Hydroelectric Development and Mercury in the Environment

How do methylmercury levels increase from new hydroelectric developments?

- If a hydroelectric development creates a new or enlarged reservoir through flooding, the production of methylmercury may increase.
- This occurs as flooded vegetation in the new reservoir decomposes, stimulating the conversion of existing inorganic mercury into methylmercury by bacteria. (Figure 1)
- Methylmercury can then start to build up in the food chain.
- The percentage of new flooding compared to the total reservoir area is an important factor in determining the extent to which methylmercury concentrations may increase.
- Wetland areas are known to be a greater source of methylmercury than upland areas.

What are the different forms of mercury in the environment?

- Mercury is naturally found in the air, soil, sediment, vegetation, lakes and rivers, mostly as inorganic mercury.
- A small fraction of the inorganic mercury can be converted by bacteria into an organic form known as methylmercury. This form of mercury, while naturally occurring, may pose a hazard to human health.

What are the sources of added mercury into the environment?

- Natural sources of mercury are added into the environment as a result of events such as forest fires and volcanic eruptions. These sources release mercury to the atmosphere which then travels long distances and is deposited in lakes and rivers, through rainfall.
- Mercury is also released slowly from minerals and rocks as they erode through weathering.
- Mercury is naturally removed from the environment through long-term burial in sediments and soils.
- Industrial activities have added new mercury to the environment through air, land and water. Key sources include fossil-fuelled generating stations, some types of pulp and paper mills and gold mines.
- Common products, such as fluorescent light bulbs, LCD screens and dental amalgam, may contain added mercury.
- Both human activities and natural processes contribute to the movement of mercury into water bodies and the food chain. (Figure 2)

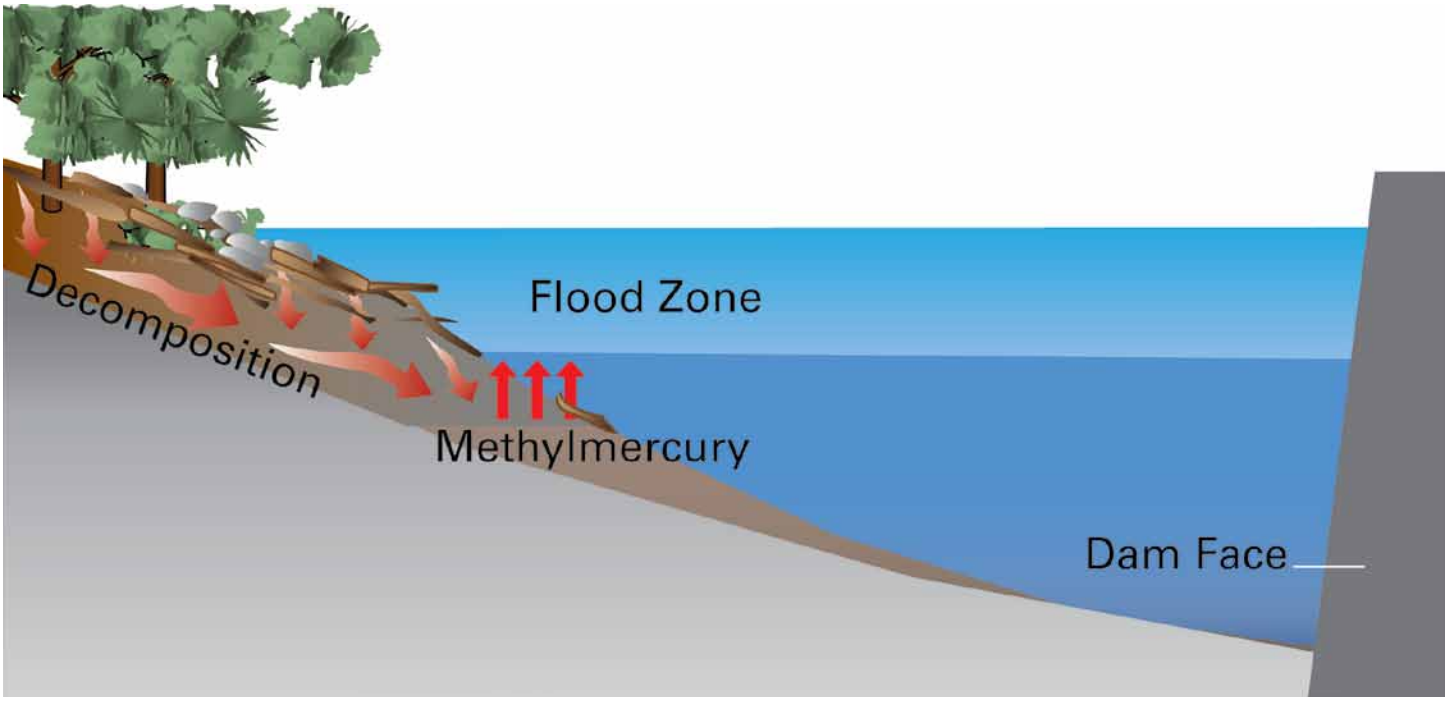

Figure 1: Decomposing vegetation in a new reservoir releases methylmercury into the food chain

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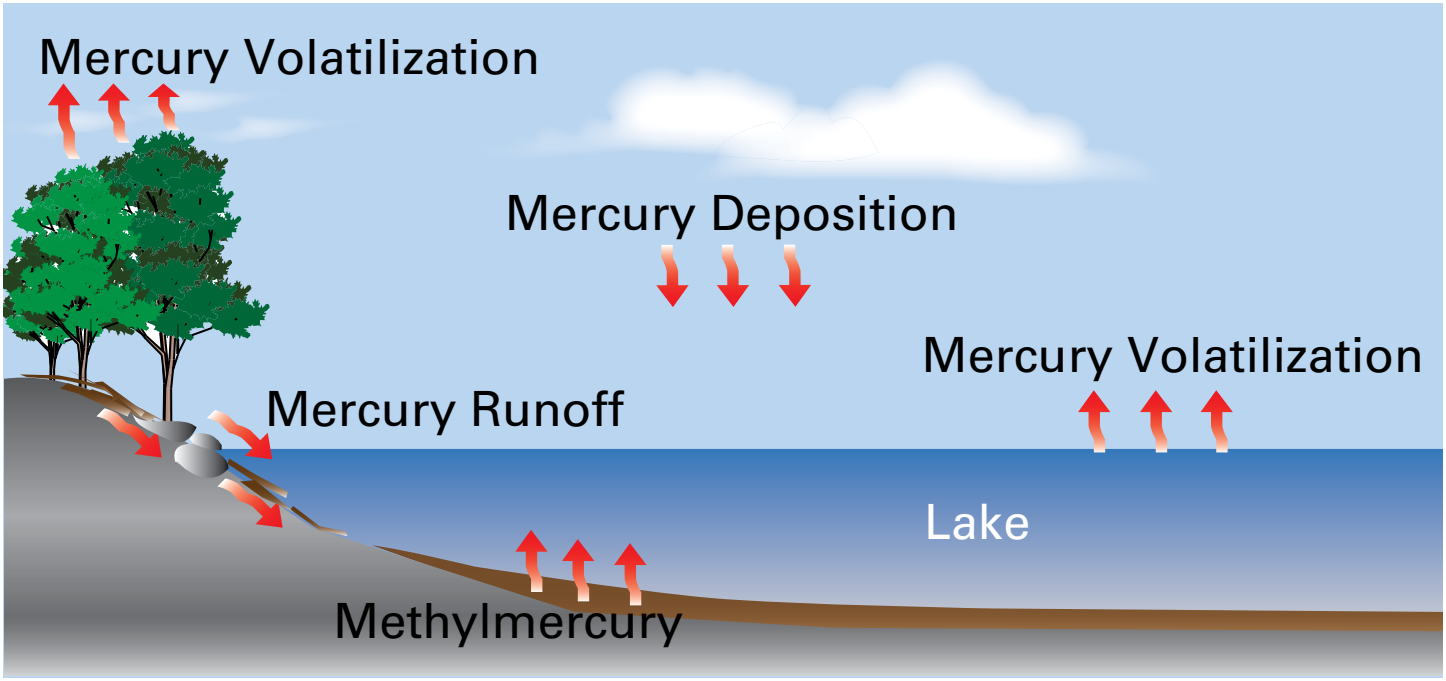

Figure 2: Mercury naturally cycles through the environment

What are the factors involved in the increase of methlymercury in fish?

- Methylmercury is transferred from water and sediments through the food chain to fish.
- Biomagnification is a gradual build-up of methlymercury with each step up the food chain. (Figure 3)
- Methylmercury levels in fish increase over time because they take it in faster than they can remove it from their bodies.
- Older fish tend to have higher concentrations than younger fish.

How long and how much will methylmercury levels be elevated?

- After initial reservoir creation, methylmercury levels typically peak in predatory fish within 5 to 15 years. Methylmercury levels then typically drop back down to pre-flood concentrations within 10 to 35 years after flooding occurred. (Figure 4)
- Top-level predatory fish take longer to reach peak concentrations.
- The extent to which methylmercury concentrations increase in predatory fish in new reservoirs depends partly on the average length of time water remains in the reservoir.
- If water is flushed through the reservoir regularly, elevated methylymercury levels in predatory fish may not be as great. This may increase the potential for downstream movement of methylmercury.

What are the factors involved in reducing methylmercury levels in new reservoirs?

- Minimizing the extent of flooding of the reservoir at the design stage.
- Clearing vegetation from the reservoir area before flooding at the construction stage.
- Minimizing frequent and extensive water level fluctuations as well as wave action during operations.

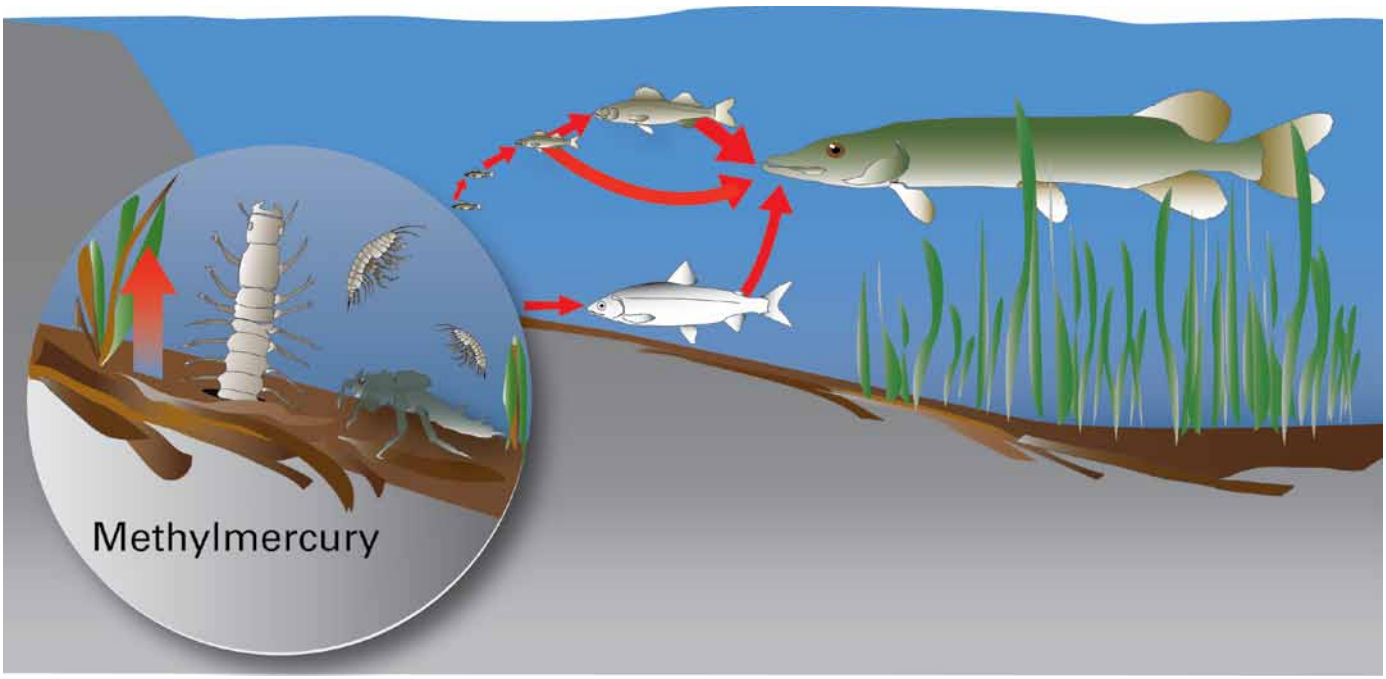

Figure 3: Biomagnification is a gradual build-up of methylmercury with each step up the food chain

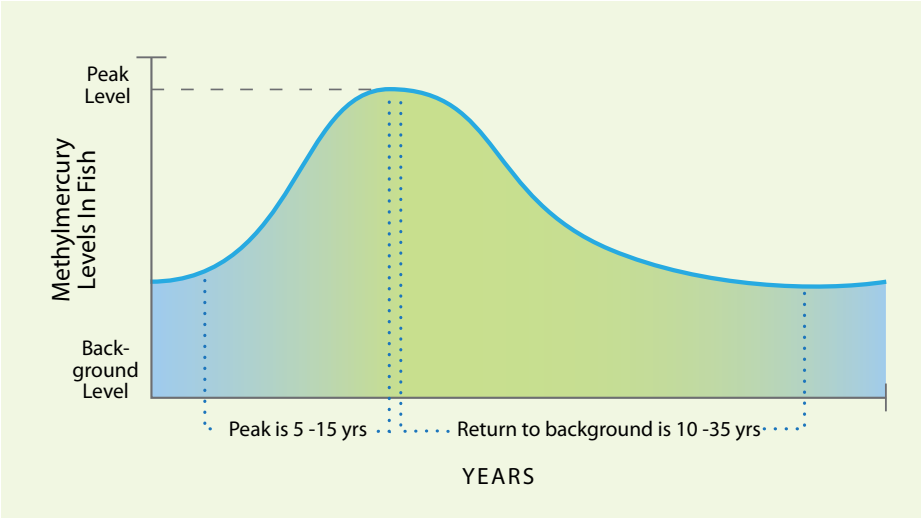

Figure 4: Typical pattern of methylmercury levels in fish after the creation of a new reservoir

Does it matter which fish are eaten?

- Yes, some fish species in the same water body can have higher mercury levels than others.
- For a given fish species and water body, smaller, younger fish tend to have lower concentrations of mercury than older, larger fish.
- Predatory fish such as northern pike and walleye have higher mercury levels because they primarily feed on other fish that have already bioaccumulated methylmercury.
- Whitefish typically have lower mercury levels because they feed primarily on plankton and insects that are lower on the food chain.

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What can be done to ensure the health of people who use newly created reservoirs for fishing?

- The main source of mercury for humans is through fish consumption, and not through drinking water.
- Mercury cannot be reduced or removed from fish during cooking or cleaning.
- It may be necessary to restrict consumption of fish caught in newly created reservoirs for a certain period of time.
- This can be facilitated by posting consumption advisory signs and through community education and communication.
- Pre- and post-construction monitoring of mercury levels is often recommended to:
  - Track fish methylmercury levels in order to determine when levels return to pre-flood concentrations;
  - Help inform people about the associated risks of consuming fish in the reservoir; and
  - Test and improve models for predicting fish methylmercury levels in waters around new hydroelectric generating stations.
- To provide advice about how much fish is safe to consume, the Ontario Ministry of the Environment has prepared guidelines for the general population and sensitive groups such as pregnant women and children.
- Based on site-specific sampling, the Ministry's *Guide to Eating Ontario Sport Fish* provides advice on the amount of fish that can be safely eaten monthly, depending on the specific water body, fish species and fish length.

Should I be concerned about increased methylmercury levels in fish, wildlife and other components of the environment linked to new reservoirs?

- Research is ongoing regarding the potential for fish individuals and populations to be affected by methylmercury levels present naturally in lakes and reservoirs.
- Methylmercury levels in fish in new reservoirs could present risks to some wildlife such as mink, otter and osprey, if reservoir fish are eaten exclusively. Research on this topic is ongoing.
- Grazing species such as moose, deer or caribou are not at risk for exposure to elevated methylmercury levels because they do not eat fish.

Where Can I Get More Information?

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Ministry of the Environment
Guide to Eating Ontario Sport Fish
is available online:
www.ontario.ca/fishguide

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