clay **As** (ppm)
62	Red-capped Bolete	Prelude Lake Trail	6.9		2.0	Archean Granitoid rocks				0 to 1		7 to 48
63	Sand Bolete	Prelude Lake Trail	**15.7**		4.1	Archean Granitoid rocks				0 to 1		7 to 48
64	White Matsutake	Prelude Lake Trail	4.1		**92.3**	Archean Granitoid rocks				0 to 1		7 to 48
65	Sand Bolete	Cameron Fall Trail	8.1		1.5	Archean Granitoid rocks				0 to 1		7 to 48
66	Slippery Jack	Cameron Fall Trail	**12.4**		1.5	Archean Granitoid rocks				0 to 1		7 to 48
67	Birch Bolete	Cameron Fall Trail	5.9		1.4	Archean Granitoid rocks				0 to 1		7 to 48
68	White Matsutake	Ingraham Trail	N/A		**28.1**	Archean Sedimentary rocks				5 to 10		
69	Red-capped Bolete	Cameron River Pk.	1.9		< 0.2	Archean Sedimentary rocks				5 to 10		
70	White Matsutake	Ingraham/C. Antler	N/A		**29.4**	Archean Sedimentary rocks				5 to 10		
71	Birch Bolete	Ingraham/C. Antler	0.9		< 0.2	Archean Sedimentary rocks				5 to 10		
72	Larch Bolete	Ingraham/C. Antler	2.2		4.6	Archean Sedimentary rocks				5 to 10		
73	Red-capped Bolete	Ingraham/C. Antler	1.9		1.7	Archean Sedimentary rocks				5 to 10		
74	Red-capped Bolete	Ingraham/C. Antler			< 0.2	Archean Sedimentary rocks				5 to 10		
75	Sand Bolete	Ingraham/C. Antler			2.4	Archean Sedimentary rocks				5 to 10		
76	Sarcodon	Ingraham/C. Antler			< 0.2	Archean Sedimentary rocks				5 to 10		
77	White Matsutake	Ingraham/C. Antler	2.5		**56.2**	Archean Sedimentary rocks				5 to 10		
78	White Matsutake	Ingraham/C. Antler			**29.8**	Archean Sedimentary rocks				5 to 10		
79	White Matsutake	Ingraham/C. Antler	N/A		**48.4**	Archean Sedimentary rocks				5 to 10		
80	White Matsutake	Ingraham/C. Antler	N/A		**11.0**	Archean Sedimentary rocks				5 to 10		
81	Hooded False Morel	Ingraham/Tibbitt L.	5.8	<0.5	< 0.5	Archean Sedimentary rocks				5 to 10		
82	Birch Bolete	Ingraham/Tibbitt L.	**11.5**	< 0.5 to 4.5	< 0.5	Archean Sedimentary rocks				5 to 10		
83	Birch Bolete	Ingraham/Tibbitt L.			< 0.5	Archean Sedimentary rocks				5 to 10		
84	Hooded False Morel	Ingraham/Tibbitt L.	7.2	<0.5	< 0.5	Archean Sedimentary rocks				5 to 10		
85	Hooded False Morel	Ingraham/Tibbitt L.	1.6	<0.5	< 0.5	Archean Sedimentary rocks				5 to 10		
86	Hooded False Morel	Ingraham/Tibbitt L.	4.1	0.5 to 1.2	< 0.5	Archean Sedimentary rocks				5 to 10		
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks				5 to 10		
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A		1.4	Archean Sedimentary rocks				5 to 10		
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.6	Archean Sedimentary rocks				5 to 10		
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A		2.3	Archean Sedimentary rocks				5 to 10		
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks				5 to 10		
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A		1.5	Archean Sedimentary rocks				5 to 10		

(Table A1. continued on next page)

(Table A1. continued)

purple = samples in Obst *et al*. 2001	blue = known unspoiled background area	Arsenic in rocks from Giant Mine	Arsenic over Bedrock
yellow = backup samples 1997 - 1999	olive green = assumed undisturbed background area	green = intermediate to mafic volcanics in the Yellowknife greenstone belt	
bold **ID #s** = shared soil from same spot	orange = known impacted core study area	(source: van Hees *et al*. 2006)	(source: Kerr 2006)

Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**bold data** = elevated levels **Total Arsenic** (ppm) dry weight **Soil**	**Wood**	**Fungi**	blank fields = no data **General Regional Bedrock Geology**	Least-altered rocks **As** (ppm)	Most-altered rocks **As** (ppm)	Most-altered rocks/gold ore **As** (ppm)	regional till **As** (ppm)	till & re-worked till **As** (ppm)	soil, silt & clay **As** (ppm)
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks				5 to 10		
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.6	Archean Sedimentary rocks				5 to 10		
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.5	Archean Sedimentary rocks				5 to 10		
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks				5 to 10		
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.6	Archean Sedimentary rocks				5 to 10		
98	Sand Bolete	Tibbitt Lake	0.8		< 0.2	Archean Sedimentary rocks				5 to 10		
99	Suillus	Tibbitt Lake	3.2		< 0.2	Archean Sedimentary rocks				5 to 10		
100	Yellow Bolete	Tibbitt Lake	2.7		< 0.2	Archean Sedimentary rocks				5 to 10		
101	White Matsutake	Tibbitt Lake	7.1		**53.1**	Archean Sedimentary rocks				5 to 10		
102	Fly Agaric	Tundra Jolly Lake	4.5		< 0.5	Archean Metamorphic rocks						
103	Fly Agaric	Tundra Jolly Lake			< 0.5	Archean Metamorphic rocks						
104	Red-capped Bolete	Tundra Jolly Lake	6.2		1.7	Archean Metamorphic rocks						
105	Birch Bolete	Tundra Jolly Lake	1.3		< 0.5	Archean Metamorphic rocks						
106	Birch Bolete	Tundra Jolly Lake	4.4		< 0.5	Archean Metamorphic rocks						
107	Birch Bolete	Tundra Jolly Lake	1.7		< 0.5	Archean Metamorphic rocks						
108	Birch Bolete	Tundra Jolly Lake			0.6	Archean Metamorphic rocks						
109	Birch Bolete	Tundra Daring L.	**11.6**		< 1.0	Archean Granitoid rocks						
110	Birch Bolete	Tundra Daring L.	3.2		**20.3**	Archean Granitoid rocks						
111	Birch Bolete	Tundra Daring L.	5.3		5.4	Archean Granitoid rocks						
112	Burn-site Morel	Drybones Bay	N/A		3.5	Archean Granitoid rocks				0 to 1		7 to 48
113	Burn-site Morel	Drybones Bay	N/A		1.6	Archean Granitoid rocks				0 to 1		7 to 48
114	Burn-site Morel	Drybones Bay	N/A		1.7	Archean Granitoid rocks				0 to 1		7 to 48
115	Burn-site Morel	NW of YK/SE of What	N/A		1.1	Archean Mixed rocks						
116	Burn-site Morel	NW of YK/SE of What	N/A		1.1	Archean Mixed rocks						
117	Burn-site Morel	NW of YK/SE of What	N/A		0.8	Archean Mixed rocks						
118	Burn-site Morel	NW of YK/SE of What	N/A		0.9	Archean Mixed rocks						
119	Burn-site Morel	50 km SW of Edzo	N/A		1.7	Archean Mixed rocks						
120	Burn-site Morel	50 km SW of Edzo	N/A		0.9	Archean Mixed rocks						
121	Burn-site Morel	50 km SW of Edzo	N/A		1.4	Archean Mixed rocks						
122	Burn-site Morel	50 km SW of Edzo	N/A		0.6	Archean Mixed rocks						
123	Burn-site Morel	50 km SW of Edzo	N/A		1.3	Archean Mixed rocks						
124	Burn-site Morel	50 km SW of Edzo	N/A		1.2	Archean Mixed rocks						

Table A2. Concentrations of Lead in Soil, Wood and Fungi, and Bedrock Geology in the North Slave Region, Northwest Territories, 1997 - 2009.

purple = samples in Obst *et al*. 2001	blue = known unspoiled background area
yellow = backup samples 1997 - 1999	olive green = assumed undisturbed background area
bold **ID #s** = shared soil from same spot	orange = known impacted core study area
	bold data = elevated levels; blank fields = no data

Fungi ID #	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Total Lead (ppm) dry weight: Soil	Wood	Fungi	Bedrock Geology (Archean rocks)
1	Burn-site Morel	100 km S of Edzo	N/A		< 0.1	Mixed rocks
2	Burn-site Morel	100 km S of Edzo	N/A		0.1	Mixed rocks
3	Burn-site Morel	100 km S of Edzo	N/A		0.3	Mixed rocks
4	Burn-site Morel	100 km S of Edzo	N/A		0.2	Mixed rocks
5	Burn-site Morel	100 km S of Edzo	N/A		0.1	Mixed rocks
6	Burn-site Morel	100 km S of Edzo	N/A		0.1	Mixed rocks
7	Burn-site Morel	100 km S of Edzo	N/A		0.2	Mixed rocks
8	Sand Bolete	46 km SW of Edzo	3.0		< 0.1	Mixed rocks
9	Sand Bolete	46 km SW of Edzo	3.0		< 0.1	Mixed rocks
10	White Matsutake	46 km SW of Edzo	3.0		< 0.1	Mixed rocks
11	Sand Bolete	46 km SW of Edzo	3.0		0.2	Mixed rocks
12	Sand Bolete	46 km SW of Edzo	2.0		< 0.1	Mixed rocks
13	White Matsutake	46 km SW of Edzo			< 0.1	Mixed rocks
14	Red-capped Bolete	43 km SW of Edzo	**11.3**		**22.2**	Mixed rocks
15	Sand Bolete	43 km SW of Edzo	**31.8**		5.2	Mixed rocks
16	Sand Bolete	17 km SW of Edzo	2.0	0.1 to 1.3	< 0.1	Mixed rocks
17	Hooded False Morel	2 km SW of Edzo	2.0	0.1 to 1.1	< 0.1	Granitoid rocks
18	Yellow Bolete	40 km W of YK	**10.0**		< 0.1	Granitoid rocks
19	Hollow-stem Bolete	YK Golf Course	**26.2**		**55.0**	Granitoid rocks
20	Puffball	YK Golf Course	3.2		**44.9**	Granitoid rocks
21	Red-capped Bolete	YK Golf Course	**12.2**		**46.0**	Granitoid rocks
22	Sand Bolete	YK Golf Course	7.6		**509.0**	Granitoid rocks
23	White Matsutake	YK Golf Course	4.7		**13.5**	Granitoid rocks
24	White Matsutake	YK Golf Course			**31.4**	Granitoid rocks
25	White Matsutake	YK Golf Course			0.2	Granitoid rocks
26	Meadow Mushroom	YK Sewage Road	5.0		< 0.1	Granitoid rocks
27	Meadow Mushroom	YK Sewage Road	5.0		0.3	Granitoid rocks
28	Meadow Mushroom	YK Sewage Road			0.5	Granitoid rocks
29	Shaggy Mane	YK Sewage Road	5.0		< 0.1	Granitoid rocks
30	Meadow Mushroom	YK Sewage Road	7.0		0.1	Granitoid rocks
31	Red-capped Bolete	YK Frame Lake	4.0		< 0.1	Volcanic rocks
32	Red-capped Bolete	YK Frame Lake			0.2	Volcanic rocks
33	Red-capped Bolete	YK Frame Lake			< 0.1	Volcanic rocks
34	Fly Agaric	YK Frame Lake	**24.0**		1.7	Volcanic rocks
35	Birch Bolete	YK Frame Lake			< 0.1	Volcanic rocks
36	Birch Bolete	YK Frame Lake			< 0.1	Volcanic rocks
37	Birch Bolete	YK Frame Lake	**13.0**		0.3	Volcanic rocks
38	Birch Bolete	YK Frame Lake			0.5	Volcanic rocks
39	Fly Agaric	YK Frame Lake	**30.0**		0.2	Volcanic rocks
40	Meadow Mushroom	YK Con Mine	**296.0**		0.6	Volcanic rocks
41	Meadow Mushroom	YK Con Mine			1.7	Volcanic rocks
42	Birch Bolete	YK Con Mine	**207.0**		1.1	Volcanic rocks
43	Meadow Mushroom	YK Old Town	**92.1**		**1010.0**	Volcanic rocks
44	Puffball	YK Old Town	**16.3**		**26.8**	Volcanic rocks
45	Birch Bolete	YK Jolliffe Island	**126.0**		**67.0**	Volcanic rocks
46	Fly Agaric	YK Jolliffe Island			0.6	Volcanic rocks
47	Puffball	YK Jolliffe Island	**33.1**		**145.0**	Volcanic rocks
48	Red-capped Bolete	YK Jolliffe Island	**15.9**		**20.6**	Volcanic rocks

(Table A2. continued on next page)

(Table A2. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area				**Lead in rocks from Giant Mine**		
yellow = backup samples 1997 - 1999			olive green = assumed undisturbed background area				green = intermediate/mafic volcanics		
bold **ID #s** = shared soil from same spot			orange = known impacted core study area				(source: van Hees *et al*. 2006)		
Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**bold data** = elevated levels; blank fields = no data **Total Lead** (ppm) dry weight **Soil**	**Wood**	**Fungi**	**Bedrock Geology** (Archean rocks)	Least-altered rocks **Pb** (ppm)	Most-altered rocks **Pb** (ppm)	Most-altered rocks/gold ore **Pb** (ppm)
49	Shaggy Mane	YK Giant Mine	**62.4**		**71.3**	Volcanic rocks	<2 to 6	<2 to 494	302 to 354
50	Shaggy Mane	YK Giant Mine			**22.3**	Volcanic rocks	<2 to 6	<2 to 494	302 to 354
51	Meadow Mushroom	YK Giant Mine	**63.0**		0.8	Volcanic rocks	<2 to 6	<2 to 494	302 to 354
52	Shaggy Mane	YK Giant/Vee L.	**27.9**		**23.5**	Volcanic rocks	<2 to 6	<2 to 494	302 to 354
53	Birch Bolete	YK Vee Lake Rd.	**217.0**		**26.4**	Volcanic rocks	<2 to 6	<2 to 494	302 to 354
54	Hollow-stem Bolete	YK River Park	**122.0**		**65.7**	Sedimentary rocks			
55	Spring Agaricus	YK River Park	**22.1**		**511.0**	Sedimentary rocks			
56	Shaggy Mane	Yk Treminco Mine	**17.5**		**24.2**	Sedimentary rocks			
57	Shaggy Mane	Yk Treminco Mine			**18.6**	Sedimentary rocks			
58	Shaggy Mane	Yk Treminco Mine			0.3	Sedimentary rocks			
59	Shaggy Mane	Yk Treminco Mine	**288.0**		**13.5**	Sedimentary rocks			
60	Forest Mushroom	Yk Treminco Mine	**39.8**		8.3	Sedimentary rocks			
61	Tippler's Bane	Yk Treminco Mine	**24.4**		5.6	Sedimentary rocks			
62	Red-capped Bolete	Prelude Lake Trail	**47.7**		**192.0**	Sedimentary rocks			
63	Sand Bolete	Prelude Lake Trail	**33.0**		**18.3**	Sedimentary rocks			
64	White Matsutake	Prelude Lake Trail	**35.0**		**72.4**	Sedimentary rocks			
65	Sand Bolete	Cameron Fall Trail	6.0		< 0.1	Sedimentary rocks			
66	Slippery Jack	Cameron Fall Trail	3.0		< 0.1	Sedimentary rocks			
67	Birch Bolete	Cameron Fall Trail	6.0		0.6	Sedimentary rocks			
68	White Matsutake	Ingraham Trail	N/A		**294.0**	Sedimentary rocks			
69	Red-capped Bolete	Cameron River Pk.	**21.1**		N/A	Sedimentary rocks			
70	White Matsutake	Ingraham/C. Antler	N/A		< 0.1	Sedimentary rocks			
71	Birch Bolete	Ingraham/C. Antler	7.8		**11.7**	Sedimentary rocks			
72	Larch Bolete	Ingraham/C. Antler	**10.6**		**27.7**	Sedimentary rocks			
73	Red-capped Bolete	Ingraham/C. Antler	**17.1**		**12.0**	Sedimentary rocks			
74	Red-capped Bolete	Ingraham/C. Antler			**110.0**	Sedimentary rocks			
75	Sand Bolete	Ingraham/C. Antler			**57.9**	Sedimentary rocks			
76	Sarcodon	Ingraham/C. Antler			**19.3**	Sedimentary rocks			
77	White Matsutake	Ingraham/C. Antler	**66.5**		**17.6**	Sedimentary rocks			
78	White Matsutake	Ingraham/C. Antler			**16.9**	Sedimentary rocks			
79	White Matsutake	Ingraham/C. Antler	N/A		< 0.1	Sedimentary rocks			
80	White Matsutake	Ingraham/C. Antler	N/A		0.1	Sedimentary rocks			
81	Hooded False Morel	Ingraham/Tibbitt L.	8.0	< 0.1 to 0.1	0.2	Sedimentary rocks			
82	Birch Bolete	Ingraham/Tibbitt L.	9.0	0.3 to 2.7	< 0.1	Sedimentary rocks			
83	Birch Bolete	Ingraham/Tibbitt L.			< 0.1	Sedimentary rocks			
84	Hooded False Morel	Ingraham/Tibbitt L.	**10.0**	0.2 to 0.5	< 0.1	Sedimentary rocks			
85	Hooded False Morel	Ingraham/Tibbitt L.	5.0	< 0.1 to 0.5	< 0.1	Sedimentary rocks			
86	Hooded False Morel	Ingraham/Tibbitt L.	**14.0**	0.2 to 0.9	< 0.1	Sedimentary rocks			
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**255.0**	Sedimentary rocks			
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**283.0**	Sedimentary rocks			
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.4	Sedimentary rocks			
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.5	Sedimentary rocks			
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**405.0**	Sedimentary rocks			
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**469.0**	Sedimentary rocks			
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**867.0**	Sedimentary rocks			
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.2	Sedimentary rocks			
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**993.0**	Sedimentary rocks			
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**50.5**	Sedimentary rocks			
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A		**55.2**	Sedimentary rocks			
98	Sand Bolete	Tibbitt Lake	**10.7**		7.2	Sedimentary rocks			

(Table A2. continued on next page)

(Table A2. continued)

purple = samples in Obst *et al*. 2001	blue = known unspoiled background area
yellow = backup samples 1997 - 1999	olive green = assumed undisturbed background area
bold **ID #s** = shared soil from same spot	orange = known impacted core study area
	bold data = elevated levels; blank fields = no data

Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**Total Lead** (ppm) dry weight **Soil**	**Wood**	**Fungi**	**Bedrock Geology** (Archean rocks)
99	Suillus	Tibbitt Lake	**12.7**		**23.0**	Sedimentary rocks
100	Yellow Bolete	Tibbitt Lake	8.7		**13.3**	Sedimentary rocks
101	White Matsutake	Tibbitt Lake	7.5		**35.1**	Sedimentary rocks
102	Fly Agaric	Tundra Jolly Lake	2.0		0.3	Metamorphic rocks
103	Fly Agaric	Tundra Jolly Lake			< 0.1	Metamorphic rocks
104	Red-capped Bolete	Tundra Jolly Lake	3.0		< 0.1	Metamorphic rocks
105	Birch Bolete	Tundra Jolly Lake	2.0		< 0.1	Metamorphic rocks
106	Birch Bolete	Tundra Jolly Lake	2.0		< 0.1	Metamorphic rocks
107	Birch Bolete	Tundra Jolly Lake	**14.0**		0.1	Metamorphic rocks
108	Birch Bolete	Tundra Jolly Lake			0.1	Metamorphic rocks
109	Birch Bolete	Tundra Daring L.	3.0		< 0.1	Granitoid rocks
110	Birch Bolete	Tundra Daring L.	2.0		0.1	Granitoid rocks
111	Birch Bolete	Tundra Daring L.	1.0		0.3	Granitoid rocks
112	Burn-site Morel	Drybones Bay	N/A		< 0.2	Granitoid rocks
113	Burn-site Morel	Drybones Bay	N/A		< 0.2	Granitoid rocks
114	Burn-site Morel	Drybones Bay	N/A		< 0.2	Granitoid rocks
115	Burn-site Morel	NW of YK/SE of Wha	N/A		0.5	Mixed rocks
116	Burn-site Morel	NW of YK/SE of Wha	N/A		0.2	Mixed rocks
117	Burn-site Morel	NW of YK/SE of Wha	N/A		0.2	Mixed rocks
118	Burn-site Morel	NW of YK/SE of Wha	N/A		< 0.1	Mixed rocks
119	Burn-site Morel	50 km SW of Edzo	N/A		0.1	Mixed rocks
120	Burn-site Morel	50 km SW of Edzo	N/A		0.1	Mixed rocks
121	Burn-site Morel	50 km SW of Edzo	N/A		0.1	Mixed rocks
122	Burn-site Morel	50 km SW of Edzo	N/A		0.2	Mixed rocks
123	Burn-site Morel	50 km SW of Edzo	N/A		0.3	Mixed rocks
124	Burn-site Morel	50 km SW of Edzo	N/A		0.1	Mixed rocks

Table A3. Concentrations of Arsenic in Bedrock, Till and at Sampling Locations of Mushrooms, Soil and Wood Samples in the North Slave Region, Northwest Territories, 1997 - 2009.

purple = samples in Obst *et al*. 2001			blue = known unspoiled area			blank fields = no data	Arsenic in Rocks from Giant Mine (van Hees *et al*. 2006) **As** (ppm)	Arsenic in regional & local (YK) till, silt, clay (Kerr 2006) **As** (ppm)	Arsenic in the Yellowknife greenstone belt area & around mines (Kerr 2006)			
yellow = backup samples 1997 - 1999			olive green = assumed undisturbed background area									
bold **ID #s** = shared soil from same spot			orange = known impacted core study area						**humus** **As** (ppm)	**leaf litter** **As** (ppm)	**spruce bark** **As** (ppm)	**labrador tea** **As** (ppm)
Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**bold data** = elevated levels **Total Arsenic** (ppm) **Soil**	**Wood**	**Fungi**	**Bedrock Geology** dark green = Yellowknife greenstone belt area						
1	Burn-site Morel	100 km S of Edzo	N/A		0.4	Archean Mixed rocks						
2	Burn-site Morel	100 km S of Edzo	N/A		0.6	Archean Mixed rocks						
3	Burn-site Morel	100 km S of Edzo	N/A		0.4	Archean Mixed rocks						
4	Burn-site Morel	100 km S of Edzo	N/A		0.5	Archean Mixed rocks						
5	Burn-site Morel	100 km S of Edzo	N/A		0.7	Archean Mixed rocks						
6	Burn-site Morel	100 km S of Edzo	N/A		0.6	Archean Mixed rocks						
7	Burn-site Morel	100 km S of Edzo	N/A		1.2	Archean Mixed rocks						
8	Sand Bolete	46 km SW of Edzo	1.7		0.6	Archean Mixed rocks						
9	Sand Bolete	46 km SW of Edzo	1.5		0.8	Archean Mixed rocks						
10	White Matsutake	46 km SW of Edzo	1.3		**30.8**	Archean Mixed rocks						
11	Sand Bolete	46 km SW of Edzo	0.9		< 0.5	Archean Mixed rocks						
12	Sand Bolete	46 km SW of Edzo	0.5		< 0.5	Archean Mixed rocks						
13	White Matsutake	46 km SW of Edzo			**101.0**	Archean Mixed rocks						
14	Red-capped Bolete	43 km SW of Edzo	1.2		< 0.2	Archean Mixed rocks						
15	Sand Bolete	43 km SW of Edzo	0.8		< 0.2	Archean Mixed rocks						
16	Sand Bolete	17 km SW of Edzo	2.4	< 0.5 to 1.3	< 0.5	Archean Mixed rocks						
17	Hooded False Morel	2 km SW of Edzo	1.6	< 0.5 to 0.5	< 0.5	Archean Granitoid rocks		0 to 1				
18	Yellow Bolete	40 km W of YK	**16.5**		1.7	Archean Granitoid rocks		0 to 1				
19	Hollow-stem Bolete	YK Golf Course	**12.4**		**19.9**	Archean Granitoid rocks		0 to 1				
20	Puffball	YK Golf Course	**30.7**		**135.0**	Archean Granitoid rocks		0 to 1				
21	Red-capped Bolete	YK Golf Course	**9.9**		5.7	Archean Granitoid rocks		0 to 1				
22	Sand Bolete	YK Golf Course	**86.9**		1.0	Archean Granitoid rocks		0 to 1				
23	White Matsutake	YK Golf Course	**68.5**		**280.0**	Archean Granitoid rocks		0 to 1				
24	White Matsutake	YK Golf Course			**340.0**	Archean Granitoid rocks		0 to 1				
25	White Matsutake	YK Golf Course			**1370.0**	Archean Granitoid rocks		0 to 1				
26	Meadow Mushroom	YK Sewage Road	**21.0**		**97.2**	Archean Granitoid rocks		0 to 1				
27	Meadow Mushroom	YK Sewage Road	**17.4**		**47.1**	Archean Granitoid rocks		0 to 1				
28	Meadow Mushroom	YK Sewage Road			**58.2**	Archean Granitoid rocks		0 to 1				
29	Shaggy Mane	YK Sewage Road	**44.5**		**44.0**	Archean Granitoid rocks		0 to 1				
30	Meadow Mushroom	YK Sewage Road	**16.4**		**286.0**	Archean Granitoid rocks		0 to 1				
31	Red-capped Bolete	YK Frame Lake	**11.9**		2.0	Archean Volcanic rocks		5 to 1560	3 to 1900			
32	Red-capped Bolete	YK Frame Lake			1.9	Archean Volcanic rocks		5 to 1560	3 to 1900			

(Table A3. continued on next page)

(Table A3. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled area			blank fields = no data	**Arsenic in Rocks from Giant Mine** (van Hees *et al*. 2006) **As** (ppm)	**Arsenic in regional & local (YK) till, silt, clay** (Kerr 2006) **As** (ppm)	**Arsenic in the Yellowknife greenstone belt area & around mines** (Kerr 2006)			
yellow = backup samples 1997 - 1999			olive green = assumed undisturbed background area									
bold **ID #s** = shared soil from same spot			orange = known impacted core study area						**humus As** (ppm)	**leaf litter As** (ppm)	**spruce bark As** (ppm)	**labrador tea As** (ppm)
Fungi ID #	**Mushroom Species**	**Location** North Slave Region & Yellowknife (YK)	**bold data** = elevated levels **Total Arsenic** (ppm) **Soil**	**Wood**	**Fungi**	**Bedrock Geology** dark green = Yellowknife greenstone belt area						
33	Red-capped Bolete	YK Frame Lake			1.4	Archean Volcanic rocks		5 to 1560	3 to 1900			
34	Fly Agaric	YK Frame Lake	**7310.0**		**17.2**	Archean Volcanic rocks		5 to 1560	3 to 1900			
35	Birch Bolete	YK Frame Lake			**14.3**	Archean Volcanic rocks		5 to 1560	3 to 1900			
36	Birch Bolete	YK Frame Lake			**13.7**	Archean Volcanic rocks		5 to 1560	3 to 1900			
37	Birch Bolete	YK Frame Lake	**40.6**		4.9	Archean Volcanic rocks		5 to 1560	3 to 1900			
38	Birch Bolete	YK Frame Lake			5.0	Archean Volcanic rocks		5 to 1560	3 to 1900			
39	Fly Agaric	YK Frame Lake	**49.4**		8.3	Archean Volcanic rocks		5 to 1560	3 to 1900			
40	Meadow Mushroom	YK Con Mine	**2460.0**		**38.2**	Archean Volcanic rocks		5 to 1560	3 to 1900	750	680 to 1400	
41	Meadow Mushroom	YK Con Mine			**37.5**	Archean Volcanic rocks		5 to 1560	3 to 1900	750	680 to 1400	
42	Birch Bolete	YK Con Mine	**1430.0**		**10.2**	Archean Volcanic rocks		5 to 1560	3 to 1900	750	680 to 1400	
43	Meadow Mushroom	YK Old Town	**14.0**		2.3	Archean Volcanic rocks		5 to 1560	3 to 1900			
44	Puffball	YK Old Town	**29.3**		1.8	Archean Volcanic rocks		5 to 1560	3 to 1900			
45	Birch Bolete	YK Jolliffe Island	**106.0**		5.6	Archean Volcanic rocks		5 to 1560	3 to 1900			
46	Fly Agaric	YK Jolliffe Island			3.8	Archean Volcanic rocks		5 to 1560	3 to 1900			
47	Puffball	YK Jolliffe Island	**123.0**		**90.7**	Archean Volcanic rocks		5 to 1560	3 to 1900			
48	Red-capped Bolete	YK Jolliffe Island	**81.1**		1.8	Archean Volcanic rocks		5 to 1560	3 to 1900			
49	Shaggy Mane	YK Giant Mine	**1730.0**		6.6	Archean Volcanic rocks	<2 to >10000	5 to 1560	3 to 1900	830	2100 to 4800	
50	Shaggy Mane	YK Giant Mine			**46.3**	Archean Volcanic rocks	<2 to >10000	5 to 1560	3 to 1900	830	2100 to 4800	
51	Meadow Mushroom	YK Giant Mine	**999.0**		**16.9**	Archean Volcanic rocks	<2 to >10000	5 to 1560	3 to 1900	830	2100 to 4800	
52	Shaggy Mane	YK Giant/Vee L.	**550.0**		4.8	Archean Volcanic rocks	<2 to >10000	5 to 1560	3 to 1900	830	2100 to 4800	
53	Birch Bolete	YK Vee Lake Rd.	**87.6**		7.8	Archean Volcanic rocks	<2 to >10000	5 to 1560	3 to 1900		330 to 2100	170 to 560
54	Hollow-stem Bolete	YK River Park	**14.7**		7.8	Archean Sedimentary rocks		5 to 10				
55	Spring Agaricus	YK River Park	**29.5**		1.4	Archean Sedimentary rocks		5 to 10				
56	Shaggy Mane	Yk Treminco Mine	**23.1**		4.9	Archean Sedimentary rocks		5 to 46	300	97		
57	Shaggy Mane	Yk Treminco Mine			**494.0**	Archean Sedimentary rocks		5 to 46	300	97		
58	Shaggy Mane	Yk Treminco Mine			**298.0**	Archean Sedimentary rocks		5 to 46	300	97		
59	Shaggy Mane	Yk Treminco Mine	**45.0**		3.6	Archean Sedimentary rocks		5 to 46	300	97		
60	Forest Mushroom	Yk Treminco Mine	**33.1**		5.0	Archean Sedimentary rocks		5 to 46	300	97		
61	Tippler's Bane	Yk Treminco Mine	**120.0**		**11.1**	Archean Sedimentary rocks		5 to 46	300	97		
62	Red-capped Bolete	Prelude Lake Trail	6.9		2.0	Archean Granitoid rocks		0 to 48				
63	Sand Bolete	Prelude Lake Trail	**15.7**		4.1	Archean Granitoid rocks		0 to 48				
64	White Matsutake	Prelude Lake Trail	4.1		**92.3**	Archean Granitoid rocks		0 to 48				
65	Sand Bolete	Cameron Fall Trail	8.1		1.5	Archean Granitoid rocks		0 to 48				
66	Slippery Jack	Cameron Fall Trail	**12.4**		1.5	Archean Granitoid rocks		0 to 48				
67	Birch Bolete	Cameron Fall Trail	5.9		1.4	Archean Granitoid rocks		0 to 48				

(Table A3. continued on next page)

(Table A3. continued)

purple = samples in Obst *et al*. 2001	blue = known unspoiled area	blank fields = no data	Arsenic in Rocks from Giant Mine (van Hees *et al*. 2006)	Arsenic in regional & local (YK) till, silt, clay (Kerr 2006)	Arsenic in the Yellowknife greenstone belt area & around mines (Kerr 2006)
yellow = backup samples 1997 - 1999	olive green = assumed undisturbed background area				
bold **ID #s** = shared soil from same spot	orange = known impacted core study area				
	bold data = elevated levels				
		dark green = Yellowknife greenstone belt area			

Fungi ID #	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Total Arsenic (ppm) Soil	Wood	Fungi	Bedrock Geology	Arsenic in Rocks from Giant Mine (van Hees *et al*. 2006) As (ppm)	Arsenic in regional & local (YK) till, silt, clay (Kerr 2006) As (ppm)	humus As (ppm)	leaf litter As (ppm)	spruce bark As (ppm)	labrador tea As (ppm)
68	White Matsutake	Ingraham Trail	N/A		**28.1**	Archean Sedimentary rocks		5 to 10				
69	Red-capped Bolete	Cameron River Pk.	1.9		< 0.2	Archean Sedimentary rocks		5 to 10				
70	White Matsutake	Ingraham/C. Antler	N/A		**29.4**	Archean Sedimentary rocks		5 to 10				
71	Birch Bolete	Ingraham/C. Antler	0.9		< 0.2	Archean Sedimentary rocks		5 to 10				
72	Larch Bolete	Ingraham/C. Antler	2.2		4.6	Archean Sedimentary rocks		5 to 10				
73	Red-capped Bolete	Ingraham/C. Antler	1.9		1.7	Archean Sedimentary rocks		5 to 10				
74	Red-capped Bolete	Ingraham/C. Antler			< 0.2	Archean Sedimentary rocks		5 to 10				
75	Sand Bolete	Ingraham/C. Antler			2.4	Archean Sedimentary rocks		5 to 10				
76	Sarcodon	Ingraham/C. Antler			< 0.2	Archean Sedimentary rocks		5 to 10				
77	White Matsutake	Ingraham/C. Antler	2.5		**56.2**	Archean Sedimentary rocks		5 to 10				
78	White Matsutake	Ingraham/C. Antler			**29.8**	Archean Sedimentary rocks		5 to 10				
79	White Matsutake	Ingraham/C. Antler	N/A		**48.4**	Archean Sedimentary rocks		5 to 10				
80	White Matsutake	Ingraham/C. Antler	N/A		**11.0**	Archean Sedimentary rocks		5 to 10				
81	Hooded False Morel	Ingraham/Tibbitt L.	5.8	<0.5	< 0.5	Archean Sedimentary rocks		5 to 10				
82	Birch Bolete	Ingraham/Tibbitt L.	**11.5**	< 0.5 to 4.5	< 0.5	Archean Sedimentary rocks		5 to 10				
83	Birch Bolete	Ingraham/Tibbitt L.			< 0.5	Archean Sedimentary rocks		5 to 10				
84	Hooded False Morel	Ingraham/Tibbitt L.	7.2	<0.5	< 0.5	Archean Sedimentary rocks		5 to 10				
85	Hooded False Morel	Ingraham/Tibbitt L.	1.6	<0.5	< 0.5	Archean Sedimentary rocks		5 to 10				
86	Hooded False Morel	Ingraham/Tibbitt L.	4.1	0.5 to 1.2	< 0.5	Archean Sedimentary rocks		5 to 10				
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks		5 to 10				
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A		1.4	Archean Sedimentary rocks		5 to 10				
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.6	Archean Sedimentary rocks		5 to 10				
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A		2.3	Archean Sedimentary rocks		5 to 10				
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks		5 to 10				
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A		1.5	Archean Sedimentary rocks		5 to 10				
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks		5 to 10				
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.6	Archean Sedimentary rocks		5 to 10				
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.5	Archean Sedimentary rocks		5 to 10				
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A		< 0.2	Archean Sedimentary rocks		5 to 10				
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A		0.6	Archean Sedimentary rocks		5 to 10				
98	Sand Bolete	Tibbitt Lake	0.8		< 0.2	Archean Sedimentary rocks		5 to 10				
99	Suillus	Tibbitt Lake	3.2		< 0.2	Archean Sedimentary rocks		5 to 10				
100	Yellow Bolete	Tibbitt Lake	2.7		< 0.2	Archean Sedimentary rocks		5 to 10				
101	White Matsutake	Tibbitt Lake	7.1		**53.1**	Archean Sedimentary rocks		5 to 10				
102	Fly Agaric	Tundra Jolly Lake	4.5		< 0.5	Archean Metamorphic rocks						

(Table A3. continued on next page)

(Table A3. continued)

purple = samples in Obst *et al*. 2001; yellow = backup samples 1997 - 1999; bold **ID #s** = shared soil from same spot; blue = known unspoiled area; olive green = assumed undisturbed background area; orange = known impacted core study area; **bold data** = elevated levels; blank fields = no data

Fungi ID #	Mushroom Species	Location North Slave Region & Yellowknife (YK)	Total Arsenic (ppm) Soil	Wood	Fungi	Bedrock Geology (dark green = Yellowknife greenstone belt area)	Arsenic in Rocks from Giant Mine (van Hees *et al*. 2006) As (ppm)	Arsenic in regional & local (YK) till, silt, clay (Kerr 2006) As (ppm)	Arsenic in the Yellowknife greenstone belt area & around mines (Kerr 2006): humus As (ppm)	leaf litter As (ppm)	spruce bark As (ppm)	labrador tea As (ppm)
103	Fly Agaric	Tundra Jolly Lake			< 0.5	Archean Metamorphic rocks						
104	Red-capped Bolete	Tundra Jolly Lake	6.2		1.7	Archean Metamorphic rocks						
105	Birch Bolete	Tundra Jolly Lake	1.3		< 0.5	Archean Metamorphic rocks						
106	Birch Bolete	Tundra Jolly Lake	4.4		< 0.5	Archean Metamorphic rocks						
107	Birch Bolete	Tundra Jolly Lake	1.7		< 0.5	Archean Metamorphic rocks						
108	Birch Bolete	Tundra Jolly Lake			0.6	Archean Metamorphic rocks						
109	Birch Bolete	Tundra Daring L.	**11.6**		< 1.0	Archean Granitoid rocks		0 to 48				
110	Birch Bolete	Tundra Daring L.	3.2		**20.3**	Archean Granitoid rocks		0 to 48				
111	Birch Bolete	Tundra Daring L.	5.3		5.4	Archean Granitoid rocks		0 to 48				
112	Burn-site Morel	Drybones Bay	N/A		3.5	Archean Granitoid rocks		0 to 48				
113	Burn-site Morel	Drybones Bay	N/A		1.6	Archean Granitoid rocks		0 to 48				
114	Burn-site Morel	Drybones Bay	N/A		1.7	Archean Granitoid rocks		0 to 48				
115	Burn-site Morel	NW of YK/SE of What	N/A		1.1	Archean Mixed rocks						
116	Burn-site Morel	NW of YK/SE of What	N/A		1.1	Archean Mixed rocks						
117	Burn-site Morel	NW of YK/SE of What	N/A		0.8	Archean Mixed rocks						
118	Burn-site Morel	NW of YK/SE of What	N/A		0.9	Archean Mixed rocks						
119	Burn-site Morel	50 km SW of Edzo	N/A		1.7	Archean Mixed rocks						
120	Burn-site Morel	50 km SW of Edzo	N/A		0.9	Archean Mixed rocks						
121	Burn-site Morel	50 km SW of Edzo	N/A		1.4	Archean Mixed rocks						
122	Burn-site Morel	50 km SW of Edzo	N/A		0.6	Archean Mixed rocks						
123	Burn-site Morel	50 km SW of Edzo	N/A		1.3	Archean Mixed rocks						
124	Burn-site Morel	50 km SW of Edzo	N/A		1.2	Archean Mixed rocks						

Table A4. Concentrations of Arsenic and Lead in Bedrock, Till, Plants and Organic Materials in the Yellowknife Greenstone Belt Area and North Slave Region, Northwest Territories, 1997 - 2009.

Arsenic and Lead in representative least-altered rocks from Giant Mine (source: van Hees *et al*. 2006)

Rock Type	Basalt	Basalt	Granite	Dacite	Gabbro	Intermediate Metagabbro	Old Metagabbro
As (ppm)	<2	<2 to 4	2 to 6	2 to 6	<2	<2	<2
Pb (ppm)	6	<2	<2 to 2	<2 to 2	<2	<2	<2

Arsenic and Lead in representative most-altered rocks from Giant Mine (source: van Hees et al. 2006)

Rock Type	Basalt	Basalt	Dacite	Low grade gold ore	High grade gold ore
As (ppm)	>10000	56 to 490	52 to 58	>10000	>10000
Pb (ppm)	38 to 494	<2 to 30	<2	354	302

Background values of Arsenic in regional till, selected till and weathered soils (source: Kerr 2006)

Source **Sample Type**	regional background till over volcanics	regional background till over meta-sediments	regional background till over granite	SE of Con Mine reworked till	2 km S of Con Mine in situ weathered volcanics	NW of Giant Mine till	2 km NE of Crestaurum in situ weathered volcanics	8 km NW of Crestaurum Mine reworked till	S of Crestaurum Mine reworked till	Ptarmigan Mine reworked till
As (ppm)	10 to 30	5 to 10	0 to 1	813	1560	320	1500	1190	16 to 24	18 to 46

Background values of Arsenic in the silt & clay fraction of till over the Yellowknife greenstone belt (source: Kerr 2006)

Sample	silt & clay over granite and granodiorite	silt & clay over migmatite and gneiss	silt & clay over meta-sedimentary rocks	silt & clay over felsic volcanics	silt & clay over intermediate to mafic volcanics
As (ppm)	7 to 48	10	5 to 62	12 to 262	10 to 1560

Arsenic in humus at selected sites in the Yellowknife greenstone belt area (source: Kerr 2006)

Sample ppm (d.w.)	humus over granite and granodiorite	humus over migmatite and gneiss	humus over meta-sedimentary rocks	humus over intermediate to mafic volcanics
As (ppm)	4 to 253	56	3 to 570	16 to 1900

Arsenic in leaf litter, humus, spruce bark and labrador tea at selected gold deposits (source: Kerr 2006)

ppm (d.w.)		Con Mine	Giant Mine	Crestaurum Mine	Ptarmigan Mine
As (ppm)	leaf litter	750	830	30	97
As (ppm)	humus	1900	626	16	300
As (ppm)	spruce bark	680	2100	500	
As (ppm)	spruce bark	1400	4800		
			NW of Giant Mine	SW of Crestaurum Mine	
As (ppm)	spruce bark		330 to 2100	260 to 810	
As (ppm)	labrador tea		170 to 560	110 to 440	

Table B. Species List of Mushrooms collected for Heavy Metal Analyses in the North Slave Region, Northwest Territories, and comparable Mushroom Species obtained from Other Regions, 1997 - 2009.

No. of Species	Common Name of Mushroom Species	Scientific Name of Mushroom Species	Genus of Mushroom	Family of Mushroom	Edibility or Toxicity	Region/Country of origin of Fungi	Samples per Species	Samples per Family
1	Spring Agaricus	*Agaricus bitorquis*	*Agaricus*	Agaricaceae	edible	North Slave Region	1	
2	Meadow Mushroom	*Agaricus campestris*	*Agaricus*	Agaricaceae	edible	North Slave Region	8	10
3	Forest Mushroom	*Agaricus silvaticus*	*Agaricus*	Agaricaceae	edible	North Slave Region	1	
4	Fly Agaric	*Amanita muscaria*	*Amanita*	Amanitaceae	poisonous	North Slave Region	5	5
5	Red-capped Bolete	*Leccinum aurantiacum*	*Leccinum*	Boletaceae	edible	North Slave Region	11	
6	Birch Bolete	*Leccinum insigne*	*Leccinum*	Boletaceae	edible	North Slave Region	18	
7	Yellow Bolete	*Suillus americanus*	*Suillus*	Boletaceae	edible	North Slave Region	2	
8	Suillus	*Suillus borealis*	*Suillus*	Boletaceae	edible	North Slave Region	1	47
9	Hollow-stem Bolete	*Suillus cavipes*	*Suillus*	Boletaceae	edible	North Slave Region	2	
10	Larch Bolete	*Suillus grevillei*	*Suillus*	Boletaceae	edible	North Slave Region	1	
11	Slippery Jack	*Suillus luteus*	*Suillus*	Boletaceae	not recommended	North Slave Region	1	
12	Sand Bolete	*Suillus tomentosus*	*Suillus*	Boletaceae	edible	North Slave Region	11	
13	Tippler's Bane	*Coprinus atramentarius*	*Coprinus*	Coprinaceae	not recommended	North Slave Region	1	9
14	Shaggy Mane	*Coprinus comatus*	*Coprinus*	Coprinaceae	edible	North Slave Region	8	
15	Hooded False Morel	*Gyromitra infula*	*Gyromitra*	Helvellaceae	poisonous	North Slave Region	5	5
16	Burn-site Morel	*Morchella atrotomentosa*	*Morchella*	Morchellaceae	edible	North Slave Region	31	31
17	Sarcodon	*Sarcodon impricatus*	*Sarcodon*	Hydnaceae	not recommended	North Slave Region	1	1
18	Puffball	*Lycoperdon perlatum*	*Lycoperdon*	Lycoperdaceae	edible	North Slave Region	3	3
19	White Matsutake	*Tricholoma magnivelare*	*Tricholoma*	Tricholomataceae	edible	North Slave Region	13	13
						Subtotal Mushroom Samples North Slave Region	**124**	**124**
20	Wood Ear	*Auricularia* sp.	*Auricularia*	Auriculariaceae	edible	BC farm import	2	2
21	Morel Mushroom	*Morchella* sp.	*Morchella*	Morchellaceae	edible	BC / US import	12	12
22	Chinese Shiitake	*Lentinula edodes*	*Lentinula*	Tricholomataceae	edible	Hongkong import	2	2
23	Oyster Mushroom	*Pleurotus porrigens*	*Pleurotus*	Tricholomataceae	edible	BC farm import	1	1
						Total Mushroom Samples	**141**	**141**

Note: Common and Scientific Names are based on the mushroom field guide books: Lincoff 1981, McKnight 1987, and Phillips 1991 (see Literature Cited).

Table C. Metal Detection Limits and Analytical Methods of Laboratory Analysis.

Sample Type	Parameter Name	Mean Detection Limit	Test Group Name	Lab Section	Preparation Method	Test Method 1997 - 2006	Test Method 2006 - 2009
mushroom	Aluminum	30	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Aluminum	0.01	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Aluminum	30	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Antimony	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Antimony	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Antimony	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Arsenate	0.1	Arsenic Speciation	Spec. Metals	Acid Met (t)	SM3113:B	
mushroom	Arsenic	0.1	Arsenic, Total	Total Metals	Acid Met (t)	SM3113:B	EPA3050A
soil	Arsenic	0.1	Arsenic, Total	Total Metals	Acid Met (s)	SM3113:B	EPA3050A
wood	Arsenic	0.1	Arsenic, Total	Total Metals	Acid Met (t)	SM3113:B	EPA3050A
mushroom	Arsenite	0.1	Arsenic Speciation	Spec. Metals	Acid Met (t)	SM3113:B	
mushroom	Barium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Barium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Barium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Beryllium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Beryllium	0.4	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Beryllium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Cadmium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Cadmium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Cadmium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Cesium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Cesium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Cesium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Chromium	0.3	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Chromium	3.0	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Chromium	0.3	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Cobalt	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Cobalt	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Cobalt	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Copper	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Copper	0.4	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Copper	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Dimethylarsenic acid	0.1	Arsenic Speciation	Spec. Metals	Acid Met (t)	SM3113:B	EPA3050A
mushroom	Iron	40	Iron, Total	Total Metals	Acid Met (t)	SM3111:B	EPA3050A
soil	Iron	0.01	Iron, Total	Total Metals	Acid Met (s)	SM3111:B	EPA3050A
wood	Iron	40	Iron, Total	Total Metals	Acid Met (t)	SM3111:B	EPA3050A
mushroom	Lead	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Lead	1.0	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Lead	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Lithium	0.3	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Lithium	0.6	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Lithium	0.3	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Manganese	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Manganese	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Manganese	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Mercury	0.01	Mercury, Total	Total Metals	Acid Hg (t)	SM3112:B	EPA3050A
soil	Mercury	0.005	Mercury, Total	Total Metals	Acid Hg (s)	SM3112:B	EPA3050A
wood	Mercury	0.01	Mercury, Total	Total Metals	Acid Hg (t)	SM3112:B	EPA3050A

(Table C. continued on next page)

(Table C. continued)

Sample Type	Parameter Name	Mean Detection Limit	Test Group Name	Lab Section	Preparation Method	Test Method 1997 - 2006	Test Method 2006 - 2009
mushroom	Molybdenum	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Molybdenum	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Molybdenum	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Monomethylarsenic acid	0.1	Arsenic Speciation	Spec. Metals	Acid Met (t)	SM3113:B	EPA3050A
mushroom	Nickel	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Nickel	1.0	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Nickel	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Rubidium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Rubidium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Rubidium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Selenium	1.0	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Selenium	2.0	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Selenium	1.0	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Silver	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Silver	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Silver	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Strontium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Strontium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Strontium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Thallium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Thallium	0.6	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Thallium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Titanium	0.3	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Titanium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Titanium	0.3	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Uranium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Uranium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Uranium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Vanadium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Vanadium	0.2	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Vanadium	0.1	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
mushroom	Zinc	10	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A
soil	Zinc	20	Total Metals (24) by ICP-MS	Total Metals	Acid Met (s)	EPA200.8	EPA3050A
wood	Zinc	10	Total Metals (24) by ICP-MS	Total Metals	Acid Met (t)	EPA200.8	EPA3050A

Table D. Estimated Consumption of Mushrooms by Harvesters and Residents of Yellowknife, Northwest Territories, 1998 - 1999.

Fungi Family:	**Agaricaceae**		**Boletaceae**						**Coprinaceae**		**Lycoperdaceae**		**Morchellaceae**	**Tricholomataceae**				**Total** fungi	**Harvester ID #s**
ID # (see Table 1	# 55	# 43	# 19	# 22	# 54	# 62	# 21	# 74	# 49 + 50	# 56 + 57	# 20	# 44	# 87, 91, 93, 96	# 23	# 64	# 24	# 68	consumed	represent an
for analytical data)																		person/year	estimated no. of
Fungi consumed:	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	local consumers
Harvester ID #																			
# 1 (category **1**)						1		1		1			7		2		3	15	6 people - category **1**
# 2 (category **1**)			0.1	0.2		0.3	0.1	0.3	0.5	0.5			9	1	1	1	1	15	6 people - category **1**
# 3 (category **1**)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.25	0.25	2	1	0.5	1	1	11	6 people - category **1**
# 4 (category **1**)		4					1						4	0.5				9.5	6 people - category **1**
# 5 (category **1**)		4					1						4	0.5				9.5	6 people - category **1**
# 6 (category **1**)	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.25	0.25	0.5	1	0.5	1	1	9	6 people - category **1**
# 7 (category **2**)													8					8	4 people - category **2**
# 8 (category **2**)													7					7	4 people - category **2**
# 9 (category **2**)													5		2			7	4 people - category **2**
# 10 (category **3**)													5					5	10 people - category **3**
# 11 (category **3**)													5					5	10 people - category **3**
# 12 (category **3**)													5					5	10 people - category **3**
# 13 (category **3**)													5					5	10 people - category **3**
# 14 (category **3**)						0.1	0.1	0.1	0.1	0.1			2.5	0.5	0.5	0.5	0.5	5	10 people - category **3**
# 15 (category **3**)							1						4					5	10 people - category **3**
# 16 (category **3**)													3		1			4	10 people - category **3**
# 17 (category **3**)													1.5		2			3.5	10 people - category **3**
# 18 (category **3**)													1		2			3	10 people - category **3**
# 19 (category **4**)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.1	0.1	0.1	2	30 people - category **4**
# 20 (category **4**)	0.1	0.1	0.2	0.2	0.2	0.1	0.1		0.2	0.2	0.1		0.1	0.1	0.1	0.1	0.1	2	30 people - category **4**
# 21 (category **4**)	0.1	0.1	0.2	0.2	0.2	0.1	0.1		0.2	0.2	0.1		0.1	0.1	0.1	0.1	0.1	2	30 people - category **4**
# 22 (category **5**)													1					1	350 people - category **5**
# 23 (category **5**)													1					1	350 people - category **5**
# 24 (category **5**)													1					1	350 people - category **5**
# 25 (category **5**)													1					1	350 people - category **5**
# 26 (category **6**)													0.25					0.25	1000 people - category **6**

Note: Data represent annual consumption of fungi (from known locations as indicated by fungi ID #s in Table 1) by 26 harvesters from September 01, 1998 to August 31, 1999.

Table E. Drying Ratios of Mushrooms from the North Slave Region, Northwest Territories, 1997 - 2008.

Mushroom Common Name	Mushroom Species Scientific Name	Mushroom Family	No. of Samples used per Family	Mean Drying Ratio Dry : Fresh
Spring Agaricus	*Agaricus bitorquis*	Agaricaceae		
Meadow Mushroom	*Agaricus campestris*	Agaricaceae	3	1 : 14.3
Forest Mushroom	*Agaricus silvaticus*	Agaricaceae		
Red-capped Bolete	*Leccinum aurantiacum*	Boletaceae	10	1 : 9.7
Birch Bolete	*Leccinum insigne*	Boletaceae		
Yellow Bolete	*Suillus americanus*	Boletaceae		
Suillus	*Suillus borealis*	Boletaceae		
Hollow-stem Bolete	*Suillus cavipes*	Boletaceae	10	1 : 13.8
Larch Bolete	*Suillus grevillei*	Boletaceae		
Sand Bolete	*Suillus tomentosus*	Boletaceae		
Tippler's Bane	*Coprinus atramentarius*	Coprinaceae		
Shaggy Mane	*Coprinus comatus*	Coprinaceae	7	1 : 18.7
Sarcodon	*Sarcodon impricatus*	Hydnaceae	1	1 : 14.3
Puffball	*Lycoperdon perlatum*	Lycoperdaceae	3	1 : 9.3
Burn-site Morel	*Morchella atrotomentosa*	Morchellaceae	4	1 : 7.0
Burn-site Morel	*Morchella atrotomentosa*	Morchellaceae	3	1 : 9.0
Oyster Mushroom	*Pleurotus porrigens*	Tricholomataceae	1	1 : 9.8
White Matsutake	*Tricholoma magnivelare*	Tricholomataceae	7	1 : 12.6
			N = 49	Mean = 1 : 11.91

Table F: Metal Concentrations (Aluminum to Cesium) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 - 2009.

purple = samples in Obst *et al*. 2001 | blue = known unspoiled background area | orange = known impacted area | yellow = backup samples 1997 - 1999

bold ID #s = shared soil samples | green = assumed undisturbed background area

Total Metal Concentrations in µg/g dry weight

Fungi	Mushroom	Location	Aluminum		Antimony		Arsenic		Barium		Beryllium		Bismuth		Cadmium		Cesium	
ID #	Species	North Slave Region	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi
1	Burn-site Morel	100 km S of Edzo		16.8		< 0.1		0.4		4.8		< 0.1	N/A	N/A		0.9		0.2
2	Burn-site Morel	100 km S of Edzo		20.4		< 0.1		0.6		5.0		< 0.1	N/A	N/A		0.7		0.3
3	Burn-site Morel	100 km S of Edzo		19.0		< 0.1		0.4		10.9		< 0.1	N/A	N/A		0.2		0.3
4	Burn-site Morel	100 km S of Edzo		25.3		< 0.1		0.5		46.8		< 0.1	N/A	N/A		0.6		0.3
5	Burn-site Morel	100 km S of Edzo		18.1		< 0.1		0.7		2.8		< 0.1	N/A	N/A		0.7		0.4
6	Burn-site Morel	100 km S of Edzo		21.4		< 0.1		0.6		16.0		< 0.1	N/A	N/A		0.5		0.3
7	Burn-site Morel	100 km S of Edzo		52.1		< 0.1		1.2		13.1		< 0.1	N/A	N/A		0.9		0.2
8	Sand Bolete	46 km SW of Edzo	6200	191.6	< 0.2	< 0.1	1.7	0.6	45.1	0.5	< 0.4	< 0.2	N/A	N/A	< 0.1	0.7	0.3	0.7
9	Sand Bolete	46 km SW of Edzo	5000	229.7	< 0.2	< 0.1	1.5	0.8	78.8	0.4	< 0.4	< 0.2	N/A	N/A	0.1	0.4	0.2	1.4
10	White Matsutake	46 km SW of Edzo	4800	238.3	< 0.2	< 0.1	1.3	30.8	37.0	1.5	< 0.4	< 0.2	N/A	N/A	< 0.1	1.2	0.2	0.2
11	Sand Bolete	46 km SW of Edzo	4200	188.2	< 0.2	< 0.1	0.9	< 0.5	57.5	0.6	< 0.4	< 0.2	N/A	N/A	0.1	0.4	0.4	0.2
12	Sand Bolete	46 km SW of Edzo	3900	133.3	< 0.2	< 0.1	< 0.5	< 0.5	31.3	0.4	< 0.4	< 0.2	N/A	N/A	< 0.1	0.5	0.2	0.2
13	White Matsutake	46 km SW of Edzo		154.0		0.2		101.0		0.8		< 0.2	N/A	N/A		0.6		0.7
14	Red-capped Bolete	43 km SW of Edzo	2100	30.0	0.2	0.1	1.2	< 0.2	42.6	0.1	0.4	0.2	0.2	0.1	0.2	0.1	0.2	0.1
15	Sand Bolete	43 km SW of Edzo	3500	30.0	0.2	0.1	0.8	< 0.2	38.2	0.4	0.4	0.2	0.2	0.1	0.2	0.8	0.2	0.2
16	Sand Bolete	17 km SW of Edzo	1800	170.6	< 0.2	< 0.1	2.4	< 0.5	48.0	0.8	< 0.4	< 0.2	N/A	N/A	0.1	< 0.1	< 0.2	0.2
17	Hooded False Morel	2 km SW of Edzo	1800	134.9	< 0.2	< 0.1	1.6	< 0.5	28.0	1.8	< 0.4	< 0.2	N/A	N/A	< 0.1	0.6	< 0.2	0.1
18	Yellow Bolete	40 km W of YK	16100	350.0	0.8	0.3	16.5	1.7	198.0	1.5	0.4	< 0.2	N/A	N/A	0.1	0.2	0.9	1.7
19	Hollow-stem Bolete	YK Golf Course	3100	36.2	1.9	0.3	12.4	19.9	25.2	0.7	0.4	0.2	0.2	0.1	0.2	0.7	0.3	0.5
20	Puffball	YK Golf Course	2900	40.8	3.2	0.8	30.7	135.0	35.6	0.8	0.4	0.2	0.2	0.1	0.2	0.4	0.3	0.1
21	Red-capped Bolete	YK Golf Course	6100	30.0	0.8	0.1	9.9	5.7	30.0	0.4	0.4	0.2	0.2	0.1	0.2	2.6	0.4	0.3
22	Sand Bolete	YK Golf Course	7500	63.7	1.4	0.1	86.9	1.0	29.0	0.9	0.4	0.2	0.2	0.1	0.2	0.6	0.6	0.7
23	White Matsutake	YK Golf Course	5800	39.7	1.6	0.3	68.5	280.0	31.7	0.9	0.4	0.2	0.2	0.1	0.2	1.7	0.5	1.8
24	White Matsutake	YK Golf Course		61.5		0.4		340.0		2.2		0.2		0.1		1.8		2.3
25	White Matsutake	YK Golf Course		53.0		0.7		1370.0		1.6		< 0.1	N/A	N/A		2.3		2.0
26	Meadow Mushroom	YK Sewage Road	15600	195.0	< 0.2	0.2	21.0	97.2	67.4	0.4	< 0.4	< 0.2	N/A	N/A	0.1	2.8	1.0	< 0.1
27	Meadow Mushroom	YK Sewage Road	10400	265.0	0.2	< 0.1	17.4	47.1	48.8	0.6	< 0.4	< 0.2	N/A	N/A	0.1	4.6	0.9	< 0.1
28	Meadow Mushroom	YK Sewage Road		216.6		< 0.1		58.2		1.4		< 0.2	N/A	N/A		5.3		< 0.1
29	Shaggy Mane	YK Sewage Road	11500	210.0	1.0	0.3	44.5	44.0	71.9	0.8	< 0.4	< 0.2	N/A	N/A	0.1	0.5	0.7	< 0.1
30	Meadow Mushroom	YK Sewage Road	18600	152.2	0.5	0.1	16.4	286.0	148.0	1.7	0.5	< 0.2	N/A	N/A	0.2	4.8	1.1	< 0.1
31	Red-capped Bolete	YK Frame Lake	10800	288.2	< 0.2	< 0.1	11.9	2.0	47.9	0.7	0.4	< 0.2	N/A	N/A	< 0.1	1.0	0.7	1.0

(Table F. continued on next page)

(Table F. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area						orange = known impacted area				yellow = backup samples 1997 - 1999					
bold ID #s = shared soil samples			green = assumed undisturbed background area						**Total Metal Concentrations in µg/g dry weight**									
Fungi	**Mushroom**	**Location**	**Aluminum**		**Antimony**		**Arsenic**		**Barium**		**Beryllium**		**Bismuth**		**Cadmium**		**Cesium**	
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**
32	Red-capped Bolete	YK Frame Lake		846.2		< 0.1		1.9		28.5		< 0.2	N/A	N/A		0.9		1.0
33	Red-capped Bolete	YK Frame Lake		153.6		< 0.1		1.4		4.7		< 0.2	N/A	N/A		0.7		1.0
34	Fly Agaric	YK Frame Lake	12700	2580.0	2.2	0.1	7310.0	17.2	73.2	23.9	< 0.4	< 0.2	N/A	N/A	0.2	12.9	0.9	1.0
35	Birch Bolete	YK Frame Lake		162.9		< 0.1		14.3		1.2		< 0.2	N/A	N/A		1.4		0.2
36	Birch Bolete	YK Frame Lake		254.0		< 0.1		13.7		26.1		< 0.2	N/A	N/A		1.3		0.2
37	Birch Bolete	YK Frame Lake	12100	207.9	0.9	0.1	40.6	4.9	68.2	2.5	0.4	< 0.2	N/A	N/A	0.1	1.1	0.9	0.5
38	Birch Bolete	YK Frame Lake		1060.0		< 0.1		5.0		6.8		< 0.2	N/A	N/A		1.1		0.5
39	Fly Agaric	YK Frame Lake	9600	212.6	1.0	< 0.1	49.4	8.3	48.2	7.7	< 0.4	< 0.2	N/A	N/A	0.1	7.5	0.9	0.3
40	Meadow Mushroom	YK Con Mine	25600	< 30.0	68.5	1.3	2460.0	38.2	52.0	3.3	< 0.4	< 0.2	N/A	N/A	2.0	8.2	0.8	< 0.1
41	Meadow Mushroom	YK Con Mine		602.6		1.2		37.5		1.8		< 0.2	N/A	N/A		8.4		< 0.1
42	Birch Bolete	YK Con Mine	24500	227.4	58.7	0.3	1430.0	10.2	74.6	1.5	< 0.4	< 0.2	N/A	N/A	3.1	0.5	1.0	0.2
43	Meadow Mushroom	YK Old Town	11000	60.3	0.7	0.1	14.0	2.3	105.0	1.5	0.4	0.2	0.2	0.3	0.5	0.8	0.9	0.1
44	Puffball	YK Old Town	12000	30.0	1.2	0.1	29.3	1.8	95.1	0.6	0.4	0.2	0.2	0.1	0.4	2.6	1.0	0.1
45	Birch Bolete	YK Jolliffe Island	4800	59.0	16.9	0.5	106.0	5.6	130.0	1.7	0.4	0.2	0.2	0.1	2.0	3.0	0.6	0.8
46	Fly Agaric	YK Jolliffe Island		78.0		0.2		3.8		20.0		< 0.2		N/A		16.9		0.2
47	Puffball	YK Jolliffe Island	17900	54.4	7.1	0.9	123.0	90.7	167.0	3.6	0.4	0.2	0.2	0.1	0.5	0.5	1.3	0.1
48	Red-capped Bolete	YK Jolliffe Island	7600	30.0	7.7	0.2	81.1	1.8	77.5	0.8	0.4	0.2	0.2	0.1	0.2	2.4	0.6	0.2
49	Shaggy Mane	YK Giant Mine	35400	65.2	87.2	2.7	1730.0	6.6	38.0	2.2	0.4	0.2	0.2	0.1	0.6	1.6	0.9	0.1
50	Shaggy Mane	YK Giant Mine		206.0		2.0		46.3		1.1		0.2		0.1		0.8		0.1
51	Meadow Mushroom	YK Giant Mine	26400	499.1	23.1	3.6	999.0	16.9	65.4	1.2	< 0.4	< 0.2	N/A	N/A	0.7	6.9	1.2	< 0.1
52	Shaggy Mane	YK Giant/Vee L.	19600	52.6	10.0	0.1	550.0	4.8	88.6	1.3	0.4	0.2	0.2	0.1	0.2	0.3	1.3	0.1
53	Birch Bolete	YK Vee Lake Rd.	4900	30.0	19.5	0.1	87.6	7.8	134.0	0.8	0.4	0.2	0.2	0.1	0.4	0.1	0.5	0.3
54	Hollow-stem Bolete	YK River Park	2500	30.0	12.8	0.1	14.7	7.8	60.3	0.5	0.4	0.2	0.2	0.1	0.5	1.3	0.4	1.2
55	Spring Agaricus	YK River Park	6100	85.0	0.6	0.2	29.5	1.4	34.5	2.7	0.4	0.2	0.2	0.1	0.2	17.1	0.8	0.1
56	Shaggy Mane	Yk Treminco Mine	26800	277.0	0.2	0.1	23.1	4.9	164.0	2.9	0.4	0.2	0.2	0.1	0.2	1.7	3.9	0.1
57	Shaggy Mane	Yk Treminco Mine		245.0		0.2		494.0		1.2		0.2		0.1		1.7		1.4
58	Shaggy Mane	Yk Treminco Mine		249.7		0.3		298.0		10.7		< 0.1	N/A	N/A		2.0		1.5
59	Shaggy Mane	Yk Treminco Mine	10100	61.3	0.2	0.1	45.0	3.6	92.3	1.2	0.4	0.2	0.3	0.1	0.8	3.6	1.9	0.1
60	Forest Mushroom	Yk Treminco Mine	11100	265.0	0.2	0.1	33.1	5.0	103.0	3.2	0.4	0.2	0.2	0.1	0.7	8.2	2.3	0.1
61	Tippler's Bane	Yk Treminco Mine	5700	331.0	0.2	0.5	120.0	11.1	44.3	3.0	0.4	0.2	0.9	0.4	6.1	32.4	4.4	0.3
62	Red-capped Bolete	Prelude Lake Trail	10000	196.0	0.2	0.1	6.9	2.0	86.9	3.5	0.4	0.2	0.2	0.1	0.2	0.4	1.3	0.2
63	Sand Bolete	Prelude Lake Trail	8300	32.9	0.2	0.1	15.7	4.1	68.8	2.4	0.4	0.2	0.2	0.1	0.2	0.8	2.3	0.2

(Table F. continued on next page)

(Table F. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area						orange = known impacted area				yellow = backup samples 1997 - 1999					
bold ID #s = shared soil samples			green = assumed undisturbed background area						**Total Metal Concentrations in µg/g dry weight**									
Fungi	**Mushroom**	**Location**	**Aluminum**		**Antimony**		**Arsenic**		**Barium**		**Beryllium**		**Bismuth**		**Cadmium**		**Cesium**	
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**
64	White Matsutake	Prelude Lake Trail	11000	N/A	0.2	0.1	4.1	92.3	70.1	2.6	0.4	0.2	0.5	0.1	0.2	1.5	1.6	0.4
65	Sand Bolete	Cameron Fall Trail	28300	234.5	< 0.2	< 0.1	8.1	1.5	319.0	1.6	0.5	< 0.2	N/A	N/A	0.1	0.7	3.7	2.1
66	Slippery Jack	Cameron Fall Trail	8600	199.2	0.3	< 0.1	12.4	1.5	80.7	0.7	0.5	< 0.2	N/A	N/A	0.3	1.3	0.5	5.5
67	Birch Bolete	Cameron Fall Trail	5900	212.8	0.2	< 0.1	5.9	1.4	50.8	0.5	< 0.4	< 0.2	N/A	N/A	0.1	0.5	0.6	1.3
68	White Matsutake	Ingraham Trail	N/A	129.0	N/A	0.1	N/A	28.1	N/A	2.6	N/A	0.2	N/A	0.1	N/A	0.8	N/A	1.8
69	Red-capped Bolete	Cameron River Pk.	7700	N/A	0.2	N/A	1.9	< 0.2	41.1	N/A	0.4	N/A	0.2	N/A	0.2	N/A	0.5	N/A
70	White Matsutake	Ingraham/C. Antler	N/A	270.1	N/A	< 0.1	N/A	29.4	N/A	1.7	N/A	< 0.2	N/A	N/A	N/A	1.7	N/A	0.4
71	Birch Bolete	Ingraham/C. Antler	2700	30.0	0.2	0.1	0.9	< 0.2	137.0	0.5	0.4	0.2	0.2	0.1	0.2	1.0	0.4	0.6
72	Larch Bolete	Ingraham/C. Antler	4900	30.0	0.2	0.1	2.2	4.6	61.5	0.9	0.4	0.2	0.2	0.1	0.2	0.1	0.6	2.8
73	Red-capped Bolete	Ingraham/C. Antler	4100	30.0	0.2	0.2	1.9	1.7	46.5	0.5	0.4	0.2	0.2	0.3	0.2	0.8	0.6	0.4
74	Red-capped Bolete	Ingraham/C. Antler		30.0		0.1		< 0.2		0.5		0.2		0.1		0.8		0.6
75	Sand Bolete	Ingraham/C. Antler		33.1		0.1		2.4		0.9		0.2		0.1		1.1		1.6
76	Sarcodon	Ingraham/C. Antler		30.0		0.1		< 0.2		0.3		0.2		0.1		0.4		22.7
77	White Matsutake	Ingraham/C. Antler	4600	37.9	0.2	0.1	2.5	56.2	111.0	1.6	0.4	0.2	0.2	0.1	0.2	1.7	0.7	0.9
78	White Matsutake	Ingraham/C. Antler		96.8		0.1		29.8		3.8		0.2		0.1		1.0		4.7
79	White Matsutake	Ingraham/C. Antler	N/A	578.7	N/A	< 0.1	N/A	48.4	N/A	4.0		< 0.2	N/A	N/A	N/A	0.9	1.6	1.6
80	White Matsutake	Ingraham/C. Antler	N/A	726.3	N/A	< 0.1	N/A	11.0	N/A	5.3		< 0.2	N/A	N/A	N/A	1.0	0.9	0.9
81	Hooded False Morel	Ingraham/Tibbitt L.	13600	337.0	< 0.2	< 0.1	5.8	< 0.5	52.3	3.1	< 0.4	< 0.2	N/A	N/A	< 0.1	0.7	0.7	0.1
82	Birch Bolete	Ingraham/Tibbitt L.	14300	202.7	< 0.2	< 0.1	11.5	< 0.5	54.7	0.8	< 0.4	< 0.2	N/A	N/A	0.1	0.4	0.8	0.7
83	Birch Bolete	Ingraham/Tibbitt L.		238.2		< 0.1		< 0.5		1.5		< 0.2	N/A	N/A		0.9		0.9
84	Hooded False Morel	Ingraham/Tibbitt L.	37100	231.4	< 0.2	< 0.1	7.2	< 0.5	126.0	3.9	0.7	< 0.2	N/A	N/A	0.1	1.5	1.5	0.3
85	Hooded False Morel	Ingraham/Tibbitt L.	13600	226.2	0.3	< 0.1	1.6	< 0.5	44.2	8.4	< 0.4	< 0.2	N/A	N/A	0.1	0.7	0.6	0.2
86	Hooded False Morel	Ingraham/Tibbitt L.	23200	401.7	0.2	< 0.1	4.1	< 0.5	119.0	2.6	0.4	< 0.2	N/A	N/A	0.4	0.9	1.0	0.3
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A	177.0	N/A	0.1	N/A	< 0.2	N/A	30.0	N/A	0.2	N/A	0.1	N/A	1.2	N/A	0.4
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A	210.0	N/A	0.2	N/A	1.4	N/A	32.9	N/A	< 0.1	N/A	N/A	N/A	1.3	N/A	0.4
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A	60.4	N/A	< 0.1	N/A	0.6	N/A	11.4	N/A	< 0.1	N/A	N/A	N/A	0.8	N/A	0.1
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A	303.0	N/A	< 0.1	N/A	2.3	N/A	51.6	N/A	< 0.1	N/A	N/A	N/A	1.5	N/A	1.8
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A	93.1	N/A	0.6	N/A	< 0.2	N/A	8.0	N/A	0.2	N/A	0.1	N/A	1.2	N/A	0.6
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A	116.1	N/A	0.8	N/A	1.5	N/A	8.5	N/A	< 0.1	N/A	N/A	N/A	1.2	N/A	0.7
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A	53.0	N/A	1.0	N/A	< 0.2	N/A	3.9	N/A	0.2	N/A	0.2	N/A	0.1	N/A	0.5
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A	33.4	N/A	< 0.1	N/A	0.6	N/A	4.0	N/A	< 0.1	N/A	N/A	N/A	< 0.1	N/A	0.5
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A	64.7	N/A	1.3	N/A	0.5	N/A	4.4	N/A	< 0.1	N/A	N/A	N/A	0.1	N/A	0.6

(Table F. continued on next page)

(Table F. continued)

purple = samples in Obst *et al*. 2001 | blue = known unspoiled background area | orange = known impacted area | yellow = backup samples 1997 - 1999

bold ID #s = shared soil samples | green = assumed undisturbed background area | **Total Metal Concentrations in µg/g dry weight**

Fungi ID #	**Mushroom Species**	**Location** North Slave Region	**Aluminum** Soil	**Aluminum** Fungi	**Antimony** Soil	**Antimony** Fungi	**Arsenic** Soil	**Arsenic** Fungi	**Barium** Soil	**Barium** Fungi	**Beryllium** Soil	**Beryllium** Fungi	**Bismuth** Soil	**Bismuth** Fungi	**Cadmium** Soil	**Cadmium** Fungi	**Cesium** Soil	**Cesium** Fungi
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A	30.0	N/A	0.8	N/A	< 0.2	N/A	2.9	N/A	0.2	N/A	0.1	N/A	0.2	N/A	0.2
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A	30.1	N/A	1.0	N/A	0.6	N/A	3.2	N/A	< 0.1	N/A	N/A	N/A	0.2	N/A	0.2
98	Sand Bolete	Tibbitt Lake	2800	30.0	0.2	0.9	0.8	< 0.2	24.6	0.7	0.4	0.2	0.2	0.1	0.2	1.7	0.3	1.1
99	Suillus	Tibbitt Lake	7600	30.0	0.2	0.1	3.2	< 0.2	54.0	2.7	0.4	0.2	0.2	0.1	0.2	0.6	1.2	2.2
100	Yellow Bolete	Tibbitt Lake	5100	30.0	0.2	0.1	2.7	< 0.2	59.5	0.4	0.4	0.2	0.3	0.1	0.2	0.6	1.0	2.1
101	White Matsutake	Tibbitt Lake	13500	79.6	0.2	0.1	7.1	53.1	87.0	2.9	0.4	0.2	0.2	0.1	0.2	1.3	1.6	4.5
102	Fly Agaric	Tundra Jolly Lake	8800	224.9	< 0.2	< 0.1	4.5	< 0.5	55.7	2.4	< 0.4	< 0.2	N/A	N/A	< 0.1	3.9	0.9	0.4
103	Fly Agaric	Tundra Jolly Lake		170.6		< 0.1		< 0.5		0.7		< 0.2	N/A	N/A		3.5		0.5
104	Red-capped Bolete	Tundra Jolly Lake	12800	190.0	< 0.2	< 0.1	6.2	1.7	38.4	1.5	< 0.4	< 0.2	N/A	N/A	0.1	1.3	1.2	1.2
105	Birch Bolete	Tundra Jolly Lake	2100	191.2	< 0.2	< 0.1	1.3	< 0.5	36.7	1.2	< 0.4	< 0.2	N/A	N/A	0.1	0.5	1.0	2.7
106	Birch Bolete	Tundra Jolly Lake	3500	166.0	< 0.2	< 0.1	4.4	< 0.5	58.6	2.0	< 0.4	< 0.2	N/A	N/A	0.2	< 0.1	0.4	0.4
107	Birch Bolete	Tundra Jolly Lake	50800	224.4	< 0.2	< 0.1	1.7	< 0.5	416.0	1.4	1.7	< 0.2	N/A	N/A	0.2	0.5	2.6	5.7
108	Birch Bolete	Tundra Jolly Lake		175.4		< 0.1		0.6		0.4		< 0.2	N/A	N/A		0.4		6.3
109	Birch Bolete	Tundra Daring L.	1100	30.0	0.4	< 0.1	11.6	< 1.0	86.2	0.2	< 0.2	< 0.2	N/A	N/A	0.3	0.2	1.0	8.0
110	Birch Bolete	Tundra Daring L.	800	< 30.0	0.3	0.2	3.2	20.3	84.7	0.9	< 0.2	< 0.2	N/A	N/A	0.2	0.1	0.4	9.5
111	Birch Bolete	Tundra Daring L.	300	30.0	< 0.2	< 0.1	5.3	5.4	96.6	0.5	< 0.2	< 0.2	N/A	N/A	< 0.2	0.8	0.8	12.4
112	Burn-site Morel	Drybones Bay	N/A	222.0	N/A	< 0.2	N/A	3.5	N/A	14.2	N/A	< 0.2	N/A	N/A	N/A	1.4	N/A	0.6
113	Burn-site Morel	Drybones Bay	N/A	207.0	N/A	< 0.2	N/A	1.6	N/A	7.6	N/A	< 0.2	N/A	N/A	N/A	0.7	N/A	1.1
114	Burn-site Morel	Drybones Bay	N/A	164.0	N/A	< 0.2	N/A	1.7	N/A	6.7	N/A	< 0.2	N/A	N/A	N/A	0.7	N/A	1.3
115	Burn-site Morel	N of YK/S of Whati	N/A	895.0	N/A	0.2	N/A	1.1	N/A	25.7	N/A	< 0.1	N/A	N/A	N/A	2.5	N/A	N/A
116	Burn-site Morel	N of YK/S of Whati	N/A	95.9	N/A	0.2	N/A	1.1	N/A	6.4	N/A	< 0.1	N/A	N/A	N/A	1	N/A	N/A
117	Burn-site Morel	N of YK/S of Whati	N/A	54.9	N/A	0.2	N/A	0.8	N/A	17.7	N/A	< 0.1	N/A	N/A	N/A	0.6	N/A	N/A
118	Burn-site Morel	N of YK/S of Whati	N/A	22.3	N/A	0.2	N/A	0.9	N/A	2.5	N/A	< 0.1	N/A	N/A	N/A	0.6	N/A	N/A
119	Burn-site Morel	50 km SW of Edzo	N/A	29.4	N/A	0.4	N/A	1.7	N/A	4.6	N/A	< 0.1	N/A	N/A	N/A	1	N/A	N/A
120	Burn-site Morel	50 km SW of Edzo	N/A	110.0	N/A	0.4	N/A	0.9	N/A	4.7	N/A	< 0.1	N/A	N/A	N/A	0.6	N/A	N/A
121	Burn-site Morel	50 km SW of Edzo	N/A	63.6	N/A	0.4	N/A	1.4	N/A	4.2	N/A	< 0.1	N/A	N/A	N/A	1.5	N/A	N/A
122	Burn-site Morel	50 km SW of Edzo	N/A	52.5	N/A	0.4	N/A	0.6	N/A	5.1	N/A	< 0.1	N/A	N/A	N/A	1.1	N/A	N/A
123	Burn-site Morel	50 km SW of Edzo	N/A	48.7	N/A	0.4	N/A	1.3	N/A	8.7	N/A	< 0.1	N/A	N/A	N/A	0.5	N/A	N/A
124	Burn-site Morel	50 km SW of Edzo	N/A	120.0	N/A	0.7	N/A	1.2	N/A	7.7	N/A	< 0.1	N/A	N/A	N/A	1.2	N/A	N/A

(Table F. continued on next page)

(Table F. continued)

Samples from other regions and imports			Total Metal Concentrations in µg/g dry weight															
Fungi	Mushroom	Location	Aluminum		Antimony		Arsenic		Barium		Beryllium		Bismuth		Cadmium		Cesium	
ID #	Species		Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi
125	Morel Mushroom	Alaska / Fairbanks	N/A	102.0	N/A	0.1	N/A	3.8	N/A	7.5	N/A	< 0.2	N/A	N/A	N/A	2.1	N/A	0.1
126	Morel Mushroom	Alaska / Fairbanks	N/A	< 30.0	N/A	0.1	N/A	1.3	N/A	12.3	N/A	< 0.2	N/A	N/A	N/A	2.2	N/A	0.2
127	Morel Mushroom	Alaska / Fairbanks	N/A	66.0	N/A	0.1	N/A	1.9	N/A	12.8	N/A	< 0.2	N/A	N/A	N/A	1.2	N/A	0.1
128	Morel Mushroom	Alaska / Fairbanks	N/A	273.0	N/A	0.3	N/A	7.2	N/A	20.6	N/A	< 0.2	N/A	N/A	N/A	1.1	N/A	0.2
129	Morel Mushroom	Alaska / Fairbanks	N/A	< 30.0	N/A	0.3	N/A	4.0	N/A	19.4	N/A	< 0.2	N/A	N/A	N/A	1.5	N/A	0.2
130	Morel Mushroom	Alaska / Fairbanks	N/A	< 30.0	N/A	0.1	N/A	11.1	N/A	7.3	N/A	< 0.2	N/A	N/A	N/A	0.6	N/A	0.1
131	Morel Mushroom	Alaska / Fairbanks	N/A	< 30.0	N/A	0.1	N/A	1.3	N/A	6.2	N/A	< 0.2	N/A	N/A	N/A	0.4	N/A	0.2
132	Morel Mushroom	Alaska / Fairbanks	N/A	336.0	N/A	0.6	N/A	6.3	N/A	41.9	N/A	< 0.2	N/A	N/A	N/A	0.2	N/A	0.1
133	Morel Mushroom	Alaska / Fairbanks	N/A	35.0	N/A	0.4	N/A	3.4	N/A	34.0	N/A	< 0.2	N/A	N/A	N/A	0.2	N/A	0.2
134	Morel Mushroom	Alaska / Fairbanks	N/A	< 30.0	N/A	0.3	N/A	< 1.0	N/A	9.5	N/A	< 0.2	N/A	N/A	N/A	0.2	N/A	0.1
135	Oyster Mushroom	BC import	N/A	165.0	N/A	0.4	N/A	< 0.5	N/A	2.7	N/A	< 0.2	N/A	N/A	N/A	0.4	N/A	< 0.1
136	Wood Ear	BC import	N/A	268.2	N/A	< 0.1	N/A	< 0.5	N/A	2.3	N/A	< 0.2	N/A	N/A	N/A	< 0.1	N/A	< 0.1
137	Wood Ear	BC import	N/A	275.4	N/A	< 0.1	N/A	< 0.5	N/A	2.5	N/A	< 0.2	N/A	N/A	N/A	< 0.1	N/A	< 0.1
138	Morel Mushroom	BC / US import	N/A	508.2	N/A	< 0.1	N/A	< 0.5	N/A	6.0	N/A	< 0.2	N/A	N/A	N/A	0.6	N/A	0.1
139	Morel Mushroom	BC / US import	N/A	974.8	N/A	< 0.1	N/A	< 0.5	N/A	6.5	N/A	< 0.2	N/A	N/A	N/A	0.6	N/A	< 0.1
140	Chinese Shiitake	Chinese import	N/A	505.4	N/A	< 0.1	N/A	0.5	N/A	4.1	N/A	< 0.2	N/A	N/A	N/A	0.3	N/A	0.2
141	Chinese Shiitake	Chinese import	N/A	465.0	N/A	< 0.1	N/A	< 0.5	N/A	2.2	N/A	< 0.2	N/A	N/A	N/A	0.5	N/A	0.1

Table G: Metal Concentrations (Chromium to Manganese) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 - 2009.

purple = samples in Obst *et al*. 2001 | blue = known unspoiled background area | orange = impacted area | yellow = backup samples 1997 - 1999

bold ID #s = shared soil samples | green = assumed undisturbed background area | **Total Metal Concentrations in µg/g dry weight**

Fungi	Mushroom	Location	Chromium		Cobalt		Copper		Iron		Lead		Lithium		Manganese	
ID #	Species	North Slave Region	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi
1	Burn-site Morel	100 km S of Edzo		0.2		< 0.1		24.8		62		< 0.1		< 0.2		20.5
2	Burn-site Morel	100 km S of Edzo		0.3		0.1		12.3		69		0.1		< 0.2		23.7
3	Burn-site Morel	100 km S of Edzo		0.4		< 0.1		19.1		78		0.3		< 0.2		16.8
4	Burn-site Morel	100 km S of Edzo		0.3		< 0.1		10.1		< 50		0.2		< 0.2		19.5
5	Burn-site Morel	100 km S of Edzo		0.2		< 0.1		9.2		52		0.1		< 0.2		16.9
6	Burn-site Morel	100 km S of Edzo		0.4		< 0.1		23.2		57		0.1		< 0.2		18.8
7	Burn-site Morel	100 km S of Edzo		0.4		< 0.1		21.1		74		0.2		< 0.2		21.9
8	Sand Bolete	46 km SW of Edzo	96.0	0.7	2.4	< 0.1	3.4	20.5	4600	497	3.0	< 0.1	6.0	< 0.3	138.0	6.3
9	Sand Bolete	46 km SW of Edzo	12.0	< 0.3	2.2	< 0.1	1.3	16.1	4800	870	3.0	< 0.1	5.0	< 0.3	1020.0	8.7
10	White Matsutake	46 km SW of Edzo	64.0	0.5	1.8	2.0	2.4	31.4	3900	76	3.0	< 0.1	5.4	< 0.3	147.0	12.9
11	Sand Bolete	46 km SW of Edzo	12.0	0.4	1.6	< 0.1	1.9	10.5	3900	783	3.0	0.2	4.8	< 0.3	340.0	3.5
12	Sand Bolete	46 km SW of Edzo	26.0	0.6	0.8	< 0.1	1.1	13.2	2500	1020	2.0	< 0.1	1.9	< 0.3	89.3	4.8
13	White Matsutake	46 km SW of Edzo		0.6		1.3		11.6		70		< 0.1		< 0.3		18.3
14	Red-capped Bolete	43 km SW of Edzo	2.2	0.3	0.6	0.1	1.4	31.9	600	300	11.3	22.2	1.7	0.3	236.0	2.8
15	Sand Bolete	43 km SW of Edzo	2.8	0.3	0.9	0.1	0.9	14.1	3300	2200	31.8	5.2	3.7	0.3	170.0	5.2
16	Sand Bolete	17 km SW of Edzo	3.0	0.7	0.6	0.2	3.1	9.2	1800	< 40	2.0	< 0.1	1.2	< 0.3	74.3	1.8
17	Hooded False Morel	2 km SW of Edzo	7.0	0.8	0.6	< 0.1	2.7	20.9	1600	< 40	2.0	< 0.1	< 0.6	< 0.3	17.8	16.9
18	Yellow Bolete	40 km W of YK	19.0	0.5	6.3	0.2	11.0	13.2	18200	< 40	10.0	< 0.1	15.1	< 0.3	611.0	5.7
19	Hollow-stem Bolete	YK Golf Course	8.7	0.5	1.0	0.2	2.2	6.4	3900	300	26.2	55.0	3.6	0.3	45.9	4.1
20	Puffball	YK Golf Course	5.6	0.4	1.0	0.1	1.8	103.0	2900	300	3.2	44.9	2.8	0.3	70.5	11.5
21	Red-capped Bolete	YK Golf Course	10.6	0.5	1.6	0.1	3.7	67.7	5400	300	12.2	46.0	6.9	0.3	74.9	9.8
22	Sand Bolete	YK Golf Course	14.3	1.6	1.8	1.2	1.8	20.8	7100	2900	7.6	509.0	11.6	0.3	76.8	7.7
23	White Matsutake	YK Golf Course	13.6	0.9	2.1	1.0	3.1	26.8	6700	300	4.7	13.5	9.9	0.3	146.0	6.0
24	White Matsutake	YK Golf Course		0.4		1.5		36.0		300		31.4		0.3		5.5
25	White Matsutake	YK Golf Course		0.4		1.1		25.6		76		0.2		0.2		7.1
26	Meadow Mushroom	YK Sewage Road	43.0	0.8	9.1	0.3	21.4	87.5	22000	75	5.0	< 0.1	18.4	< 0.3	327.0	10.1
27	Meadow Mushroom	YK Sewage Road	29.0	0.4	6.9	5.2	19.4	77.6	16400	45	5.0	0.3	14.8	< 0.3	266.0	8.6
28	Meadow Mushroom	YK Sewage Road		0.6		6.3		94.3		87		0.5		< 0.3		12.6
29	Shaggy Mane	YK Sewage Road	26.0	1.3	6.3	< 0.1	17.4	142.0	16500	91	5.0	< 0.1	15.6	< 0.3	313.0	10.2
30	Meadow Mushroom	YK Sewage Road	26.0	< 0.3	7.1	2.2	21.7	97.4	23500	44	7.0	0.1	21.0	< 0.3	340.0	11.3
31	Red-capped Bolete	YK Frame Lake	125.0	1.4	3.4	0.3	5.6	80.8	8800	54	4.0	< 0.1	13.2	< 0.3	1890.0	7.3

(Table G. continued on next page)

(Table G. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area						orange = impacted area			yellow = backup samples 1997 - 1999				
bold ID #s = shared soil samples			green = assumed undisturbed background area							**Total Metal Concentrations in μg/g dry weight**						
Fungi	**Mushroom**	**Location**	**Chromium**		**Cobalt**		**Copper**		**Iron**		**Lead**		**Lithium**		**Manganese**	
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**
31	Red-capped Bolete	YK Frame Lake	125.0	1.4	3.4	0.3	5.6	80.8	8800	54	4.0	< 0.1	13.2	< 0.3	1890.0	7.3
32	Red-capped Bolete	YK Frame Lake		0.9		0.5		77.0		121		0.2		< 0.3		9.6
33	Red-capped Bolete	YK Frame Lake		0.4		0.3		55.9		< 40		< 0.1		< 0.3		5.5
34	Fly Agaric	YK Frame Lake	40.0	3.3	5.4	0.4	18.1	44.2	13900	661	24.0	1.7	16.2	0.7	10.6	21.3
35	Birch Bolete	YK Frame Lake		0.9		0.1		17.3		56		< 0.1		< 0.3		11.8
36	Birch Bolete	YK Frame Lake		0.4		0.1		16.8		42		< 0.1		< 0.3		13.2
37	Birch Bolete	YK Frame Lake	36.0	0.7	4.5	0.4	12.1	15.8	11000	66	13.0	0.3	17.8	< 0.3	1.6	7.3
38	Birch Bolete	YK Frame Lake		2.7		0.4		14.5		209		0.5		0.4		7.8
39	Fly Agaric	YK Frame Lake	33.0	1.3	5.8	0.2	8.3	28.2	10100	71	30.0	0.2	15.3	< 0.3	22.4	8.0
40	Meadow Mushroom	YK Con Mine	34.0	1.2	19.5	0.9	326.0	176.0	43800	131	296.0	0.6	18.3	< 0.3	823.0	12.2
41	Meadow Mushroom	YK Con Mine		1.2		1.4		148.0		360		1.7		< 0.3		15.4
42	Birch Bolete	YK Con Mine	40.0	0.8	20.4	< 0.1	105.0	13.4	43300	90	207.0	1.1	17.5	< 0.3	795.0	7.1
43	Meadow Mushroom	YK Old Town	26.1	1.5	5.6	0.1	19.1	61.8	14700	300	92.1	1010.0	13.0	0.3	237.0	10.7
44	Puffball	YK Old Town	26.8	0.5	7.1	0.1	26.4	63.4	16100	300	16.3	26.8	15.4	0.3	226.0	8.7
45	Birch Bolete	YK Jolliffe Island	12.9	0.3	27.2	0.1	61.7	15.2	6800	300	126.0	67.0	3.6	0.3	1750.0	6.3
46	Fly Agaric	YK Jolliffe Island		1.9		0.1		32.5		96		0.6		< 0.3		5.5
47	Puffball	YK Jolliffe Island	33.1	1.4	9.2	0.2	9.6	140.0	36200	400	33.1	145.0	15.6	0.3	636.0	24.8
48	Red-capped Bolete	YK Jolliffe Island	25.5	0.8	2.6	0.1	4.9	32.2	11000	300	15.9	20.6	9.0	0.3	262.0	3.4
49	Shaggy Mane	YK Giant Mine	67.2	0.6	27.3	0.7	61.5	57.1	67100	400	62.4	71.3	22.3	0.3	1150.0	12.4
50	Shaggy Mane	YK Giant Mine		1.1		0.5		87.3		900		22.3		0.3		15.7
51	Meadow Mushroom	YK Giant Mine	49.0	1.2	20.1	8.4	57.7	106.0	47900	364	63.0	0.8	23.1	< 0.3	782.0	24.6
52	Shaggy Mane	YK Giant/Vee L.	43.9	0.8	12.7	0.1	30.0	40.0	31900	300	27.9	23.5	20.9	0.3	469.0	6.7
53	Birch Bolete	YK Vee Lake Rd.	15.3	1.1	3.8	0.1	15.7	8.1	6500	300	217.0	26.4	6.2	0.3	85.4	3.3
54	Hollow-stem Bolete	YK River Park	8.0	0.3	10.7	0.1	11.0	7.8	4100	300	122.0	65.7	2.4	0.3	500.0	3.2
55	Spring Agaricus	YK River Park	17.3	2.2	4.5	0.4	7.9	54.3	9700	400	22.1	511.0	12.2	0.3	109.0	9.4
56	Shaggy Mane	Yk Treminco Mine	83.7	2.0	27.6	0.8	37.6	81.2	43900	1100	17.5	24.2	32.3	0.7	450.0	16.5
57	Shaggy Mane	Yk Treminco Mine		1.1		0.9		68.1		500		18.6		0.3		10.0
58	Shaggy Mane	Yk Treminco Mine		0.7		1.0		77.3		212		0.3		0.3		12.0
59	Shaggy Mane	Yk Treminco Mine	32.0	0.6	9.1	0.2	20.3	51.5	20200	400	288.0	13.5	17.3	0.3	279.0	10.0
60	Forest Mushroom	Yk Treminco Mine	36.0	1.7	7.7	0.3	20.2	103.0	19800	1300	39.8	8.3	16.9	0.7	240.0	13.8
61	Tippler's Bane	Yk Treminco Mine	25.5	1.9	6.0	0.5	14.0	56.2	12900	1900	24.4	5.6	9.4	0.8	148.0	16.2
62	Red-capped Bolete	Prelude Lake Trail	26.0	0.9	4.5	0.1	5.7	6.6	14700	500	47.7	192.0	20.4	0.3	509.0	21.1

(Table G. continued on next page)

(Table G. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area							orange = impacted area			yellow = backup samples 1997 - 1999				
bold ID #s = shared soil samples			green = assumed undisturbed background area							**Total Metal Concentrations in µg/g dry weight**							
Fungi	**Mushroom**	**Location**	**Chromium**		**Cobalt**		**Copper**		**Iron**		**Lead**		**Lithium**		**Manganese**		
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	
63	Sand Bolete	Prelude Lake Trail	16.5	0.3	7.3	0.1	4.8	20.6	10400	2400	33.0	18.3	18.0	0.3	948.0	7.5	
64	White Matsutake	Prelude Lake Trail	27.2	0.9	5.7	0.9	7.8	29.0	16600	300	35.0	72.4	22.1	0.3	565.0	25.3	
65	Sand Bolete	Cameron Fall Trail	49.0	0.6	14.8	0.3	11.4	35.9	35000	447	6.0	< 0.1	28.5	< 0.3	1500.0	14.9	
66	Slippery Jack	Cameron Fall Trail	8.0	0.7	14.0	0.3	16.3	21.0	8100	< 40	3.0	< 0.1	5.1	< 0.3	897.0	10.7	
67	Birch Bolete	Cameron Fall Trail	9.0	0.3	3.5	< 0.1	14.0	9.1	6800	< 40	6.0	0.6	6.1	< 0.3	137.0	4.6	
68	White Matsutake	Ingraham Trail	N/A	0.7	N/A	0.9	N/A	14.1	N/A	700	N/A	294.0	N/A	0.3	N/A	14.1	
69	Red-capped Bolete	Cameron River Pk.	12.1	N/A	2.7	N/A	5.7	N/A	8000	N/A	21.1	N/A	8.9	N/A	116.0	N/A	
70	White Matsutake	Ingraham/C. Antler	N/A	4.1	N/A	1.6	N/A	46.1	N/A	94	N/A	< 0.1	N/A	< 0.3	N/A	10.8	
71	Birch Bolete	Ingraham/C. Antler	3.9	0.3	1.1	0.1	4.5	42.2	2900	300	7.8	11.7	1.4	0.3	357.0	5.6	
72	Larch Bolete	Ingraham/C. Antler	8.8	0.3	3.0	0.1	3.2	8.5	6700	300	10.6	27.7	6.2	0.3	282.0	7.1	
73	Red-capped Bolete	Ingraham/C. Antler	7.5	0.6	1.5	0.2	2.2	44.2	7000	300	17.1	12.0	6.0	0.3	340.0	6.9	
74	Red-capped Bolete	Ingraham/C. Antler		0.6		0.3		74.1		300		110.0		0.3		10.3	
75	Sand Bolete	Ingraham/C. Antler		0.3		0.2		34.7		3000		57.9		0.3		6.6	
76	Sarcodon	Ingraham/C. Antler		0.3		0.9		15.7		300		19.3		0.3		9.2	
77	White Matsutake	Ingraham/C. Antler	11.4	0.4	3.0	1.5	4.8	21.3	6900	300	66.5	17.6	6.6	0.3	428.0	11.1	
78	White Matsutake	Ingraham/C. Antler		0.3		0.5		25.9		300		16.9		0.3		3.9	
79	White Matsutake	Ingraham/C. Antler	N/A	0.9	N/A	1.1	N/A	14.1		131	N/A	< 0.1	N/A	< 0.3		12.4	
80	White Matsutake	Ingraham/C. Antler	N/A	0.7	N/A	1.2	N/A	17.9		208	N/A	0.1	N/A	< 0.3		9.7	
81	Hooded False Morel	Ingraham/Tibbitt L.	22.0	1.0	3.5	0.5	5.8	41.4	17300	71	8.0	0.2	11.1	< 0.3	111.0	24.3	
82	Birch Bolete	Ingraham/Tibbitt L.	23.0	1.3	3.7	0.2	5.9	15.9	18300	412	9.0	< 0.1	12.4	< 0.3	117.0	3.6	
83	Birch Bolete	Ingraham/Tibbitt L.		0.3		0.2		24.6		420		< 0.1		< 0.3		6.3	
84	Hooded False Morel	Ingraham/Tibbitt L.	60.0	0.4	28.4	0.6	59.4	45.3	35800	< 40	10.0	< 0.1	38.7	< 0.3	293.0	18.3	
85	Hooded False Morel	Ingraham/Tibbitt L.	18.0	0.4	4.7	0.4	7.1	29.2	15200	51	5.0	< 0.1	10.0	< 0.3	133.0	15.1	
86	Hooded False Morel	Ingraham/Tibbitt L.	34.0	0.5	9.4	0.3	44.1	51.0	28700	85	14.0	< 0.1	16.0	< 0.3	183.0	13.5	
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A	1.2	N/A	0.5	N/A	19.7	N/A	900	N/A	255.0	N/A	0.5	N/A	106.0	
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A	1.1	N/A	0.5	N/A	21.9	N/A	380	N/A	283.0	N/A	0.5	N/A	115.0	
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.5	N/A	0.2	N/A	22.0	N/A	105	N/A	0.4	N/A	< 0.2	N/A	67.8	
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.8	N/A	0.9	N/A	19.2	N/A	301	N/A	0.5	N/A	0.8	N/A	123.0	
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A	1.1	N/A	0.3	N/A	30.0	N/A	700	N/A	405.0	N/A	0.3	N/A	42.1	
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A	1.1	N/A	0.4	N/A	33.5	N/A	375	N/A	469.0	N/A	0.2	N/A	46.8	
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.6	N/A	0.1	N/A	15.2	N/A	900	N/A	867.0	N/A	0.3	N/A	46.8	
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.4	N/A	< 0.1	N/A	19.1	N/A	64	N/A	0.2	N/A	< 0.2	N/A	59.4	

(Table G. continued on next page)

(Table G. continued)

purple = samples in Obst *et al*. 2001	blue = known unspoiled background area	orange = impacted area	yellow = backup samples 1997 - 1999
bold ID #s = shared soil samples	green = assumed undisturbed background area	**Total Metal Concentrations in µg/g dry weight**	

Fungi ID #	**Mushroom Species**	**Location** North Slave Region	**Chromium** Soil	Fungi	**Cobalt** Soil	Fungi	**Copper** Soil	Fungi	**Iron** Soil	Fungi	**Lead** Soil	Fungi	**Lithium** Soil	Fungi	**Manganese** Soil	Fungi
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.9	N/A	< 0.1	N/A	18.5	N/A	404	N/A	993.0	N/A	< 0.2	N/A	55.2
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.3	N/A	0.1	N/A	13.6	N/A	300	N/A	50.5	N/A	0.3	N/A	33.1
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.4	N/A	< 0.1	N/A	16.2	N/A	80	N/A	55.2	N/A	0.3	N/A	37.8
98	Sand Bolete	Tibbitt Lake	3.0	0.3	0.5	0.2	0.6	23.5	2000	2100	10.7	7.2	1.9	0.3	29.0	7.8
99	Suillus	Tibbitt Lake	37.6	0.4	3.5	0.3	2.7	17.4	12400	300	12.7	23.0	7.6	0.3	103.0	4.9
100	Yellow Bolete	Tibbitt Lake	12.2	0.3	2.6	0.1	1.5	16.1	7100	1600	8.7	13.3	7.3	0.3	237.0	6.6
101	White Matsutake	Tibbitt Lake	39.1	0.3	8.4	1.3	11.6	15.3	20400	300	7.5	35.1	18.0	0.3	311.0	13.9
102	Fly Agaric	Tundra Jolly Lake	18.0	0.6	4.1	0.2	9.0	29.3	10700	43	2.0	0.3	12.8	< 0.3	148.0	5.9
103	Fly Agaric	Tundra Jolly Lake		0.8		0.2		25.3		< 40		< 0.1		< 0.3		6.0
104	Red-capped Bolete	Tundra Jolly Lake	29.0	0.4	4.2	0.3	6.8	75.5	1700	< 40	3.0	< 0.1	16.9	< 0.3	171.0	9.0
105	Birch Bolete	Tundra Jolly Lake	17.0	0.6	3.2	< 0.1	7.4	11.1	1400	< 40	2.0	< 0.1	9.3	< 0.3	112.0	5.6
106	Birch Bolete	Tundra Jolly Lake	3.0	0.8	2.5	< 0.1	6.4	8.2	4300	< 40	2.0	< 0.1	1.3	< 0.3	46.3	4.0
107	Birch Bolete	Tundra Jolly Lake	45.0	0.4	36.4	< 0.1	41.8	9.1	48300	48	14.0	0.1	37.3	< 0.3	1320.0	4.6
108	Birch Bolete	Tundra Jolly Lake		0.4		0.2		8.1		< 40		0.1		< 0.3		3.0
109	Birch Bolete	Tundra Daring L.	7.0	1.2	0.6	< 0.1	12.2	7.9	2100	13	3.0	< 0.1	3.8	< 0.3	249.0	2.5
110	Birch Bolete	Tundra Daring L.	6.0	1.2	1.0	< 0.1	12.9	5.1	1100	23	2.0	0.1	0.8	0.3	168.0	9.9
111	Birch Bolete	Tundra Daring L.	3.0	1.4	0.3	< 0.1	9.8	14.0	400	25	1.0	0.3	0.7	< 0.3	383.0	12.0
112	Burn-site Morel	Drybones Bay	N/A	0.4	N/A	< 0.2	N/A	11.5	N/A	109	N/A	< 0.2	N/A	< 0.4	N/A	87.6
113	Burn-site Morel	Drybones Bay	N/A	0.3	N/A	< 0.2	N/A	7.8	N/A	188	N/A	< 0.2	N/A	< 0.4	N/A	46.3
114	Burn-site Morel	Drybones Bay	N/A	0.4	N/A	< 0.2	N/A	13.3	N/A	164	N/A	< 0.2	N/A	0.4	N/A	55.0
115	Burn-site Morel	N of YK/S of Whati	N/A	2.7	N/A	0.7	N/A	36.2	N/A	1000	N/A	0.5	N/A	1.2	N/A	106.0
116	Burn-site Morel	N of YK/S of Whati	N/A	0.4	N/A	0.2	N/A	16.0	N/A	168	N/A	0.2	N/A	0.2	N/A	47.2
117	Burn-site Morel	N of YK/S of Whati	N/A	0.4	N/A	0.1	N/A	11.6	N/A	104	N/A	0.2	N/A	< 0.2	N/A	128.0
118	Burn-site Morel	N of YK/S of Whati	N/A	0.3	N/A	0.2	N/A	12.3	N/A	150	N/A	< 0.1	N/A	0.2	N/A	49.2
119	Burn-site Morel	50 km SW of Edzo	N/A	0.2	N/A	0.1	N/A	18.1	N/A	83.4	N/A	0.1	N/A	< 0.2	N/A	38.9
120	Burn-site Morel	50 km SW of Edzo	N/A	1.0	N/A	0.2	N/A	15.2	N/A	184	N/A	0.1	N/A	0.2	N/A	54.7
121	Burn-site Morel	50 km SW of Edzo	N/A	0.4	N/A	0.3	N/A	7.7	N/A	218	N/A	< 0.1	N/A	< 0.2	N/A	55.5
122	Burn-site Morel	50 km SW of Edzo	N/A	0.3	N/A	0.3	N/A	35.0	N/A	128	N/A	0.2	N/A	< 0.2	N/A	49.3
123	Burn-site Morel	50 km SW of Edzo	N/A	0.7	N/A	0.5	N/A	18.3	N/A	149	N/A	0.3	N/A	< 0.2	N/A	53.8
124	Burn-site Morel	50 km SW of Edzo	N/A	0.5	N/A	0.5	N/A	12.9	N/A	199	N/A	0.1	N/A	0.7	N/A	68.9

(Table G. continued on next page)

(Table G. continued)

Samples from other regions and imports			Total Metal Concentrations in µg/g dry weight													
Fungi ID #	Mushroom Species	Location	Chromium Soil	Chromium Fungi	Cobalt Soil	Cobalt Fungi	Copper Soil	Copper Fungi	Iron Soil	Iron Fungi	Lead Soil	Lead Fungi	Lithium Soil	Lithium Fungi	Manganese Soil	Manganese Fungi
125	Morel Mushroom	Alaska / Fairbanks	N/A	1.5	N/A	0.2	N/A	23.3	N/A	140	N/A	1.6	N/A	0.5	N/A	36.6
126	Morel Mushroom	Alaska / Fairbanks	N/A	1.4	N/A	0.3	N/A	33.9	N/A	109	N/A	0.1	N/A	< 0.3	N/A	76.4
127	Morel Mushroom	Alaska / Fairbanks	N/A	1.5	N/A	0.1	N/A	23.6	N/A	205	N/A	0.4	N/A	0.3	N/A	77.7
128	Morel Mushroom	Alaska / Fairbanks	N/A	2.9	N/A	0.7	N/A	29.8	N/A	484	N/A	0.4	N/A	1.0	N/A	101.0
129	Morel Mushroom	Alaska / Fairbanks	N/A	1.0	N/A	0.5	N/A	31.1	N/A	68	N/A	0.1	N/A	0.7	N/A	61.7
130	Morel Mushroom	Alaska / Fairbanks	N/A	1.3	N/A	0.1	N/A	26.9	N/A	95	N/A	0.2	N/A	< 0.3	N/A	37.0
131	Morel Mushroom	Alaska / Fairbanks	N/A	1.2	N/A	0.1	N/A	27.0	N/A	80	N/A	0.5	N/A	0.3	N/A	52.1
132	Morel Mushroom	Alaska / Fairbanks	N/A	1.8	N/A	0.9	N/A	38.9	N/A	533	N/A	0.5	N/A	5.2	N/A	103.0
133	Morel Mushroom	Alaska / Fairbanks	N/A	1.2	N/A	0.3	N/A	24.5	N/A	137	N/A	0.4	N/A	1.9	N/A	62.9
134	Morel Mushroom	Alaska / Fairbanks	N/A	1.0	N/A	0.1	N/A	27.7	N/A	79	N/A	0.4	N/A	0.9	N/A	36.5
135	Oyster Mushroom	BC import	N/A	1.5	N/A	< 0.1	N/A	13.6	N/A	130	N/A	1.9	N/A	< 0.3	N/A	13.2
136	Wood Ear	BC import	N/A	0.7	N/A	< 0.1	N/A	2.3	N/A	56	N/A	0.3	N/A	< 0.3	N/A	3.1
137	Wood Ear	BC import	N/A	0.7	N/A	< 0.1	N/A	4.4	N/A	65	N/A	0.3	N/A	< 0.3	N/A	4.5
138	Morel Mushroom	BC / US import	N/A	1.6	N/A	0.2	N/A	29.1	N/A	317	N/A	0.2	N/A	< 0.3	N/A	52.8
139	Morel Mushroom	BC / US import	N/A	1.2	N/A	0.3	N/A	27.2	N/A	607	N/A	0.2	N/A	< 0.3	N/A	48.9
140	Chinese Shiitake	Chinese import	N/A	< 0.3	N/A	< 0.1	N/A	9.6	N/A	111	N/A	0.3	N/A	< 0.3	N/A	26.4
141	Chinese Shiitake	Chinese import	N/A	2.4	N/A	0.1	N/A	13.5	N/A	150	N/A	0.3	N/A	< 0.3	N/A	23.6

Table H: Metal Concentrations (Mercury to Strontium) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 - 2009.

purple = samples in Obst *et al*. 2001 | blue = known unspoiled background area | orange = impacted area | yellow = backup samples 1997 - 1999

bold ID #s = shared soil samples | green = assumed undisturbed background area

Total Metal Concentrations in µg/g dry weight

Fungi ID #	Mushroom Species	Location North Slave Region	Mercury Soil	Mercury Fungi	Molybdenum Soil	Molybdenum Fungi	Nickel Soil	Nickel Fungi	Rubidium Soil	Rubidium Fungi	Selenium Soil	Selenium Fungi	Silver Soil	Silver Fungi	Strontium Soil	Strontium Fungi
1	Burn-site Morel	100 km S of Edzo		< 0.02		0.1		0.9		13.2		< 0.3		< 0.1		22.0
2	Burn-site Morel	100 km S of Edzo		< 0.02		0.3		0.7		19.1		< 0.3		< 0.1		35.9
3	Burn-site Morel	100 km S of Edzo		< 0.02		0.2		0.5		13.0		< 0.3		0.2		47.6
4	Burn-site Morel	100 km S of Edzo		< 0.02		0.2		0.3		21.0		< 0.3		< 0.1		11.2
5	Burn-site Morel	100 km S of Edzo		< 0.02		0.2		0.3		28.3		< 0.3		< 0.1		18.5
6	Burn-site Morel	100 km S of Edzo		< 0.02		0.2		0.9		15.0		0.3		< 0.1		8.4
7	Burn-site Morel	100 km S of Edzo		< 0.02		0.2		0.7		15.4		< 0.3		< 0.1		11.0
8	Sand Bolete	46 km SW of Edzo	< 0.005	0.17	**1.7**	0.2	**47.0**	< 0.1	10.8	162.0	< 2.0	< 1.0	< 0.2	0.1	**21.2**	0.2
9	Sand Bolete	46 km SW of Edzo	< 0.005	0.13	0.3	0.1	6.0	< 0.1	8.3	133.0	< 2.0	< 1.0	< 0.2	< 0.1	15.5	0.1
10	White Matsutake	46 km SW of Edzo	< 0.005	0.38	**1.1**	< 0.1	**33.0**	0.3	9.3	172.0	< 2.0	2.0	< 0.2	0.3	19.7	0.6
11	Sand Bolete	46 km SW of Edzo	< 0.005	0.08	0.2	0.1	6.0	< 0.1	8.5	79.9	< 2.0	< 1.0	< 0.2	0.1	12.9	0.3
12	Sand Bolete	46 km SW of Edzo	< 0.005	0.10	0.6	0.1	15.0	< 0.1	8.9	72.5	< 2.0	< 1.0	< 0.2	< 0.1	8.9	0.2
13	White Matsutake	46 km SW of Edzo		0.21		< 0.1		0.2		150.0		1.0		0.3		0.6
14	Red-capped Bolete	43 km SW of Edzo	0.020	0.48	0.2	0.3	1.7	0.1	6.0	96.5	2.0	2.4	0.2	0.5	10.2	0.1
15	Sand Bolete	43 km SW of Edzo	0.010	0.15	0.2	0.1	2.0	0.2	7.0	68.3	2.0	1.0	0.2	0.2	12.1	0.2
16	Sand Bolete	17 km SW of Edzo	0.010	0.16	0.3	0.2	4.0	< 0.1	3.5	107.0	< 2.0	3.0	< 0.2	0.2	**21.6**	0.4
17	Hooded False Morel	2 km SW of Edzo	0.010	0.05	0.5	0.4	7.0	0.3	3.7	24.0	< 2.0	< 1.0	< 0.2	0.2	9.7	**1.4**
18	Yellow Bolete	40 km W of YK	0.010	0.01	0.7	0.2	17.0	< 0.1	**36.4**	**299.0**	< 2.0	2.0	0.3	0.3	**63.7**	**1.2**
19	Hollow-stem Bolete	YK Golf Course	0.040	0.14	0.2	0.1	4.7	0.2	5.9	78.1	2.0	1.0	0.2	0.2	6.4	0.1
20	Puffball	YK Golf Course	0.020	**1.05**	0.2	0.3	2.8	0.3	6.0	31.1	2.0	1.9	0.2	**5.1**	6.7	0.7
21	Red-capped Bolete	YK Golf Course	0.020	0.22	0.2	**0.8**	5.5	0.4	8.2	87.6	2.0	**5.6**	0.2	0.7	10.0	0.2
22	Sand Bolete	YK Golf Course	0.020	0.13	0.2	0.2	6.8	0.2	8.4	112.0	2.0	1.0	0.2	0.4	6.2	0.3
23	White Matsutake	YK Golf Course	0.010	**0.67**	0.2	0.1	6.7	0.4	6.7	**252.0**	2.0	2.8	0.2	**3.6**	6.2	0.4
24	White Matsutake	YK Golf Course		**1.70**		0.1		0.4		**231.0**		2.5		**5.7**		0.4
25	White Matsutake	YK Golf Course		0.75		< 0.1		0.4		263.0		4.3		3.0		0.5
26	Meadow Mushroom	YK Sewage Road	0.010	**0.70**	0.6	0.2	**30.0**	0.5	14.2	19.6	< 2.0	**6.0**	0.2	**13.5**	15.6	0.6
27	Meadow Mushroom	YK Sewage Road	0.010	**0.65**	0.5	0.1	**23.0**	0.2	10.2	10.2	< 2.0	**5.0**	< 0.2	**2.0**	11.8	0.6
28	Meadow Mushroom	YK Sewage Road		**0.97**		0.1		0.4		14.1		**6.0**		**1.8**		0.8
29	Shaggy Mane	YK Sewage Road	0.030	**2.69**	0.4	0.1	19.0	0.3	9.0	53.5	2.0	2.0	< 0.2	0.4	**21.0**	0.7
30	Meadow Mushroom	YK Sewage Road	0.010	**0.54**	**1.0**	0.1	**22.0**	0.3	**24.0**	14.5	< 2.0	**6.0**	0.2	**8.3**	**43.8**	0.2
31	Red-capped Bolete	YK Frame Lake	< 0.005	0.12	**2.2**	**0.7**	**62.0**	0.5	13.6	135.0	2.0	2.0	< 0.2	**1.5**	12.6	0.2

(Table H. continued on next page)

(Table H. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area						orange = impacted area		yellow = backup samples 1997 - 1999					
bold ID #s = shared soil samples			green = assumed undisturbed background area						**Total Metal Concentrations in μg/g dry weight**							
Fungi	**Mushroom**	**Location**	**Mercury**		**Molybdenum**		**Nickel**		**Rubidium**		**Selenium**		**Silver**		**Strontium**	
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**
32	Red-capped Bolete	YK Frame Lake		0.09		**0.7**		**1.2**		142.0		1.0		0.6		**1.6**
33	Red-capped Bolete	YK Frame Lake		0.07		**0.5**		0.3		132.0		1.0		0.9		0.2
34	Fly Agaric	YK Frame Lake	0.030	0.14	0.7	< 0.1	**22.0**	**2.0**	15.4	**203.0**	< 2.0	3.0	0.2	**5.5**	16.9	**5.3**
35	Birch Bolete	YK Frame Lake		0.16		**0.7**		0.3		39.1		< 1.0		0.3		0.5
36	Birch Bolete	YK Frame Lake		0.15		**0.7**		0.3		37.5		< 1.0		0.3		0.8
37	Birch Bolete	YK Frame Lake	< 0.005	0.03	0.6	**0.5**	19.0	0.5	14.4	101.0	2.0	< 1.0	< 0.2	0.5	13.6	0.6
38	Birch Bolete	YK Frame Lake		0.05		0.4		0.7		93.2		< 1.0		0.5		**2.1**
39	Fly Agaric	YK Frame Lake	0.010	0.07	0.4	< 0.1	17.0	0.9	12.9	52.1	< 2.0	< 1.0	< 0.2	**2.8**	11.1	0.7
40	Meadow Mushroom	YK Con Mine	0.360	0.22	**1.3**	0.2	**50.0**	0.9	16.5	13.0	< 2.0	**4.0**	**2.5**	**3.6**	**53.4**	**2.6**
41	Meadow Mushroom	YK Con Mine		0.25		0.1		0.6		10.4		3.0		**7.1**		**1.4**
42	Birch Bolete	YK Con Mine	0.090	0.05	**1.0**	0.3	**45.0**	0.5	16.5	44.1	< 2.0	< 1.0	**1.9**	0.2	**64.9**	0.8
43	Meadow Mushroom	YK Old Town	0.050	0.48	**1.2**	0.4	16.5	0.6	15.0	1.8	2.0	**6.5**	0.2	**17.7**	**40.7**	**1.5**
44	Puffball	YK Old Town	0.050	0.24	**1.3**	0.4	**20.5**	0.2	15.6	1.0	2.0	1.0	0.2	**1.1**	**30.0**	0.5
45	Birch Bolete	YK Jolliffe Island	0.300	0.32	**1.0**	**0.5**	**36.4**	0.5	5.5	88.1	2.0	1.0	0.4	0.2	**56.0**	0.4
46	Fly Agaric	YK Jolliffe Island		0.14		< 0.1		0.5		50.6		**6.0**		**2.8**		0.6
47	Puffball	YK Jolliffe Island	0.120	**1.31**	0.6	**0.5**	18.7	0.8	**22.4**	17.8	2.0	1.9	0.2	**7.4**	17.3	0.7
48	Red-capped Bolete	YK Jolliffe Island	0.080	0.06	**9.4**	0.4	11.7	0.3	11.3	42.0	2.0	2.1	0.2	0.7	9.9	0.1
49	Shaggy Mane	YK Giant Mine	0.160	**1.67**	0.5	0.2	**51.7**	0.8	7.7	24.1	2.0	1.3	0.5	**2.0**	**32.3**	**1.4**
50	Shaggy Mane	YK Giant Mine		**4.29**		0.2		0.6		23.8		1.6		**3.1**		0.5
51	Meadow Mushroom	YK Giant Mine	0.100	**1.33**	0.8	0.2	**46.0**	0.8	13.2	4.1	< 2.0	2.0	**1.6**	**7.1**	**22.7**	0.8
52	Shaggy Mane	YK Giant/Vee L.	0.050	**1.13**	0.7	0.1	**29.5**	0.1	19.5	9.4	2.0	1.0	0.3	**1.3**	**52.4**	0.8
53	Birch Bolete	YK Vee Lake Rd.	0.140	0.14	**1.2**	0.2	11.7	0.1	8.5	81.5	2.0	1.0	0.2	0.3	**25.1**	0.1
54	Hollow-stem Bolete	YK River Park	0.170	0.14	**2.1**	0.1	10.3	0.1	7.0	149.0	2.0	1.0	0.2	0.6	**57.0**	0.1
55	Spring Agaricus	YK River Park	0.010	**1.65**	0.5	0.2	15.9	**27.8**	12.0	11.9	2.0	2.9	0.2	**15.8**	15.0	0.8
56	Shaggy Mane	Yk Treminco Mine	0.010	0.24	**1.2**	0.2	**94.8**	**2.1**	**40.2**	11.8	2.0	1.0	0.2	0.9	17.2	**3.6**
57	Shaggy Mane	Yk Treminco Mine		**0.80**		0.1		0.5		183.0		3.0		**1.5**		**1.1**
58	Shaggy Mane	Yk Treminco Mine		0.65		0.2		0.7		178.0		2.1		1.2		1.5
59	Shaggy Mane	Yk Treminco Mine	0.020	**0.63**	0.6	0.1	**21.0**	0.3	19.4	13.4	2.0	1.0	0.2	**1.9**	14.9	0.7
60	Forest Mushroom	Yk Treminco Mine	0.020	**0.71**	0.6	0.3	**21.9**	**3.2**	**20.0**	1.5	2.0	2.1	0.2	**24.2**	17.0	**1.4**
61	Tippler's Bane	Yk Treminco Mine	0.010	0.04	0.8	**0.5**	13.2	**1.4**	13.4	44.1	2.0	1.0	0.2	**1.0**	5.6	**2.9**
62	Red-capped Bolete	Prelude Lake Trail	0.010	0.06	0.2	0.4	13.6	0.5	**21.2**	60.5	2.0	1.0	0.2	0.1	11.0	0.7
63	Sand Bolete	Prelude Lake Trail	0.020	0.33	0.2	0.1	9.4	0.1	**23.2**	60.1	2.0	1.0	0.2	0.3	9.1	0.3

(Table H. continued on next page)

(Table H. continued)

purple = samples in Obst *et al*. 2001 | blue = known unspoiled background area | orange = impacted area | yellow = backup samples 1997 - 1999

bold ID #s = shared soil samples | green = assumed undisturbed background area | **Total Metal Concentrations in µg/g dry weight**

Fungi ID #	Mushroom Species	Location North Slave Region	Mercury Soil	Mercury Fungi	Molybdenum Soil	Molybdenum Fungi	Nickel Soil	Nickel Fungi	Rubidium Soil	Rubidium Fungi	Selenium Soil	Selenium Fungi	Silver Soil	Silver Fungi	Strontium Soil	Strontium Fungi
64	White Matsutake	Prelude Lake Trail	0.020	**0.67**	0.2	0.1	15.4	0.4	**23.8**	123.0	2.0	3.0	0.2	**4.4**	10.6	0.6
65	Sand Bolete	Cameron Fall Trail	0.010	0.34	0.6	0.2	**45.0**	0.6	**43.7**	135.0	< 2.0	< 1.0	0.2	0.1	11.1	0.6
66	Slippery Jack	Cameron Fall Trail	0.040	0.08	0.7	0.1	12.0	0.3	7.3	195.0	< 2.0	< 1.0	< 0.2	0.1	**51.5**	0.5
67	Birch Bolete	Cameron Fall Trail	0.020	0.13	0.3	0.3	11.0	0.3	6.5	84.2	< 2.0	< 1.0	< 0.2	< 0.1	16.0	0.1
68	White Matsutake	Ingraham Trail	N/A	**0.59**	N/A	0.1	N/A	0.7	N/A	**264.0**	N/A	3.0	N/A	**3.7**	N/A	0.3
69	Red-capped Bolete	Cameron River Pk.	0.010	N/A	0.2	N/A	7.4	N/A	10.0	N/A	2.0	N/A	0.2	N/A	14.2	N/A
70	White Matsutake	Ingraham/C. Antler	N/A	**0.59**	N/A	0.1	N/A	0.3	N/A	152.0	N/A	**4.0**	N/A	**2.6**	N/A	0.6
71	Birch Bolete	Ingraham/C. Antler	0.030	0.12	0.2	**0.5**	3.4	0.2	4.6	115.0	2.0	1.4	0.2	**1.8**	**21.3**	0.1
72	Larch Bolete	Ingraham/C. Antler	0.010	0.10	0.2	0.2	6.3	0.2	10.3	**246.0**	2.0	1.0	0.2	**1.3**	11.8	0.4
73	Red-capped Bolete	Ingraham/C. Antler	0.020	0.17	0.2	**0.6**	3.8	0.3	7.1	87.3	2.0	1.9	0.2	**1.9**	8.0	0.2
74	Red-capped Bolete	Ingraham/C. Antler		0.41		**0.7**		0.3		186.0		2.9		**2.0**		0.2
75	Sand Bolete	Ingraham/C. Antler		0.22		0.2		0.2		142.0		1.0		0.4		0.4
76	Sarcodon	Ingraham/C. Antler		**0.57**		0.1		0.4		**422.0**		**5.0**		0.6		0.3
77	White Matsutake	Ingraham/C. Antler	0.010	**0.58**	0.2	0.1	6.6	0.3	10.9	**207.0**	2.0	3.6	0.2	**6.0**	14.7	0.5
78	White Matsutake	Ingraham/C. Antler		**0.64**		0.1		0.3		**521.0**		**4.7**		**5.4**		**1.3**
79	White Matsutake	Ingraham/C. Antler	N/A	0.22	N/A	< 0.1	N/A	0.3	N/A	**227.0**	N/A	3.0	N/A	0.3	N/A	**1.8**
80	White Matsutake	Ingraham/C. Antler	N/A	0.28	N/A	< 0.1	N/A	0.5	N/A	104.0	N/A	3.0	N/A	**4.4**	N/A	**2.4**
81	Hooded False Morel	Ingraham/Tibbitt L.	0.020	0.07	**1.0**	0.2	12.0	0.7	6.3	18.3	< 2.0	< 1.0	< 0.2	0.2	6.7	**2.3**
82	Birch Bolete	Ingraham/Tibbitt L.	0.010	**0.70**	**1.0**	0.2	13.0	0.4	7.0	48.7	< 2.0	< 1.0	< 0.2	< 0.1	7.3	0.4
83	Birch Bolete	Ingraham/Tibbitt L.		0.29		0.2		0.3		72.5		< 1.0		0.2		**7.4**
84	Hooded False Morel	Ingraham/Tibbitt L.	0.020	0.06	**1.2**	0.2	**107.0**	**1.0**	16.0	23.0	< 2.0	< 1.0	0.2	0.1	18.5	**2.5**
85	Hooded False Morel	Ingraham/Tibbitt L.	< 0.005	0.05	0.4	0.1	13.0	0.7	8.8	17.6	< 2.0	< 1.0	0.3	0.2	10.0	**1.7**
86	Hooded False Morel	Ingraham/Tibbitt L.	0.010	0.05	0.9	0.3	**39.0**	0.6	9.6	21.8	< 2.0	< 1.0	0.3	0.3	16.2	**1.6**
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.08	N/A	0.3	N/A	**1.4**	N/A	20.3	N/A	1.0	N/A	0.1	N/A	**23.8**
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.02	N/A	0.3	N/A	1.5	N/A	20.7	N/A	0.4	N/A	< 0.1	N/A	23.4
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.02	N/A	0.2	N/A	0.8	N/A	4.5	N/A	< 0.3	N/A	< 0.1	N/A	11.9
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.02	N/A	0.3	N/A	1.7	N/A	43.0	N/A	< 0.3	N/A	< 0.1	N/A	14.9
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.04	N/A	0.2	N/A	**1.6**	N/A	14.7	N/A	1.0	N/A	0.1	N/A	**11.8**
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.03	N/A	0.2	N/A	1.6	N/A	14.4	N/A	< 0.3	N/A	< 0.1	N/A	11.5
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.03	N/A	0.2	N/A	0.7	N/A	20.0	N/A	1.0	N/A	0.1	N/A	1.9
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.02	N/A	0.2	N/A	0.5	N/A	19.9	N/A	< 0.3	N/A	< 0.1	N/A	2.8
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.02	N/A	0.3	N/A	0.9	N/A	21.6	N/A	< 0.3	N/A	< 0.1	N/A	2.2

(Table H. continued on next page)

(Table H. continued)

purple = samples in Obst *et al*. 2001			blue = known unspoiled background area						orange = impacted area		yellow = backup samples 1997 - 1999					
bold ID #s = shared soil samples			green = assumed undisturbed background area						**Total Metal Concentrations in µg/g dry weight**							
Fungi	**Mushroom**	**Location**	**Mercury**		**Molybdenum**		**Nickel**		**Rubidium**		**Selenium**		**Silver**		**Strontium**	
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.03	N/A	0.1	N/A	0.5	N/A	9.4	N/A	1.0	N/A	0.1	N/A	2.5
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.02	N/A	0.2	N/A	0.6	N/A	9.9	N/A	< 0.3	N/A	< 0.1	N/A	2.7
98	Sand Bolete	Tibbitt Lake	0.010	0.14	0.2	0.6	1.5	0.3	4.2	89.0	2.0	1.0	0.2	0.5	8.2	0.3
99	Suillus	Tibbitt Lake	0.020	0.15	0.4	0.2	10.1	0.4	12.4	172.0	2.0	**8.1**	0.2	0.7	7.7	0.4
100	Yellow Bolete	Tibbitt Lake	0.010	0.13	0.2	0.2	6.3	0.2	11.6	**202.0**	2.0	1.0	0.2	0.4	10.7	0.2
101	White Matsutake	Tibbitt Lake	0.030	**0.58**	0.5	0.1	**24.6**	0.8	14.4	**225.0**	2.0	**9.3**	0.2	**2.3**	10.5	0.6
102	Fly Agaric	Tundra Jolly Lake	0.010	0.19	0.2	< 0.1	13.0	0.3	12.1	96.0	< 2.0	1.0	< 0.2	0.6	12.5	0.5
103	Fly Agaric	Tundra Jolly Lake		0.11		< 0.1		0.3		113.0		2.0		0.5		0.2
104	Red-capped Bolete	Tundra Jolly Lake	< 0.005	0.27	0.4	**0.6**	15.0	0.5	15.0	133.0	2.0	**5.0**	< 0.2	0.2	12.3	0.4
105	Birch Bolete	Tundra Jolly Lake	0.050	0.08	0.2	0.3	11.0	0.2	15.3	133.0	< 2.0	< 1.0	< 0.2	0.2	10.2	0.3
106	Birch Bolete	Tundra Jolly Lake	0.010	0.08	0.5	0.2	7.0	0.3	4.3	52.1	< 2.0	< 1.0	< 0.2	0.1	**21.0**	0.2
107	Birch Bolete	Tundra Jolly Lake	0.040	0.11	0.6	0.3	**49.0**	0.3	**53.8**	186.0	< 2.0	< 1.0	0.4	0.2	**37.6**	0.3
108	Birch Bolete	Tundra Jolly Lake		0.04		0.2		0.3		189.0		< 1.0		< 0.1		< 0.1
109	Birch Bolete	Tundra Daring L.	0.070	0.03	**1.0**	0.2	3.0	< 0.1	15.7	**250.0**	< 2.0	< 1.0	< 0.2	0.2	17.6	0.2
110	Birch Bolete	Tundra Daring L.	< 0.005	0.01	**1.3**	0.3	5.0	< 0.1	5.4	165.0	< 2.0	< 1.0	< 0.2	0.3	19.5	0.4
111	Birch Bolete	Tundra Daring L.	0.100	0.07	**1.1**	0.4	2.0	< 0.1	12.5	**276.0**	< 2.0	< 1.0	< 0.2	0.6	9.9	0.3
112	Burn-site Morel	Drybones Bay	N/A	N/A	N/A	0.6	N/A	1.4	N/A	18.9	N/A	< 1.0	N/A	< 0.2	N/A	8.1
113	Burn-site Morel	Drybones Bay	N/A	N/A	N/A	< 0.2	N/A	1.1	N/A	16.7	N/A	< 1.0	N/A	< 0.2	N/A	5.1
114	Burn-site Morel	Drybones Bay	N/A	N/A	N/A	< 0.2	N/A	1.4	N/A	125.0	N/A	< 1.0	N/A	< 0.2	N/A	5.7
115	Burn-site Morel	N of YK/S of Whati	N/A	0.02	N/A	0.3	N/A	3.5	N/A	N/A	N/A	0.5	N/A	0.4	N/A	27.5
116	Burn-site Morel	N of YK/S of Whati	N/A	0.02	N/A	0.3	N/A	1.4	N/A	N/A	N/A	0.5	N/A	0.2	N/A	4.0
117	Burn-site Morel	N of YK/S of Whati	N/A	0.01	N/A	0.2	N/A	1.3	N/A	N/A	N/A	0.5	N/A	0.1	N/A	8.4
118	Burn-site Morel	N of YK/S of Whati	N/A	0.01	N/A	0.1	N/A	1.1	N/A	N/A	N/A	0.5	N/A	< 0.1	N/A	1.7
119	Burn-site Morel	50 km SW of Edzo	N/A	0.04	N/A	0.3	N/A	1.7	N/A	N/A	N/A	0.5	N/A	< 0.1	N/A	4.6
120	Burn-site Morel	50 km SW of Edzo	N/A	0.01	N/A	0.3	N/A	1.4	N/A	N/A	N/A	0.5	N/A	< 0.1	N/A	2.3
121	Burn-site Morel	50 km SW of Edzo	N/A	< 0.01	N/A	0.2	N/A	1.1	N/A	N/A	N/A	0.5	N/A	< 0.1	N/A	2.1
122	Burn-site Morel	50 km SW of Edzo	N/A	0.05	N/A	0.2	N/A	1.2	N/A	N/A	N/A	0.5	N/A	0.2	N/A	3.0
123	Burn-site Morel	50 km SW of Edzo	N/A	< 0.01	N/A	0.4	N/A	1.7	N/A	N/A	N/A	0.5	N/A	< 0.1	N/A	5.0
124	Burn-site Morel	50 km SW of Edzo	N/A	< 0.01	N/A	0.3	N/A	2.1	N/A	N/A	N/A	0.5	N/A	< 0.1	N/A	3.1

(Table H. continued on next page)

(Table H. continued)

Samples from other regions and imports			Total Metal Concentrations in µg/g dry weight													
Fungi	Mushroom	Location	Mercury		Molybdenum		Nickel		Rubidium		Selenium		Silver		Strontium	
ID #	Species		Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi
125	Morel Mushroom	Alaska / Fairbanks	N/A	0.04	N/A	0.1	N/A	< 0.1	N/A	8.8	N/A	< 1.0	N/A	0.2	N/A	**5.6**
126	Morel Mushroom	Alaska / Fairbanks	N/A	0.01	N/A	0.1	N/A	0.4	N/A	9.3	N/A	< 1.0	N/A	0.3	N/A	**14.8**
127	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.01	N/A	< 0.1	N/A	0.6	N/A	7.4	N/A	< 1.0	N/A	0.3	N/A	**10.4**
128	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.13	N/A	< 0.1	N/A	< 0.1	N/A	10.7	N/A	< 1.0	N/A	0.2	N/A	**12.6**
129	Morel Mushroom	Alaska / Fairbanks	N/A	0.01	N/A	**0.6**	N/A	**1.1**	N/A	9.2	N/A	< 1.0	N/A	0.3	N/A	**41.1**
130	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.01	N/A	0.2	N/A	0.4	N/A	6.1	N/A	< 1.0	N/A	0.3	N/A	**4.3**
131	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.01	N/A	0.1	N/A	0.9	N/A	8.6	N/A	< 1.0	N/A	0.1	N/A	**8.1**
132	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.01	N/A	**2.2**	N/A	**1.2**	N/A	8.8	N/A	**6.0**	N/A	0.3	N/A	**130.0**
133	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.01	N/A	**3.3**	N/A	0.9	N/A	14.8	N/A	2.0	N/A	0.1	N/A	**82.8**
134	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.01	N/A	**0.6**	N/A	0.5	N/A	14.2	N/A	1.0	N/A	0.2	N/A	**32.8**
135	Oyster Mushroom	BC import	N/A	0.02	N/A	0.2	N/A	**1.2**	N/A	10.1	N/A	< 1.0	N/A	0.3	N/A	0.7
136	Wood Ear	BC import	N/A	0.07	N/A	0.1	N/A	0.3	N/A	5.7	N/A	< 1.0	N/A	< 0.1	N/A	**9.7**
137	Wood Ear	BC import	N/A	0.06	N/A	0.1	N/A	0.1	N/A	3.0	N/A	< 1.0	N/A	< 0.1	N/A	**10.8**
138	Morel Mushroom	BC / US import	N/A	0.05	N/A	0.2	N/A	0.6	N/A	14.5	N/A	< 1.0	N/A	0.1	N/A	**11.4**
139	Morel Mushroom	BC / US import	N/A	0.08	N/A	0.2	N/A	0.8	N/A	3.7	N/A	< 1.0	N/A	< 0.1	N/A	**6.9**
140	Chinese Shiitake	Chinese import	N/A	0.06	N/A	0.3	N/A	< 0.1	N/A	90.7	N/A	< 1.0	N/A	< 0.1	N/A	**1.4**
141	Chinese Shiitake	Chinese import	N/A	0.06	N/A	0.3	N/A	0.1	N/A	70.0	N/A	< 1.0	N/A	< 0.1	N/A	**1.3**

Table I: Metal Concentrations (Thalium to Zinc) in Soil and Mushrooms from the North Slave Region, Northwest Territories, and in comparable Mushrooms from Other Regions, 1997 - 2009.

purple = samples in Obst *et al*. 2001 | blue = unspoiled background area | orange = impacted area | Metal in µg/g dry weight

bold ID #s = shared soil samples | green = assumed undisturbed background area | yellow = backup samples 1997 - 1999

Fungi ID #	Mushroom Species	Location North Slave Region	Thallium Soil	Thallium Fungi	Titanium Soil	Titanium Fungi	Uranium Soil	Uranium Fungi	Vanadium Soil	Vanadium Fungi	Zinc Soil	Zinc Fungi
1	Burn-site Morel	100 km S of Edzo		< 0.1		2.8		< 0.1		0.4		83.5
2	Burn-site Morel	100 km S of Edzo		< 0.1		3.2		0.3		0.4		142.6
3	Burn-site Morel	100 km S of Edzo		< 0.1		2.8		< 0.1		0.3		116.9
4	Burn-site Morel	100 km S of Edzo		< 0.1		2.7		< 0.1		0.4		105.0
5	Burn-site Morel	100 km S of Edzo		< 0.1		2.7		< 0.1		0.4		113.9
6	Burn-site Morel	100 km S of Edzo		< 0.1		3.3		< 0.1		0.4		110.6
7	Burn-site Morel	100 km S of Edzo		< 0.1		3.6		< 0.1		0.5		117.4
8	Sand Bolete	46 km SW of Edzo	< 0.6	< 0.1	169.0	1.4	0.5	< 0.1	6.8	0.1	< 20	79.0
9	Sand Bolete	46 km SW of Edzo	< 0.6	< 0.1	280.0	2.2	0.4	< 0.1	11.3	< 0.1	< 20	64.0
10	White Matsutake	46 km SW of Edzo	< 0.6	< 0.1	216.0	5.3	0.4	< 0.1	7.5	0.1	84	56.0
11	Sand Bolete	46 km SW of Edzo	< 0.6	< 0.1	230.0	1.5	0.5	< 0.1	8.5	0.2	< 20	38.0
12	Sand Bolete	46 km SW of Edzo	< 0.6	< 0.1	85.9	1.0	0.4	< 0.1	4.5	0.1	< 20	65.0
13	White Matsutake	46 km SW of Edzo		< 0.1		4.4		< 0.1		0.2		77.0
14	Red-capped Bolete	43 km SW of Edzo	0.2	0.1	67.8	0.3	0.3	0.1	3.1	0.2	20	46.6
15	Sand Bolete	43 km SW of Edzo	0.2	0.1	126.0	1.1	0.3	0.1	5.7	0.1	20	62.4
16	Sand Bolete	17 km SW of Edzo	< 0.6	< 0.1	50.9	1.7	0.3	< 0.1	3.4	0.1	< 20	30.0
17	Hooded False Morel	2 km SW of Edzo	< 0.6	< 0.1	54.1	3.0	0.3	< 0.1	3.2	0.1	< 20	74.0
18	Yellow Bolete	40 km W of YK	< 0.6	< 0.1	468.0	2.6	1.4	< 0.1	30.5	0.1	45	44.0
19	Hollow-stem Bolete	YK Golf Course	0.2	0.1	157.0	0.9	0.4	0.1	7.7	0.1	20	51.0
20	Puffball	YK Golf Course	0.2	0.1	96.5	0.8	0.3	0.1	5.7	0.2	20	80.0
21	Red-capped Bolete	YK Golf Course	0.2	0.1	278.0	0.7	0.6	0.1	10.7	0.2	20	74.7
22	Sand Bolete	YK Golf Course	0.2	0.1	279.0	0.9	0.5	0.1	14.0	0.1	20	48.9
23	White Matsutake	YK Golf Course	0.2	0.1	277.0	1.6	0.5	0.1	13.1	0.1	20	56.7
24	White Matsutake	YK Golf Course		0.1		1.5		0.1		0.2		49.3
25	White Matsutake	YK Golf Course		< 0.1		2.1		< 0.1		0.5		59.7
26	Meadow Mushroom	YK Sewage Road	< 0.6	< 0.1	560.0	3.1	1.6	< 0.1	34.2	0.2	31	108.0
27	Meadow Mushroom	YK Sewage Road	< 0.6	< 0.1	304.0	3.1	1.5	0.1	23.7	0.1	25	125.0
28	Meadow Mushroom	YK Sewage Road		< 0.1		11.2		0.1		0.3		166.0
29	Shaggy Mane	YK Sewage Road	< 0.6	< 0.1	368.0	4.7	3.9	0.2	25.1	0.2	27	167.0
30	Meadow Mushroom	YK Sewage Road	< 0.6	< 0.1	677.0	3.6	3.6	< 0.1	33.0	0.2	37	110.0
31	Red-capped Bolete	YK Frame Lake	< 0.6	< 0.1	788.0	4.0	0.8	< 0.1	15.6	0.2	< 20	157.0

(Table I. continued on next page)

(Table I. continued)

purple = samples in Obst *et al*. 2001			blue = unspoiled background area				orange = impacted area			Metal in µg/g dry weight		
bold ID #s = shared soil samples			green = assumed undisturbed background area					yellow = backup samples 1997 - 1999				
Fungi	**Mushroom**	**Location**	**Thallium**		**Titanium**		**Uranium**		**Vanadium**		**Zinc**	
ID #	**Species**	North Slave Region	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**	**Soil**	**Fungi**
32	Red-capped Bolete	YK Frame Lake		< 0.1		11.8		< 0.1		0.3		158.0
33	Red-capped Bolete	YK Frame Lake		< 0.1		2.2		< 0.1		0.1		108.0
34	Fly Agaric	YK Frame Lake	< 0.6	< 0.1	9.3	43.5	1.0	< 0.1	25.6	143.0	53	154.0
35	Birch Bolete	YK Frame Lake		< 0.1		3.5		< 0.1		0.1		291.0
36	Birch Bolete	YK Frame Lake		< 0.1		4.2		< 0.1		0.2		269.0
37	Birch Bolete	YK Frame Lake	< 0.6	< 0.1	1.1	3.4	0.9	< 0.1	20.9	0.3	35	84.0
38	Birch Bolete	YK Frame Lake		< 0.1		25.3		< 0.1		0.6		87.0
39	Fly Agaric	YK Frame Lake	< 0.6	< 0.1	22.8	5.8	0.9	< 0.1	19.0	46.2	55	166.0
40	Meadow Mushroom	YK Con Mine	< 0.6	< 0.1	165.0	7.4	0.5	< 0.1	51.3	0.3	419	96.0
41	Meadow Mushroom	YK Con Mine		< 0.1		24.7		< 0.1		0.8		79.0
42	Birch Bolete	YK Con Mine	< 0.6	< 0.1	660.0	5.1	0.5	< 0.1	51.5	0.2	317	115.0
43	Meadow Mushroom	YK Old Town	0.2	0.1	328.0	1.9	3.4	0.1	22.4	0.3	41	118.0
44	Puffball	YK Old Town	0.2	0.1	388.0	0.4	3.9	0.1	27.2	0.2	55	110.0
45	Birch Bolete	YK Jolliffe Island	0.2	0.1	43.5	1.3	3.9	0.1	10.1	0.2	264	212.0
46	Fly Agaric	YK Jolliffe Island		< 0.1		3.4		< 0.1		22.3		155.0
47	Puffball	YK Jolliffe Island	0.2	0.1	1310.0	1.1	0.4	0.1	60.1	0.2	89	134.0
48	Red-capped Bolete	YK Jolliffe Island	0.2	0.1	283.0	0.7	0.4	0.1	20.7	0.1	24	37.7
49	Shaggy Mane	YK Giant Mine	0.2	0.1	636.0	1.5	0.4	2.4	84.5	0.3	100	82.1
50	Shaggy Mane	YK Giant Mine		0.1		4.5		0.7		0.9		108.0
51	Meadow Mushroom	YK Giant Mine	< 0.6	< 0.1	371.0	23.3	3.3	< 0.1	64.8	1.0	108	188.0
52	Shaggy Mane	YK Giant/Vee L.	0.2	0.1	771.0	1.1	1.5	0.1	47.2	0.2	55	62.2
53	Birch Bolete	YK Vee Lake Rd.	0.2	0.1	165.0	0.7	0.3	0.1	11.7	0.1	23	78.2
54	Hollow-stem Bolete	YK River Park	0.2	0.1	72.2	0.4	0.9	0.1	10.0	0.1	32	47.9
55	Spring Agaricus	YK River Park	0.2	0.1	456.0	2.3	1.4	0.1	20.1	0.4	20	154.0
56	Shaggy Mane	Yk Treminco Mine	0.2	0.1	1300.0	12.2	2.3	0.5	57.4	1.1	67	95.1
57	Shaggy Mane	Yk Treminco Mine		0.1		3.3		0.2		0.4		100.0
58	Shaggy Mane	Yk Treminco Mine		< 0.1		8.2		0.3		0.7		119.0
59	Shaggy Mane	Yk Treminco Mine	0.2	0.1	626.0	2.6	1.7	0.4	29.9	0.3	83	72.7
60	Forest Mushroom	Yk Treminco Mine	0.2	0.1	964.0	13.2	1.6	0.5	32.8	1.0	59	77.9
61	Tippler's Bane	Yk Treminco Mine	0.2	0.1	318.0	15.5	0.3	0.3	18.9	1.4	233	126.0
62	Red-capped Bolete	Prelude Lake Trail	0.2	0.1	538.0	7.3	0.7	0.1	26.6	0.4	45	60.0
63	Sand Bolete	Prelude Lake Trail	0.2	0.1	420.0	0.3	2.0	0.1	20.6	0.1	92	78.8

(Table I. continued on next page)

(Table I. continued)

purple = samples in Obst *et al*. 2001 | blue = unspoiled background area | orange = impacted area | Metal in µg/g dry weight

bold ID #s = shared soil samples | green = assumed undisturbed background area | yellow = backup samples 1997 - 1999

Fungi	Mushroom	Location	Thallium		Titanium		Uranium		Vanadium		Zinc	
ID #	Species	North Slave Region	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi
64	White Matsutake	Prelude Lake Trail	0.2	0.1	641.0	2.1	0.7	0.1	29.8	0.4	53	83.9
65	Sand Bolete	Cameron Fall Trail	< 0.6	< 0.1	1050.0	3.6	0.7	< 0.1	57.7	0.1	124	117.0
66	Slippery Jack	Cameron Fall Trail	< 0.6	< 0.1	219.0	0.2	0.9	< 0.1	15.0	0.2	27	122.0
67	Birch Bolete	Cameron Fall Trail	< 0.6	< 0.1	211.0	1.5	0.5	< 0.1	13.1	0.1	31	176.0
68	White Matsutake	Ingraham Trail	N/A	0.1	N/A	5.5	N/A	0.1	N/A	0.4	N/A	36.7
69	Red-capped Bolete	Cameron River Pk.	0.2	N/A	392.0	N/A	0.8	N/A	14.6	N/A	20	N/A
70	White Matsutake	Ingraham/C. Antler	N/A	< 0.1	N/A	3.7	N/A	< 0.1	N/A	0.1	N/A	107.0
71	Birch Bolete	Ingraham/C. Antler	0.2	0.1	140.0	0.4	0.3	0.1	6.1	0.1	23	105.0
72	Larch Bolete	Ingraham/C. Antler	0.2	0.1	292.0	0.4	0.5	0.1	12.2	0.1	34	61.6
73	Red-capped Bolete	Ingraham/C. Antler	0.2	0.1	342.0	0.7	0.6	0.1	13.2	0.1	20	94.7
74	Red-capped Bolete	Ingraham/C. Antler		0.1		0.5		0.1		0.1		85.5
75	Sand Bolete	Ingraham/C. Antler		0.1		0.5		0.1		0.1		76.1
76	Sarcodon	Ingraham/C. Antler		0.1		0.3		0.1		0.1		80.5
77	White Matsutake	Ingraham/C. Antler	0.2	0.1	299.0	1.5	0.5	0.1	13.9	0.2	33	60.7
78	White Matsutake	Ingraham/C. Antler		0.1		4.0		0.1		0.3		75.0
79	White Matsutake	Ingraham/C. Antler	N/A	< 0.1		11.0	N/A	< 0.1	N/A	0.3	N/A	49.0
80	White Matsutake	Ingraham/C. Antler	N/A	< 0.1		22.4	N/A	< 0.1	N/A	0.4	N/A	40.0
81	Hooded False Morel	Ingraham/Tibbitt L.	< 0.6	< 0.1	473.0	9.3	0.7	< 0.1	28.7	0.2	< 20	71.0
82	Birch Bolete	Ingraham/Tibbitt L.	< 0.6	< 0.1	512.0	2.4	0.8	< 0.1	30.7	< 0.1	< 20	38.0
83	Birch Bolete	Ingraham/Tibbitt L.	<	< 0.1		1.6		< 0.1		0.1		56.0
84	Hooded False Morel	Ingraham/Tibbitt L.	< 0.6	0.2	746.0	4.3	1.2	< 0.1	52.9	0.1	95	64.0
85	Hooded False Morel	Ingraham/Tibbitt L.	< 0.6	< 0.1	434.0	3.9	0.8	< 0.1	27.2	0.2	25	66.0
86	Hooded False Morel	Ingraham/Tibbitt L.	< 0.6	< 0.1	663.0	9.7	0.8	< 0.1	44.2	0.3	70	72.0
87	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.1	N/A	4.3	N/A	0.1	N/A	0.8	N/A	101.0
88	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	10.2	N/A	0.1	N/A	0.8	N/A	119.1
89	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	4.8	N/A	< 0.1	N/A	0.6	N/A	103.9
90	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	13.1	N/A	0.2	N/A	1.0	N/A	151.2
91	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.1	N/A	3.8	N/A	0.1	N/A	0.5	N/A	96.1
92	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	6.6	N/A	< 0.1	N/A	0.7	N/A	109.6
93	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.1	N/A	2.8	N/A	0.1	N/A	0.2	N/A	121.0
94	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	3.7	N/A	< 0.1	N/A	0.5	N/A	120.5
95	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	4.5	N/A	< 0.1	N/A	0.4	N/A	150.5

(Table I. continued on next page)

(Table I. continued)

purple = samples in Obst *et al*. 2001			blue = unspoiled background area				orange = impacted area			Metal in µg/g dry weight		
bold ID #s = shared soil samples			green = assumed undisturbed background area					yellow = backup samples 1997 - 1999				
Fungi ID #	**Mushroom Species**	**Location** North Slave Region	**Thallium** Soil	Fungi	**Titanium** Soil	Fungi	**Uranium** Soil	Fungi	**Vanadium** Soil	Fungi	**Zinc** Soil	Fungi
96	Burn-site Morel	Ingraham/Tibbitt L.	N/A	0.1	N/A	1.1	N/A	0.1	N/A	0.2	N/A	96.5
97	Burn-site Morel	Ingraham/Tibbitt L.	N/A	< 0.1	N/A	3.4	N/A	< 0.1	N/A	0.4	N/A	122.3
98	Sand Bolete	Tibbitt Lake	0.2	0.1	125.0	0.3	0.4	0.1	4.5	0.1	20	71.9
99	Suillus	Tibbitt Lake	0.2	0.1	542.0	0.3	0.5	0.1	24.3	0.1	22	56.3
100	Yellow Bolete	Tibbitt Lake	0.2	0.1	404.0	0.3	0.6	0.1	12.4	0.1	31	57.4
101	White Matsutake	Tibbitt Lake	0.2	0.2	651.0	3.3	0.8	0.1	34.0	0.3	50	51.2
102	Fly Agaric	Tundra Jolly Lake	< 0.6	< 0.1	304.0	22.9	0.5	< 0.1	17.4	38.9	< 20	66.0
103	Fly Agaric	Tundra Jolly Lake	<	< 0.1		2.7		< 0.1		67.1		75.0
104	Red-capped Bolete	Tundra Jolly Lake	< 0.6	< 0.1	559.0	2.2	0.6	< 0.1	31.3	0.2	22	64.0
105	Birch Bolete	Tundra Jolly Lake	< 0.6	< 0.1	36.3	1.8	0.5	< 0.1	18.2	0.1	< 20	79.0
106	Birch Bolete	Tundra Jolly Lake	< 0.6	< 0.1	117.0	2.1	0.3	< 0.1	4.2	0.2	< 20	57.0
107	Birch Bolete	Tundra Jolly Lake	< 0.6	< 0.1	882.0	8.0	2.7	< 0.1	73.0	0.1	86	76.0
108	Birch Bolete	Tundra Jolly Lake	<	< 0.1		1.5		< 0.1		0.1		62.0
109	Birch Bolete	Tundra Daring L.	< 0.2	< 0.1	83.2	1.0	0.5	< 0.1	2.3	0.3	56	72.0
110	Birch Bolete	Tundra Daring L.	< 0.2	< 0.1	18.0	1.1	< 0.2	< 0.1	1.9	0.3	91	128.0
111	Birch Bolete	Tundra Daring L.	< 0.2	< 0.1	6.8	1.6	< 0.2	< 0.1	0.9	0.4	61	173.0
112	Burn-site Morel	Drybones Bay	N/A	< 0.2	N/A	24.6	N/A	< 0.2	N/A	0.3	N/A	131.0
113	Burn-site Morel	Drybones Bay	N/A	< 0.2	N/A	21.4	N/A	< 0.2	N/A	< 0.2	N/A	122.0
114	Burn-site Morel	Drybones Bay	N/A	< 0.2	N/A	18.5	N/A	< 0.2	N/A	< 0.2	N/A	139.0
115	Burn-site Morel	N of YK/S of Whati	N/A	< 0.1	N/A	38.6	N/A	< 0.1	N/A	2.0	N/A	156.0
116	Burn-site Morel	N of YK/S of Whati	N/A	< 0.1	N/A	5.1	N/A	< 0.1	N/A	0.4	N/A	147.0
117	Burn-site Morel	N of YK/S of Whati	N/A	< 0.1	N/A	3.7	N/A	< 0.1	N/A	0.4	N/A	147.0
118	Burn-site Morel	N of YK/S of Whati	N/A	< 0.1	N/A	2.5	N/A	< 0.1	N/A	0.3	N/A	99.8
119	Burn-site Morel	50 km SW of Edzo	N/A	< 0.1	N/A	3.3	N/A	< 0.1	N/A	0.4	N/A	120.0
120	Burn-site Morel	50 km SW of Edzo	N/A	< 0.1	N/A	5.4	N/A	< 0.1	N/A	0.5	N/A	232.0
121	Burn-site Morel	50 km SW of Edzo	N/A	< 0.1	N/A	3.7	N/A	< 0.1	N/A	0.4	N/A	163.0
122	Burn-site Morel	50 km SW of Edzo	N/A	< 0.1	N/A	3.5	N/A	< 0.1	N/A	0.4	N/A	78.9
123	Burn-site Morel	50 km SW of Edzo	N/A	< 0.1	N/A	3.4	N/A	< 0.1	N/A	0.4	N/A	94.8
124	Burn-site Morel	50 km SW of Edzo	N/A	< 0.1	N/A	4.9	N/A	< 0.1	N/A	0.6	N/A	177.0

(Table I. continued on next page)

(Table I. continued)

Samples from other regions and imports			Total Metal Concentrations in µg/g dry weight									
Fungi	Mushroom	Location	Thallium		Titanium		Uranium		Vanadium		Zinc	
ID #	Species		Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi	Soil	Fungi
125	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	4.6	N/A	< 0.1	N/A	0.3	N/A	91.0
126	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	2.5	N/A	< 0.1	N/A	0.2	N/A	106.0
127	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	4.0	N/A	< 0.1	N/A	0.4	N/A	105.0
128	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	5.6	N/A	< 0.1	N/A	1.2	N/A	147.0
129	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	3.6	N/A	< 0.1	N/A	0.3	N/A	141.0
130	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	3.3	N/A	< 0.1	N/A	0.3	N/A	142.0
131	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	2.6	N/A	< 0.1	N/A	0.3	N/A	85.0
132	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	16.6	N/A	0.7	N/A	1.1	N/A	94.0
133	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	4.3	N/A	0.5	N/A	0.5	N/A	84.0
134	Morel Mushroom	Alaska / Fairbanks	N/A	< 0.1	N/A	3.1	N/A	0.2	N/A	0.3	N/A	90.0
135	Oyster Mushroom	BC import	N/A	< 0.1	N/A	9.2	N/A	< 0.1	N/A	0.3	N/A	103.0
136	Wood Ear	BC import	N/A	< 0.1	N/A	5.3	N/A	< 0.1	N/A	0.2	N/A	< 10.0
137	Wood Ear	BC import	N/A	< 0.1	N/A	5.7	N/A	< 0.1	N/A	0.2	N/A	< 10.0
138	Morel Mushroom	BC / US import	N/A	< 0.1	N/A	36.9	N/A	< 0.1	N/A	0.7	N/A	158.0
139	Morel Mushroom	BC / US import	N/A	< 0.1	N/A	86.3	N/A	< 0.1	N/A	1.5	N/A	131.0
140	Chinese Shiitake	Chinese import	N/A	< 0.1	N/A	14.0	N/A	< 0.1	N/A	0.2	N/A	79.0
141	Chinese Shiitake	Chinese import	N/A	< 0.1	N/A	15.9	N/A	< 0.1	N/A	0.3	N/A	101.0

Table J: Concentrations of 26 Metals in Wood Samples from Forest Fire Sites in the North Slave Region, Northwest Territories, and from Alaska, 1997 - 2001.

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Aluminum	1260	22	< 30	20			< 30	19	0.030	1979	17 km SW of Edzo
17	Aluminum	53	25	80	25					0.200	1999	2 km SW of Edzo
81	Aluminum	189	30	36	16					0.250	1998	Ingraham/Tibbitt L.
82	Aluminum	4340	30	< 30	30	94	40			0.750	1998	Ingraham/Tibbitt L.
84	Aluminum	184	25	< 30	25					0.750	1998	Ingraham/Tibbitt L.
85	Aluminum	54	40	< 30	40					0.500	1998	Ingraham/Tibbitt L.
86	Aluminum	710	21	37	21					1.000	1998	Ingraham/Tibbitt L.
112	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
113	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
114	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
115	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
116	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
117	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
118	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
119	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
120	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
121	Aluminum			< 30	UK					3.000	2001	Fairbanks/Alaska
16	Antimony	0.2	22	< 0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Antimony	< 0.1	25	< 0.1	25					0.200	1999	2 km SW of Edzo
81	Antimony	< 0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Antimony	< 0.1	30	< 0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Antimony	< 0.1	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Antimony	< 0.1	40	< 0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Antimony	< 0.1	21	< 0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Antimony			0.2	UK					3.000	2001	Fairbanks/Alaska
113	Antimony			< 0.1	UK					3.000	2001	Fairbanks/Alaska
114	Antimony			0.2	UK					3.000	2001	Fairbanks/Alaska
115	Antimony			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Antimony			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Antimony			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Antimony			0.2	UK					3.000	2001	Fairbanks/Alaska
119	Antimony			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Antimony			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Antimony			0.4	UK					3.000	2001	Fairbanks/Alaska
16	Arsenic	1.3	22	< 0.5	20			< 0.5	19	0.030	1979	17 km SW of Edzo
17	Arsenic	0.5	25	< 0.5	25					0.200	1999	2 km SW of Edzo
81	Arsenic	< 0.5	30	< 0.5	16					0.250	1998	Ingraham/Tibbitt L.
82	Arsenic	4.5	30	< 0.5	30	< 0.5	40			0.750	1998	Ingraham/Tibbitt L.
84	Arsenic	< 0.5	25	< 0.5	25					0.750	1998	Ingraham/Tibbitt L.
85	Arsenic	< 0.5	40	< 0.5	40					0.500	1998	Ingraham/Tibbitt L.
86	Arsenic	1.2	21	0.5	21					1.000	1998	Ingraham/Tibbitt L.
112	Arsenic			3.4	UK					3.000	2001	Fairbanks/Alaska
113	Arsenic			4.8	UK					3.000	2001	Fairbanks/Alaska
114	Arsenic			4.9	UK					3.000	2001	Fairbanks/Alaska
115	Arsenic			2.6	UK					3.000	2001	Fairbanks/Alaska
116	Arsenic			2.2	UK					3.000	2001	Fairbanks/Alaska
117	Arsenic			2.8	UK					3.000	2001	Fairbanks/Alaska
118	Arsenic			11.5	UK					3.000	2001	Fairbanks/Alaska
119	Arsenic			< 1.0	UK					3.000	2001	Fairbanks/Alaska
120	Arsenic			2.0	UK					3.000	2001	Fairbanks/Alaska
121	Arsenic			5.1	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood	Wood	Type 1	Tree	Type 2	Tree	Type 3	Tree	Type 4	Tree	Distance	Year of	Metals in µg/g
ID	Metals	Burned	Age	Not	Age	Not	Age	Live/	Age	in km from	Forest	dry weight
#	Analyzed	Coal	yrs	Burned	yrs	Burned	yrs	Fresh	yrs	Highway	Fire	Location
16	Barium	23.4	22	2.3	20			1.6	19	0.030	1979	17 km SW of Edzo
17	Barium	13.4	25	2.6	25					0.200	1999	2 km SW of Edzo
81	Barium	12.8	30	6.3	16					0.250	1998	Ingraham/Tibbitt L.
82	Barium	188.0	30	8.7	30	2.5	40			0.750	1998	Ingraham/Tibbitt L.
84	Barium	29.3	25	3.3	25					0.750	1998	Ingraham/Tibbitt L.
85	Barium	8.7	40	3.4	40					0.500	1998	Ingraham/Tibbitt L.
86	Barium	33.3	21	3.9	21					1.000	1998	Ingraham/Tibbitt L.
112	Barium			28.9	UK					3.000	2001	Fairbanks/Alaska
113	Barium			22.7	UK					3.000	2001	Fairbanks/Alaska
114	Barium			43.2	UK					3.000	2001	Fairbanks/Alaska
115	Barium			12.9	UK					3.000	2001	Fairbanks/Alaska
116	Barium			30.5	UK					3.000	2001	Fairbanks/Alaska
117	Barium			53.4	UK					3.000	2001	Fairbanks/Alaska
118	Barium			47.1	UK					3.000	2001	Fairbanks/Alaska
119	Barium			31.2	UK					3.000	2001	Fairbanks/Alaska
120	Barium			27.8	UK					3.000	2001	Fairbanks/Alaska
121	Barium			33.0	UK					3.000	2001	Fairbanks/Alaska
16	Beryllium	< 0	22	< 0	20			< 0	19	0.030	1979	17 km SW of Edzo
17	Beryllium	< 0	25	< 0	25					0.200	1999	2 km SW of Edzo
81	Beryllium	< 0	30	< 0	16					0.250	1998	Ingraham/Tibbitt L.
82	Beryllium	0	30	< 0	30	< 0	40			0.750	1998	Ingraham/Tibbitt L.
84	Beryllium	< 0	25	< 0	25					0.750	1998	Ingraham/Tibbitt L.
85	Beryllium	< 0	40	< 0	40					0.500	1998	Ingraham/Tibbitt L.
86	Beryllium	< 0	21	< 0	21					1.000	1998	Ingraham/Tibbitt L.
112	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
113	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
114	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
115	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
116	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
117	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
118	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
119	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
120	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
121	Beryllium			< 0.2	UK					3.000	2001	Fairbanks/Alaska
16	Cadmium	0.1	22	0.1	20			0.1	19	0.030	1979	17 km SW of Edzo
17	Cadmium	0.1	25	0.1	25					0.200	1999	2 km SW of Edzo
81	Cadmium	0.1	30	0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Cadmium	< 0.1	30	0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Cadmium	0.1	25	0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Cadmium	0.1	40	0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Cadmium	0.1	21	0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Cadmium			0.2	UK					3.000	2001	Fairbanks/Alaska
114	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Cadmium			0.4	UK					3.000	2001	Fairbanks/Alaska
119	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Cadmium			< 0.1	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Cesium	0.1	22	< 0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Cesium	< 0.1	25	< 0.1	25					0.200	1999	2 km SW of Edzo
81	Cesium	< 0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Cesium	0.2	30	< 0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Cesium	< 0.1	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Cesium	< 0.1	40	< 0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Cesium	0.1	21	< 0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
114	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
119	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Cesium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
16	Chromium	2.8	22	1.4	20			< 0.3	19	0.030	1979	17 km SW of Edzo
17	Chromium	1.7	25	0.3	25					0.200	1999	2 km SW of Edzo
81	Chromium	1.0	30	0.4	16					0.250	1998	Ingraham/Tibbitt L.
82	Chromium	6.7	30	0.3	30	0.4	40			0.750	1998	Ingraham/Tibbitt L.
84	Chromium	1.7	25	0.4	25					0.750	1998	Ingraham/Tibbitt L.
85	Chromium	0.9	40	0.8	40					0.500	1998	Ingraham/Tibbitt L.
86	Chromium	2.3	21	< 0.3	21					1.000	1998	Ingraham/Tibbitt L.
112	Chromium			1.6	UK					3.000	2001	Fairbanks/Alaska
113	Chromium			1.5	UK					3.000	2001	Fairbanks/Alaska
114	Chromium			1.4	UK					3.000	2001	Fairbanks/Alaska
115	Chromium			1.4	UK					3.000	2001	Fairbanks/Alaska
116	Chromium			1.6	UK					3.000	2001	Fairbanks/Alaska
117	Chromium			1.6	UK					3.000	2001	Fairbanks/Alaska
118	Chromium			1.4	UK					3.000	2001	Fairbanks/Alaska
119	Chromium			1.4	UK					3.000	2001	Fairbanks/Alaska
120	Chromium			1.7	UK					3.000	2001	Fairbanks/Alaska
121	Chromium			1.5	UK					3.000	2001	Fairbanks/Alaska
16	Cobalt	0.4	22	< 0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Cobalt	0.2	25	0.1	25					0.200	1999	2 km SW of Edzo
81	Cobalt	0.9	30	0.7	16					0.250	1998	Ingraham/Tibbitt L.
82	Cobalt	2.2	30	0.1	30	0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Cobalt	1.0	25	0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Cobalt	0.3	40	0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Cobalt	0.6	21	0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Cobalt			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Cobalt			0.4	UK					3.000	2001	Fairbanks/Alaska
114	Cobalt			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Cobalt			0.1	UK					3.000	2001	Fairbanks/Alaska
116	Cobalt			0.1	UK					3.000	2001	Fairbanks/Alaska
117	Cobalt			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Cobalt			0.2	UK					3.000	2001	Fairbanks/Alaska
119	Cobalt			0.1	UK					3.000	2001	Fairbanks/Alaska
120	Cobalt			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Cobalt			0.1	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Copper	2.9	22	0.4	20			1.1	19	0.030	1979	17 km SW of Edzo
17	Copper	2.1	25	1.1	25					0.200	1999	2 km SW of Edzo
81	Copper	4.4	30	1.2	16					0.250	1998	Ingraham/Tibbitt L.
82	Copper	4.3	30	0.7	30	0.6	40			0.750	1998	Ingraham/Tibbitt L.
84	Copper	2.6	25	1.6	25					0.750	1998	Ingraham/Tibbitt L.
85	Copper	1.3	40	0.4	40					0.500	1998	Ingraham/Tibbitt L.
86	Copper	3.2	21	0.3	21					1.000	1998	Ingraham/Tibbitt L.
112	Copper			0.9	UK					3.000	2001	Fairbanks/Alaska
113	Copper			1.4	UK					3.000	2001	Fairbanks/Alaska
114	Copper			1.2	UK					3.000	2001	Fairbanks/Alaska
115	Copper			1.1	UK					3.000	2001	Fairbanks/Alaska
116	Copper			1.3	UK					3.000	2001	Fairbanks/Alaska
117	Copper			1.1	UK					3.000	2001	Fairbanks/Alaska
118	Copper			6.5	UK					3.000	2001	Fairbanks/Alaska
119	Copper			1.0	UK					3.000	2001	Fairbanks/Alaska
120	Copper			1.4	UK					3.000	2001	Fairbanks/Alaska
121	Copper			2.6	UK					3.000	2001	Fairbanks/Alaska
16	Iron	793	22	< 40	20			< 40	19	0.030	1979	17 km SW of Edzo
17	Iron	46	25	< 40	25					0.200	1999	2 km SW of Edzo
81	Iron	97	30	< 40	16					0.250	1998	Ingraham/Tibbitt L.
82	Iron	3310	30	< 40	30	54	40			0.750	1998	Ingraham/Tibbitt L.
84	Iron	113	25	< 40	25					0.750	1998	Ingraham/Tibbitt L.
85	Iron	< 40	40	< 40	40					0.500	1998	Ingraham/Tibbitt L.
86	Iron	351	21	50	21					1.000	1998	Ingraham/Tibbitt L.
112	Iron			13	UK					3.000	2001	Fairbanks/Alaska
113	Iron			20	UK					3.000	2001	Fairbanks/Alaska
114	Iron			25	UK					3.000	2001	Fairbanks/Alaska
115	Iron			14	UK					3.000	2001	Fairbanks/Alaska
116	Iron			11	UK					3.000	2001	Fairbanks/Alaska
117	Iron			17	UK					3.000	2001	Fairbanks/Alaska
118	Iron			43	UK					3.000	2001	Fairbanks/Alaska
119	Iron			10	UK					3.000	2001	Fairbanks/Alaska
120	Iron			12	UK					3.000	2001	Fairbanks/Alaska
121	Iron			32	UK					3.000	2001	Fairbanks/Alaska
16	Lead	1.3	22	0.5	20			0.1	19	0.030	1979	17 km SW of Edzo
17	Lead	0.1	25	1.1	25					0.200	1999	2 km SW of Edzo
81	Lead	0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Lead	2.7	30	1.0	30	0.3	40			0.750	1998	Ingraham/Tibbitt L.
84	Lead	0.5	25	0.2	25					0.750	1998	Ingraham/Tibbitt L.
85	Lead	< 0.1	40	0.5	40					0.500	1998	Ingraham/Tibbitt L.
86	Lead	0.9	21	0.2	21					1.000	1998	Ingraham/Tibbitt L.
112	Lead			0.2	UK					3.000	2001	Fairbanks/Alaska
113	Lead			0.2	UK					3.000	2001	Fairbanks/Alaska
114	Lead			0.4	UK					3.000	2001	Fairbanks/Alaska
115	Lead			0.1	UK					3.000	2001	Fairbanks/Alaska
116	Lead			0.1	UK					3.000	2001	Fairbanks/Alaska
117	Lead			0.1	UK					3.000	2001	Fairbanks/Alaska
118	Lead			0.4	UK					3.000	2001	Fairbanks/Alaska
119	Lead			0.1	UK					3.000	2001	Fairbanks/Alaska
120	Lead			0.6	UK					3.000	2001	Fairbanks/Alaska
121	Lead			0.4	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Lithium	2.3	22	< 0.3	20			< 0.3	19	0.030	1979	17 km SW of Edzo
17	Lithium	< 0.3	25	< 0.3	25					0.200	1999	2 km SW of Edzo
81	Lithium	< 0.3	30	< 0.3	16					0.250	1998	Ingraham/Tibbitt L.
82	Lithium	5.8	30	< 0.3	30	< 0.3	40			0.750	1998	Ingraham/Tibbitt L.
84	Lithium	< 0.3	25	< 0.3	25					0.750	1998	Ingraham/Tibbitt L.
85	Lithium	< 0.3	40	< 0.3	40					0.500	1998	Ingraham/Tibbitt L.
86	Lithium	< 0.3	21	< 0.3	21					1.000	1998	Ingraham/Tibbitt L.
112	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
113	Lithium			0.3	UK					3.000	2001	Fairbanks/Alaska
114	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
115	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
116	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
117	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
118	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
119	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
120	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
121	Lithium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
16	Manganese	85.8	22	33.5	20			9.5	19	0.030	1979	17 km SW of Edzo
17	Manganese	195	25	58.8	25					0.200	1999	2 km SW of Edzo
81	Manganese	320	30	329	16					0.250	1998	Ingraham/Tibbitt L.
82	Manganese	219	30	45.1	30	5.8	40			0.750	1998	Ingraham/Tibbitt L.
84	Manganese	169	25	21.5	25					0.750	1998	Ingraham/Tibbitt L.
85	Manganese	85.8	40	38.6	40					0.500	1998	Ingraham/Tibbitt L.
86	Manganese	136	21	8.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Manganese			45.9	UK					3.000	2001	Fairbanks/Alaska
113	Manganese			106	UK					3.000	2001	Fairbanks/Alaska
114	Manganese			41.0	UK					3.000	2001	Fairbanks/Alaska
115	Manganese			92.5	UK					3.000	2001	Fairbanks/Alaska
116	Manganese			86.7	UK					3.000	2001	Fairbanks/Alaska
117	Manganese			43.4	UK					3.000	2001	Fairbanks/Alaska
118	Manganese			144	UK					3.000	2001	Fairbanks/Alaska
119	Manganese			208	UK					3.000	2001	Fairbanks/Alaska
120	Manganese			61.4	UK					3.000	2001	Fairbanks/Alaska
121	Manganese			83.7	UK					3.000	2001	Fairbanks/Alaska
16	Mercury	< 0.01	22	0.02	20			0.01	19	0.030	1979	17 km SW of Edzo
17	Mercury	0.04	25	< 0.01	25					0.200	1999	2 km SW of Edzo
81	Mercury	0.03	30	< 0.01	16					0.250	1998	Ingraham/Tibbitt L.
82	Mercury	0.08	30	0.03	30	< 0.01	40			0.750	1998	Ingraham/Tibbitt L.
84	Mercury	0.03	25	< 0.01	25					0.750	1998	Ingraham/Tibbitt L.
85	Mercury	0.01	40	0.01	40					0.500	1998	Ingraham/Tibbitt L.
86	Mercury	0.09	21	0.01	21					1.000	1998	Ingraham/Tibbitt L.
112	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
113	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
114	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
115	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
116	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
117	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
118	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
119	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
120	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska
121	Mercury			< 0.01	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Molybdenum	0.1	22	< 0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Molybdenum	< 0.1	25	< 0.1	25					0.200	1999	2 km SW of Edzo
81	Molybdenum	< 0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Molybdenum	0.3	30	< 0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Molybdenum	< 0.1	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Molybdenum	< 0.1	40	< 0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Molybdenum	< 0.1	21	< 0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
114	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
119	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Molybdenum			< 0.1	UK					3.000	2001	Fairbanks/Alaska
16	Nickel	1.8	22	0.4	20			0.4	19	0.030	1979	17 km SW of Edzo
17	Nickel	0.6	25	2.6	25					0.200	1999	2 km SW of Edzo
81	Nickel	0.7	30	0.4	16					0.250	1998	Ingraham/Tibbitt L.
82	Nickel	4.9	30	0.3	30	0.2	40			0.750	1998	Ingraham/Tibbitt L.
84	Nickel	2.1	25	0.2	25					0.750	1998	Ingraham/Tibbitt L.
85	Nickel	1.1	40	0.8	40					0.500	1998	Ingraham/Tibbitt L.
86	Nickel	2.7	21	0.5	21					1.000	1998	Ingraham/Tibbitt L.
112	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
114	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Nickel			0.5	UK					3.000	2001	Fairbanks/Alaska
119	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Nickel			< 0.1	UK					3.000	2001	Fairbanks/Alaska
16	Rubidium	5.4	22	0.5	20			0.6	19	0.030	1979	17 km SW of Edzo
17	Rubidium	1.3	25	0.2	25					0.200	1999	2 km SW of Edzo
81	Rubidium	1.2	30	0.7	16					0.250	1998	Ingraham/Tibbitt L.
82	Rubidium	4.7	30	< 0.1	30	0.4	40			0.750	1998	Ingraham/Tibbitt L.
84	Rubidium	1.7	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Rubidium	0.8	40	0.3	40					0.500	1998	Ingraham/Tibbitt L.
86	Rubidium	1.2	21	0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Rubidium			0.1	UK					3.000	2001	Fairbanks/Alaska
113	Rubidium			0.5	UK					3.000	2001	Fairbanks/Alaska
114	Rubidium			0.1	UK					3.000	2001	Fairbanks/Alaska
115	Rubidium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Rubidium			0.7	UK					3.000	2001	Fairbanks/Alaska
117	Rubidium			0.6	UK					3.000	2001	Fairbanks/Alaska
118	Rubidium			0.8	UK					3.000	2001	Fairbanks/Alaska
119	Rubidium			0.8	UK					3.000	2001	Fairbanks/Alaska
120	Rubidium			0.5	UK					3.000	2001	Fairbanks/Alaska
121	Rubidium			1.4	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Selenium	< 1	22	< 1	20			< 1	19	0.030	1979	17 km SW of Edzo
17	Selenium	< 1	25	< 1	25					0.200	1999	2 km SW of Edzo
81	Selenium	< 1	30	< 1	16					0.250	1998	Ingraham/Tibbitt L.
82	Selenium	< 1	30	< 1	30	< 1	40			0.750	1998	Ingraham/Tibbitt L.
84	Selenium	< 1	25	< 1	25					0.750	1998	Ingraham/Tibbitt L.
85	Selenium	< 1	40	< 1	40					0.500	1998	Ingraham/Tibbitt L.
86	Selenium	< 1	21	< 1	21					1.000	1998	Ingraham/Tibbitt L.
112	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
113	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
114	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
115	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
116	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
117	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
118	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
119	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
120	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
121	Selenium			< 1	UK					3.000	2001	Fairbanks/Alaska
16	Silver	0.4	22	0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Silver	0.1	25	< 0.1	25					0.200	1999	2 km SW of Edzo
81	Silver	0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Silver	0.2	30	< 0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Silver	1.5	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Silver	0.1	40	0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Silver	0.3	21	< 0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Silver			0.1	UK					3.000	2001	Fairbanks/Alaska
113	Silver			0.4	UK					3.000	2001	Fairbanks/Alaska
114	Silver			0.1	UK					3.000	2001	Fairbanks/Alaska
115	Silver			0.2	UK					3.000	2001	Fairbanks/Alaska
116	Silver			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Silver			0.1	UK					3.000	2001	Fairbanks/Alaska
118	Silver			< 0.1	UK					3.000	2001	Fairbanks/Alaska
119	Silver			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Silver			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Silver			< 0.1	UK					3.000	2001	Fairbanks/Alaska
16	Strontium	10.7	22	1.1	20			1.9	19	0.030	1979	17 km SW of Edzo
17	Strontium	8.6	25	2.2	25					0.200	1999	2 km SW of Edzo
81	Strontium	9.4	30	4.7	16					0.250	1998	Ingraham/Tibbitt L.
82	Strontium	67.2	30	6.6	30	2.6	40			0.750	1998	Ingraham/Tibbitt L.
84	Strontium	20.5	25	1.4	25					0.750	1998	Ingraham/Tibbitt L.
85	Strontium	10.6	40	4.2	40					0.500	1998	Ingraham/Tibbitt L.
86	Strontium	15.1	21	3.7	21					1.000	1998	Ingraham/Tibbitt L.
112	Strontium			5.7	UK					3.000	2001	Fairbanks/Alaska
113	Strontium			9.4	UK					3.000	2001	Fairbanks/Alaska
114	Strontium			7.5	UK					3.000	2001	Fairbanks/Alaska
115	Strontium			5.9	UK					3.000	2001	Fairbanks/Alaska
116	Strontium			10.1	UK					3.000	2001	Fairbanks/Alaska
117	Strontium			11.4	UK					3.000	2001	Fairbanks/Alaska
118	Strontium			7.7	UK					3.000	2001	Fairbanks/Alaska
119	Strontium			7.9	UK					3.000	2001	Fairbanks/Alaska
120	Strontium			13.6	UK					3.000	2001	Fairbanks/Alaska
121	Strontium			13.8	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Thallium	< 0.1	22	< 0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Thallium	< 0.1	25	< 0.1	25					0.200	1999	2 km SW of Edzo
81	Thallium	< 0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Thallium	0.1	30	< 0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Thallium	< 0.1	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Thallium	< 0.1	40	< 0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Thallium	< 0.1	21	< 0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
114	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
119	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Thallium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
16	Titanium	98.7	22	0.9	20			0.8	19	0.030	1979	17 km SW of Edzo
17	Titanium	4.9	25	4.8	25					0.200	1999	2 km SW of Edzo
81	Titanium	8.9	30	4.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Titanium	256	30	1.4	30	14.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Titanium	9.7	25	0.5	25					0.750	1998	Ingraham/Tibbitt L.
85	Titanium	2.3	40	0.6	40					0.500	1998	Ingraham/Tibbitt L.
86	Titanium	28.0	21	3.5	21					1.000	1998	Ingraham/Tibbitt L.
112	Titanium			0.3	UK					3.000	2001	Fairbanks/Alaska
113	Titanium			0.5	UK					3.000	2001	Fairbanks/Alaska
114	Titanium			0.7	UK					3.000	2001	Fairbanks/Alaska
115	Titanium			0.4	UK					3.000	2001	Fairbanks/Alaska
116	Titanium			0.3	UK					3.000	2001	Fairbanks/Alaska
117	Titanium			0.4	UK					3.000	2001	Fairbanks/Alaska
118	Titanium			0.9	UK					3.000	2001	Fairbanks/Alaska
119	Titanium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
120	Titanium			< 0.3	UK					3.000	2001	Fairbanks/Alaska
121	Titanium			0.4	UK					3.000	2001	Fairbanks/Alaska
16	Uranium	0.1	22	< 0.1	20			< 0.1	19	0.030	1979	17 km SW of Edzo
17	Uranium	0.1	25	< 0.1	25					0.200	1999	2 km SW of Edzo
81	Uranium	< 0.1	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Uranium	0.5	30	< 0.1	30	< 0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Uranium	< 0.1	25	< 0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Uranium	< 0.1	40	< 0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Uranium	< 0.1	21	< 0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
113	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
114	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
115	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
116	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
117	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
118	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
119	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
120	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska
121	Uranium			< 0.1	UK					3.000	2001	Fairbanks/Alaska

(Table J. continued on next page)

(Table J. continued)

Wood ID #	Wood Metals Analyzed	Type 1 Burned Coal	Tree Age yrs	Type 2 Not Burned	Tree Age yrs	Type 3 Not Burned	Tree Age yrs	Type 4 Live/ Fresh	Tree Age yrs	Distance in km from Highway	Year of Forest Fire	Metals in µg/g dry weight Location
16	Vanadium	2.0	22	0.1	20			0.1	19	0.030	1979	17 km SW of Edzo
17	Vanadium	0.4	25	0.1	25					0.200	1999	2 km SW of Edzo
81	Vanadium	0.4	30	< 0.1	16					0.250	1998	Ingraham/Tibbitt L.
82	Vanadium	9.9	30	< 0.1	30	0.1	40			0.750	1998	Ingraham/Tibbitt L.
84	Vanadium	0.6	25	0.1	25					0.750	1998	Ingraham/Tibbitt L.
85	Vanadium	0.3	40	0.1	40					0.500	1998	Ingraham/Tibbitt L.
86	Vanadium	1.3	21	0.1	21					1.000	1998	Ingraham/Tibbitt L.
112	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
113	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
114	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
115	Vanadium			0.3	UK					3.000	2001	Fairbanks/Alaska
116	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
117	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
118	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
119	Vanadium			0.3	UK					3.000	2001	Fairbanks/Alaska
120	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
121	Vanadium			0.4	UK					3.000	2001	Fairbanks/Alaska
16	Zinc	25	22	11	20			17	19	0.030	1979	17 km SW of Edzo
17	Zinc	32	25	< 10	25					0.200	1999	2 km SW of Edzo
81	Zinc	14	30	< 10	16					0.250	1998	Ingraham/Tibbitt L.
82	Zinc	12	30	16	30	< 10	40			0.750	1998	Ingraham/Tibbitt L.
84	Zinc	49	25	< 10	25					0.750	1998	Ingraham/Tibbitt L.
85	Zinc	25	40	11	40					0.500	1998	Ingraham/Tibbitt L.
86	Zinc	24	21	11	21					1.000	1998	Ingraham/Tibbitt L.
112	Zinc			25	UK					3.000	2001	Fairbanks/Alaska
113	Zinc			24	UK					3.000	2001	Fairbanks/Alaska
114	Zinc			21	UK					3.000	2001	Fairbanks/Alaska
115	Zinc			35	UK					3.000	2001	Fairbanks/Alaska
116	Zinc			28	UK					3.000	2001	Fairbanks/Alaska
117	Zinc			29	UK					3.000	2001	Fairbanks/Alaska
118	Zinc			73	UK					3.000	2001	Fairbanks/Alaska
119	Zinc			45	UK					3.000	2001	Fairbanks/Alaska
120	Zinc			23	UK					3.000	2001	Fairbanks/Alaska
121	Zinc			41	UK					3.000	2001	Fairbanks/Alaska