POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) in TRADITIONAL FOODS

Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds that can be formed by burning organic substances like oil, gas, coal, wood, garbage, tobacco and even grilling meat. Soils and sediments can be contaminated with PAHs as air pollution settles out to the ground, with runoff from paved surfaces and from accidental fuel spills or even naturally occurring oils seeps in some regions of Canada.[1]

http://web.uri.edu/lohmannlab/welcome/great-lakes-passive-sampling/data/pahs/

There are over 100 different PAHs, and it is common to find more than one of them together. When PAHs are measured in water, soil or food, the total of all PAHs found is often reported as a 'toxic equivalent' amount (TEQ). This means that the level of each individual PAH is measured then changed to account for its toxicity compared to benzo[a]pyrene – a very toxic PAH that is clearly linked to cancer.[2]

In 2010, the First Nations Food, Nutrition and the Environment Study[3] (FNFNES) tested samples of traditional foods in Ontario for contaminants. They measured 16 different PAHs, some of which are known or suspected to cause cancer (Table 1) and reported the total amount in TEQ for different ecozones of Ontario.

We used the CAREX Canada eRISK tool[4] to calculate the lifetime excess cancer risk due to PAHs in the most commonly consumed traditional foods reported for Ecozone 2, which included participants from Batchewana First Nation of Ojibways, Garden River First Nation, Sagamok Anishnawbek First Nation and Atikameksheng Anishnawbek (Table 2). Lifetime excess cancer risk of less than 10 in a million is considered to be safe by Health Canada. This means that a person eating the same amount of food with the same amount of contaminant for 70 years has an extra 10 chances in a million of developing cancer. The eRISK results showed lifetime excess cancer risk from PAHs in traditional foods could range from 14 per million (average consumption level and average PAH levels) to as high as 4,050 per million (high consumption level and high PAH levels) (Figure 1).

Because eRISK is a screening level tool, it can only be used to identify the *possibility* of excess cancer risk. The tool uses a number of basic assumptions that may not truly represent any one person. However, when the results are above the 10 per million threshold set by Health Canada, additional information is helpful in determining the safety of eating the traditional foods included in the analysis.

Table 1. PAHs measured in the First Nations Food, Nutrition and the Environment Study

PAH	Carcinogen Classification*	PAH	Carcinogen Classification*
Benzo[a]pyrene	Known	Acenaphthene	Unclassifiable
Dibenz[a,h]anthracene	Probable	Acenaphthylene	Not reviewed
Benz[a]anthracene	Possible	Anthracence	Unclassifiable
Benzo[b]fluoranthene	Possible	Benzo[g,h,i]perylene	Unclassifiable
Benzo[k]fluoranthene	Possible	Fluoranthene	Unclassifiable
Chrysene	Possible	Fluorene	Unclassifiable
Indeno[1,2,3-cd]pyrene	Possible	Phenanthrene	Unclassifiable
Naphthalene	Possible	Pyrene	Unclassifiable

* Classified by the International Agency for Research on Cancer (IARC). Unclassifiable indicates the PAH was reviewed but there were not enough studies to support a classification.

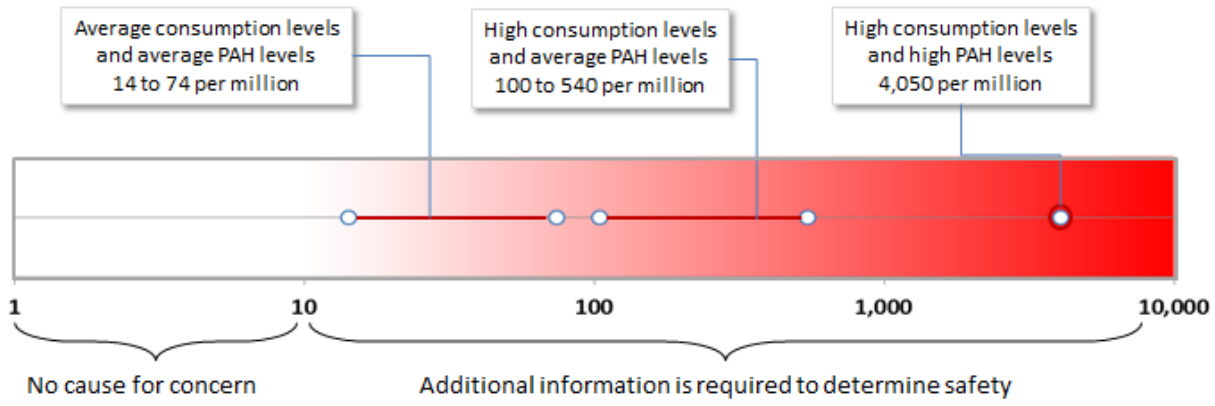
Table 2. PAH levels in traditional foods and consumption levels in Southern Ontario

Food*	Samples	Average PAH ug/g TEQ	Maximum PAH ug/g TEQ	Average Consumption kg/year	High Consumption kg/year	Percent of people who eat this food**
Lake whitefish	11	0.07761	0.7669	3.1	14.7	46
Canada goose	2	0.07504	0.14935	0.5	1.1	4
Deer	2	0.0127	0.01866	2.2	9.8	40
Moose	4	0.00638	0.00733	4.4	22.0	57
Partridge	1	0.00628	0.00628	0.7	4.4	23
Walleye-pickerel	18	0.00554	0.0279	2.1	7.2	56
Moose liver	1	0.00541	0.00541	2.9	11.2	5
Trout	6	0.00466	0.01547	1.0	3.4	36

* Listed in Table 10c – FNFNES report

** Listed in Table 6 for Ecozone 2 (Southern Ontario) – FNFNES report

Figure 1. Possible lifetime excess cancer risk from PAHs in some traditional foods in Ontario



We want to move forward in improving environmental quality: the air we breathe, the land we walk on, the water we drink, the food we eat; that's who we are as a people. If our earth is health, we are healthy.[10]

The highest levels of PAHs measured in the FNFNES were found in geese, ducks, and bottom-feeding fish like Lake whitefish and suckers. This suggests that contaminated lake and stream sediments are the likely source of PAHs in these birds and fish. Many studies of the Great Lakes, too numerous to cite, have found a wide range of industrial pollutants in the sediments, and these can be found in the aquatic organisms and fish living in the lakes.

46 percent of the people in Ecozone 2 reported they consumed Lake whitefish, some slightly more than once a month, and some almost every week. Because of this frequent consumption, and the relatively high levels of PAHs measured, much of the calculated lifetime excess cancer risk is due to eating Lake whitefish. For example, if Lake whitefish is removed from the analysis, the lifetime excess cancer risk ranges from 7 per million (average consumption and average PAH levels) to 160 per million (high consumption and average PAH levels), with a worst case scenario of 270 per million (high consumption and high PAH levels).

We confirmed that the Lake whitefish sampled for FNFNES were taken from the northern Lake Huron area.[5] The fish consumption guidelines for the northern Huron Lake area include limits on Lake whitefish consumption due to the presence of polychlorinated biphenyls (PCBs) and dioxin/furans[6] (Figure 2 and Table 3).

- To reduce exposure to PAHs (and other known contaminants), community members in the North Channel region of Lake Huron should follow the Health Canada fish consumption guidelines for this area.

Other foods also contributed to the possible lifetime excess cancer risk.

- If community members do not eat all the foods listed in Table 2 regularly. If they do not, the risk will be lower. More detailed information on consumption levels could be used to refine the eRISK estimate of lifetime excess cancer risk.

Figure 2. Fish consumption advisory areas

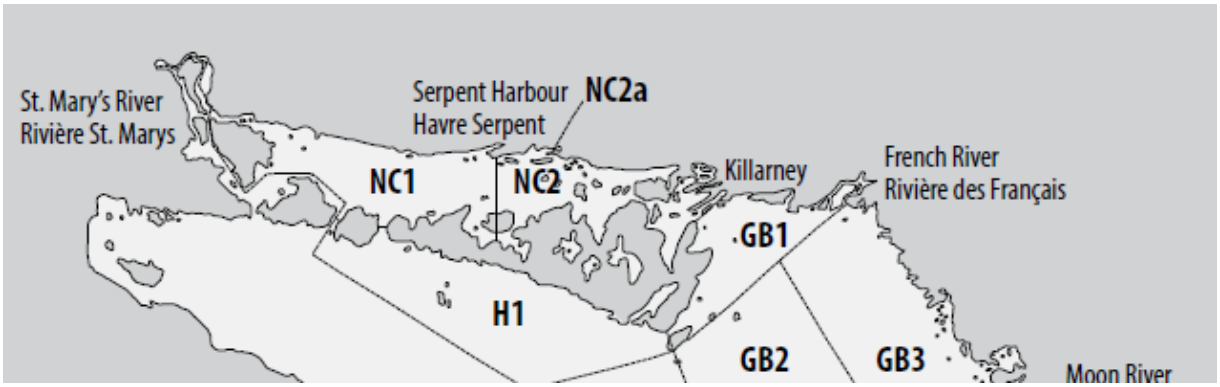


Table 2. Guidelines for Lake whitefish consumption

Area	General population	Women of childbearing age and children under 15 years of age
North Channel – NC1 (due to dioxin/furans)	1 meal per month of fish sized 18 to 20 inches	Advised not to eat any Lake whitefish from this area
North Channel – NC2 (due to dioxin/furans)	1 meal per month of fish sized 16 to 20 inches	Advised not to eat any Lake whitefish from this area.
Georgian Bay - GB1 (due to PCBs)	2 meals per week of fish sized18 to 20 inches 1 meal per week of fish sized 24 to 28 inches	

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[1] International Agency for Research on Cancer (IARC) monograph summary, Volume 92 (2006) http://monographs.iarc.fr/ENG/Monographs/vol92/mono92.pdf
[2] Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health – Polycyclic Aromatic Hydrocarbons 2010. http://ceqg-rcqe.ccme.ca/download/en/320
[3] First Nations Food, Nutrition and the Environment Study – Results for Ontario. http://www.fnfnes.ca/download
[4] CAREX Canada eRISK tool. http://www.carexcanada.ca/en/tools/
[5] Personal Communication, Sue Anne Chiblow, Mississauga First Nation and Community Coordinator for the FNFNES in Ecozone 2.
[6] Government of Ontario 2015-2016 Guide to Eating Ontario Fish http://www.ontario.ca/document/guide-eating-ontario-fish