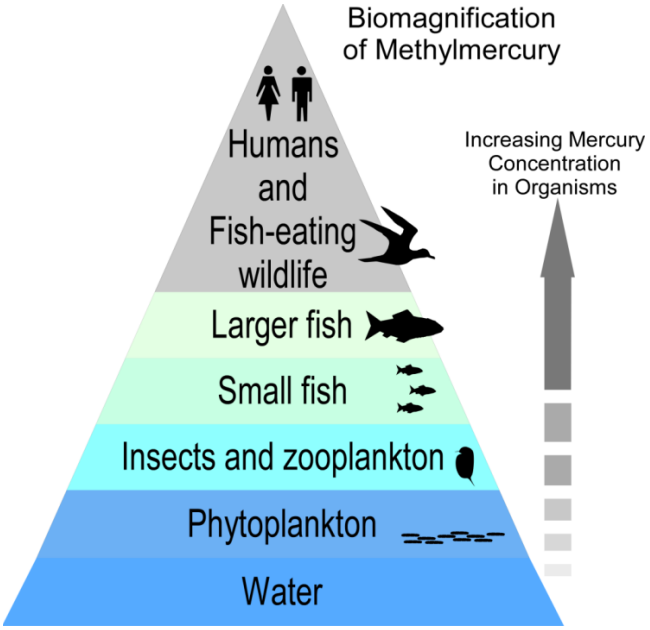
Reference Information about Mercury

Background

Mercury occurs naturally in the environment and can be found in many rocks and minerals around the world. There are three forms of mercury: elemental (metallic) mercury, inorganic mercury salts and organic mercury compounds (e.g. methylmercury). Mercury can be released into the environment through natural processes and human activities. Forest fires and flooding can release mercury when rocks containing the element are disturbed and/or exposed. In air, atmospheric deposition contains the three main forms of mercury, although elemental mercury is the most common form. Once in surface water, mercury that is attached to particles can settle onto the sediments where it can diffuse into the water column, be re-suspended, be buried by other sediments, or become methylated.

Bacteria that process sulfate in the environment (e.g., in surface water and/or sediment) take up mercury in its inorganic form and convert it to methylmercury (MeHg) through metabolic processes. These methylmercury-containing bacteria may be consumed by an organism in the next level in the food chain, or the bacteria may release methylmercury into the water where it can quickly adsorb to plankton, which are also consumed by the organisms in next level of the food chain. Because animals accumulate MeHg faster than they eliminate it (i.e., bioaccumulation), animals consume higher concentrations of mercury at each successive level of the food chain (i.e., biomagnification). Therefore, small environmental concentrations of MeHg can accumulate to potentially harmful concentrations in fish, fish-eating wildlife and people. The picture below illustrates both the concepts of bioaccumulation at individual level and biomagnification across the food chain.



Health effects of Mercury

The toxic effects of mercury depend on its chemical form and the route of exposure (e.g., ingestion vs inhalation). People are typically exposed to small amounts of mercury in the air, water and food. Exposure to methylmercury (MeHg) is usually by eating or drinking (e.g. eating MeHg containing fish)

and it is absorbed more readily and released more slowly than other forms of mercury. MeHg is the most toxic form of mercury and is a known human neurotoxin. MeHg is particularly damaging to developing fetuses, which are more sensitive than adults. Because MeHg is a known neurotoxin and accumulates in the body over time, it is necessary to limit human exposure. Other forms of mercury can also cause significant health effects when people are exposed to it over a long period of time at significant repeated doses (e.g., daily dose).

Health Canada has proposed a few mercury guidelines and advisories for different fish consumer groups based on total mercury (THg) or MeHg. These values are expressed either in units of ug THg per g of fish flesh or as a Provisional Tolerable Daily Intake (pTDI) in units of ug MeHg per kg of consumer body mass per day. The Government of Alberta is responsible for issuing and reviewing fish consumption advisories for fish caught in local water bodies. In order to balance the benefits and risks of eating fish, consumption limits in advisories are recommended for Albertans who eat fish caught from local water bodies on a regular basis for their entire life time. These fish consumers, also called a “high intake group,” may include First Nations people and recreational anglers in Alberta. Different fish consumption limits are provided to four consumer groups: children one to four years old; children five to 11 years old; women of child-bearing age (15 to 49 years old) and pregnant women; and adults, plus children over 12 years old. Because women of child-bearing age and young children are at greater risk of potential health risks as a result of being exposed to high levels of mercury, they should eat less fish.

For the current fish consumption advisories, please consult My Wild Alberta website: https://mywildalberta.ca/fishing/safety-procedures/fish-consumption-advisory.aspx

Analytical Methodology for measuring mercury levels in fish

Mercury (Hg) concentrations represent total mercury (THg) in fish muscle and are presented based on wet weight. Between 1997-2008, 1 g of tissue from each fish sample was digested using 5 mL of nitric acid using microwave digestion, diluted to 100 mL with distilled water and BrCl. Hg was analyzed using a flow injection Hg system and cold-vapour atomic absorption detection. The sample volume used was 500 uL. The method detection limit (MDL) was 0.003 mg/kg.

In 2009, 0.2 g of tissue from each sample was digested with 7 mL of 7:3 HNO_3/H_2SO_4 in a vented oven and diluted with 19 mL of distilled water. 1 mL of BrCl was used as an oxidizing agent. A 0.5 mL subsample was diluted with distilled water to 50 mL, and neutralized with 0.04% (v/v) hydroxylamine hydrochloride. Samples were analyzed for THg using cold-vapor atomic fluorescence detection. The MDL was 5.1 x 10-4 mg/kg.

For samples collected between 2010 and 2016, 0.09-0.12 g of tissue was introduced into the Milestone DMA-80 Direct Mercury Analyzer (DMA-80) to be thermally decomposed in an oxygen flow. Combustion products were further decomposed in a hot catalyst bed. Mercury vapours were trapped on a gold amalgamator and desorbed for quantitation using atomic absorption detection. The MDL was 0.005 mg/kg. SRM controls are within ±10% of certified values. The percent difference in concentration in duplicate samples is within ±10%. A percent difference of >10% may be acceptable if the concentration is <LOQ. When there was duplicate analysis of a sample, the first result was reported in this dataset.

For additional information about sampling protocols or analytical methodology, please consult the Alberta Health (AH) series of reports (http://www.health.alberta.ca/newsroom/pub-environmental-health.html). The reports and fish consumption advisories may contain data from other agencies that AH does not own nor have permission to release. Therefore the dataset provided here may not be sufficient to generate the results shown in the reports or current fish consumption advisories.

For additional details, please consult the AH reports on Mercury in Fish.

For access to Alberta Health Mercury in Fish dataset at Open Government Portal:
http://open.alberta.ca/opendata/chemical-monitoring-in-local-foods-mercury-in-fish#summary

Links to other references:

US EPA Glossary (http://archive.epa.gov/reg5sfun/ecology/web/html/glossary.html)**:**

*Bioaccumulation / Bioconcentration / Biomagnification***:**
Bioaccumulation is the general term describing a process by which chemicals are taken up by a plant or animal either directly from exposure to a contaminated medium (soil, sediment, water) or by eating food containing the chemical. Related terms are *bioconcentration* in which chemicals are absorbed by an animal or plant to levels higher than the surrounding environment; and *biomagnification,* in which chemical levels in plants or animals increase from transfer through the food web (e.g., predators have greater concentrations of a particular chemical than their prey).

AEP: http://environmentalmonitoring.alberta.ca/water/why-we-monitor-mercury/

USGS: http://www.usgs.gov/themes/factsheet/146-00/:

US EPA: http://www2.epa.gov/mercury

US EPA Integrated Risk Information System (IRIS) Methylmercury Summary and Supporting Documents (epa.gov): http://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=73

ToxFAQs on mercury and metallic mercury (ATSDR.gov):
http://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=113&tid=24

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