Statewide Mercury Control Program for Reservoirs

The State Water Resources Control Board is in the process of developing a statewide mercury control program for reservoirs.

Overview

Fish containing harmful amounts of mercury are found in numerous reservoirs across the state. Mercury is a heavy metal that is poisonous in very small amounts. Infants, young children, and women of childbearing age are most at risk. It is known to cause brain damage as well as kidney and lung problems in humans and wildlife. To begin to address this widespread mercury contamination, the State Water Board is developing a program that will focus on mercury in California's reservoirs.

How are humans exposed to mercury?

Most human exposure to harmful amounts of mercury is through eating contaminated fish. Toxic levels of mercury in fish are present in more than 180 reservoirs and rivers in California, making some of the fish unsafe for humans or wildlife to eat. Many of these water bodies have posted fish consumption warnings advising people to limit their consumption of certain species and sizes of locally caught fish. The methylmercury concentration in water is one of the primary factors determining methylmercury concentrations in fish.

What is "methylmercury"?

Mercury (also called inorganic mercury) is toxic in all of its forms, but methylmercury is highly toxic and readily available to bioaccumulate in fish, birds, and people. Methylmercury is formed from inorganic mercury where sediments are low in oxygen and bacteria are present, such as at the bottom of reservoirs and in wetland habitats.

What is "bioaccumulation"?

When methylmercury moves into water, it binds to organic matter, including phytoplankton at the base of the aquatic food web. Contaminated phytoplankton are consumed by zooplankton, which are then fed upon by small and large fish. The methylmercury accumulates in each species as it moves through the aquatic food web. The highest concentrations of methylmercury are usually found in large, old fish such as bass, which eat smaller fish.

How does mercury enter reservoirs?

Inorganic mercury enters reservoirs and other water bodies through a variety of sources including:

- Atmospheric deposition (mercury emitted from industry that deposits on land and water surface)
- Tributary streams carrying runoff from mercury, gold, and silver mines
- Erosion of soils naturally enriched with mercury within a watershed
- Urban runoff and municipal and industrial discharges (but loading is usually significantly lower than other sources compared to other sources)

What are some potential methods to reduce methylmercury levels fish?

Reservoirs can create a habitat and an environment that can increase the methylmercury exposure risk to fish consumers. The magnitude of methylmercury risk in reservoirs is related to three factors that may be controllable:

1. Changes to management of water chemistry

   Chemical properties of reservoir water such as oxygen and nutrient levels can affect methylmercury production.

2. Changes to management of fish species

   Which fish species are present and how they are managed can affect how methylmercury bioaccumulates and the level of methylmercury in small and large fish.

3. Reductions in concentrations of inorganic mercury

   Reducing concentrations of inorganic mercury in reservoir sediment are one way to limit methylmercury production and its subsequent bioaccumulation in fish. Potential source controls include cleanup of legacy mercury, gold and silver mines upstream of reservoirs. However, atmospheric deposition from uncontrollable global mercury sources may continue to add significant amounts of mercury to many reservoirs.

What are some in-reservoir management practices likely to reduce fish methylmercury levels?

Manage reservoir water chemistry to reduce methylmercury production

- Oxidant addition to reservoir bottom waters (near the sediment-water interface) to reduce anoxia or adjust redox potential when reservoirs are stratified to suppress methylation of mercury. Evaluate various oxidants (e.g., dissolved oxygen, ozone, nitrate, others) for (a) efficacy for methylmercury reduction, (b) multiple benefits (e.g., drinking water quality, algal controls), and (c) avoidance of adverse consequences (e.g., application only when a reservoir is stratified and not discharging bottom waters from the dam, with monitoring to ensure that added oxidant does not increase nutrient levels in the reservoir or downstream); and
- In-reservoir sediment removal or encapsulation to address inorganic mercury hotspots such as submerged or near-shore mine sites and mining waste.

Manage fisheries to reduce fish bioaccumulation of methylmercury

- Intensive fishing to increase the growth rate of remaining fish;
- New or changes to fish stocking practices to increase the abundance of fish with lower methylmercury levels, such as (a) stock low-methylmercury prey fish for reservoir predator fish to consume, (b) stock more or different sport fish species, such as lower trophic level sport fish, and/or (c) stock large, old predator fish from hatcheries that supply low methylmercury fish; and
- Assess potential changes to make to fish assemblage that result in top predator fish with lower methylmercury levels.

What additional actions can be taken to protect human health?

- Post fish consumption warning signs;
- Change fish catch restrictions to reduce human consumption of larger, older fish with high methylmercury levels, e.g., “slot limits” that specify a safe size range of fish for consumption; and
- Conduct public outreach and educational activities to discourage people from consuming fish with highly elevated methylmercury.