Science and Research on the Great Salt Lake:

Mercury in the Great Salt Lake Ecosystem

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STATE OF UTAH
NATURAL RESOURCES
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U.S. FISH & WILDLIFE SERVICE

USGS
science for a changing world

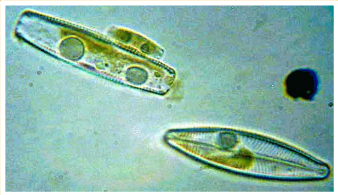
Overview:

- What is the Natural Resource?
- What is the Great Salt Lake Ecosystem?
- **What is the Problem?**
- **What can we do about it?**

What are the Resources on the GSL?

- Migratory birds and waterfowl, and their supporting habitats
- Brine Shrimp and other lake biota-
  - Food source for bird populations
  - Economic resource- product, market, revenues
- Water quality and quantity, air quality
- Other public values
  - Recreation, tourism, social value

GSL Open Lake Ecosystem



Diatoms (“golden algae”)

Brine Shrimp

Birds (Eared Grebe)

- **Sunlight fueled “food production facility”**
- **Economically important to Utahns**
- **Hemispherically important to migratory birds**

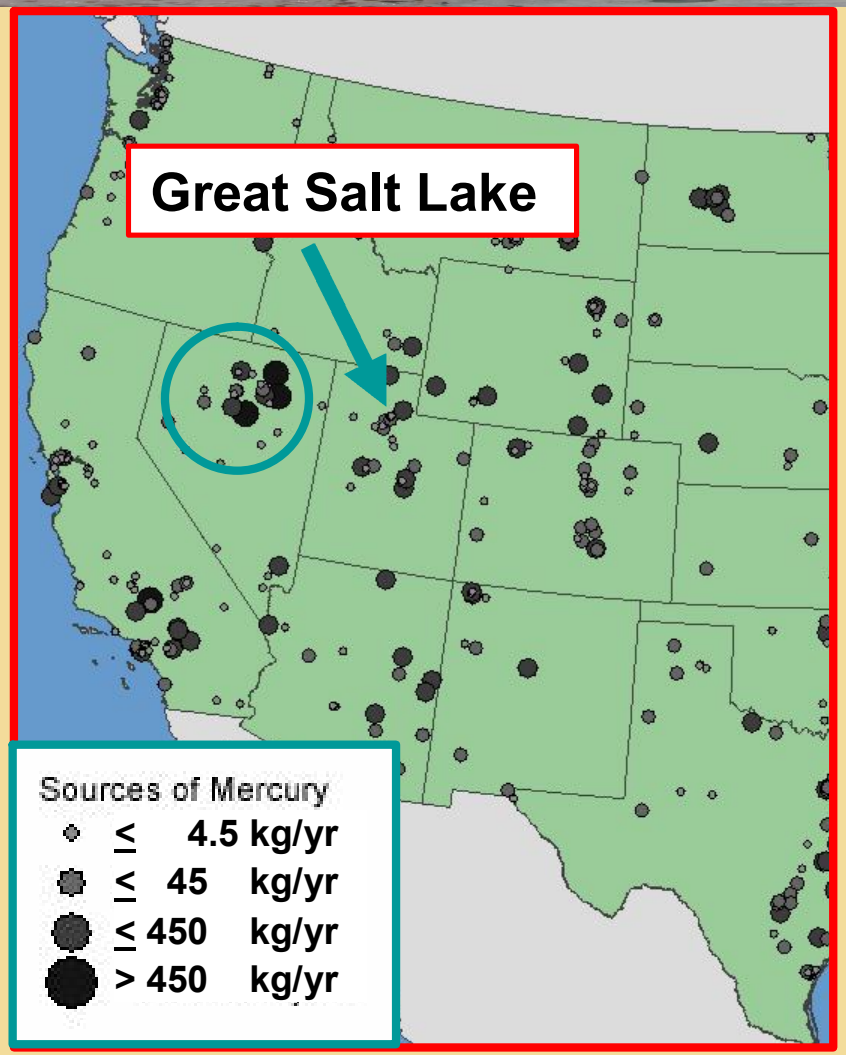
Great Salt Lake Wetlands

- **75% of Utah's remaining wetlands fringe the GSL**
  - **Including areas that are vital for bird populations**
  - State Waterfowl Management Areas (WMAs)
  - Bear River Migratory Bird Refuge
- **Gradient of fresh-to-salt water creates high diversity and productivity**
  - **63 million breeding birds/yr**
  - **Key breeding species:**
    - Mallard, cinnamon teal, other waterfowl
    - Numerous shorebirds

What's the Problem with Mercury in the GSL?

1. **There are high concentrations of mercury in the GSL ecosystem**
   - Some of the highest concentrations ever measured in water
   - High concentrations observed in algae, brine shrimp and hunted waterfowl species
2. **Mercury is toxic & bioaccumulative in both people and wildlife**
   - Potent neurotoxin- can cause illness and loss of physical abilities (movement, cognition)
   - Harmful to developing embryos & young

Where does the Mercury come from?



1) Upwind regional sources

- Regulated- Gold mining, coal-fired power
- Also- wildfires

2) "Global" Sources

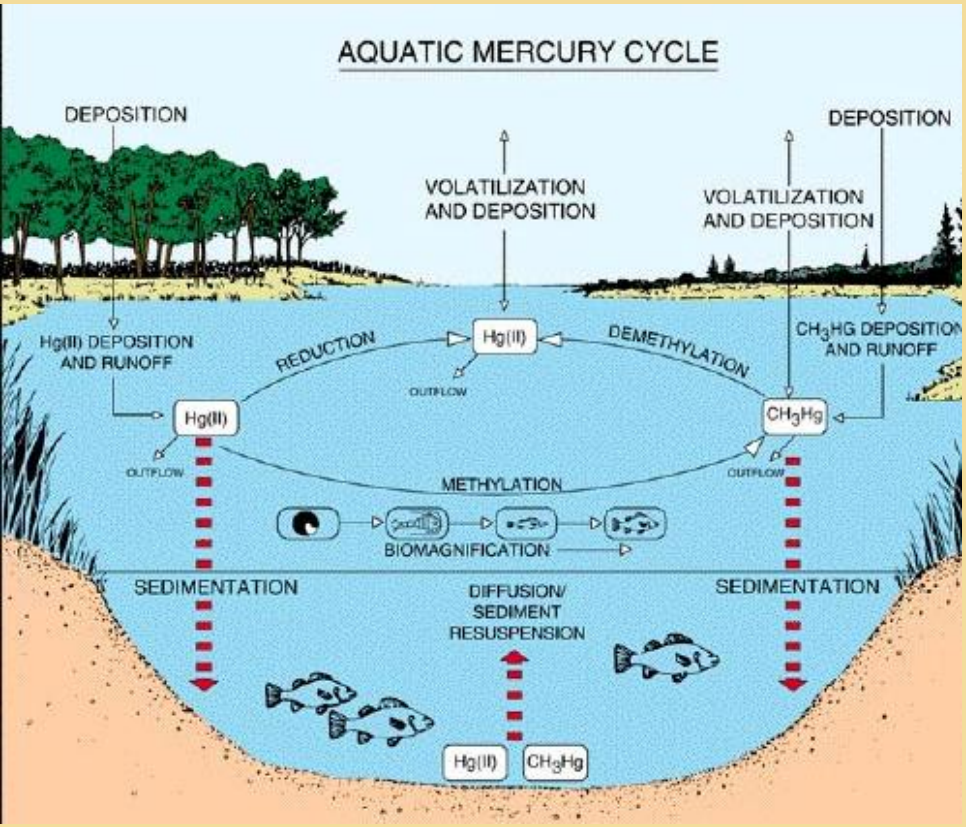
- Asian continent
- "global mercury pool"

3) Local sources

- Stormwater, local air emissions
- Historic contamination into a terminal lake system

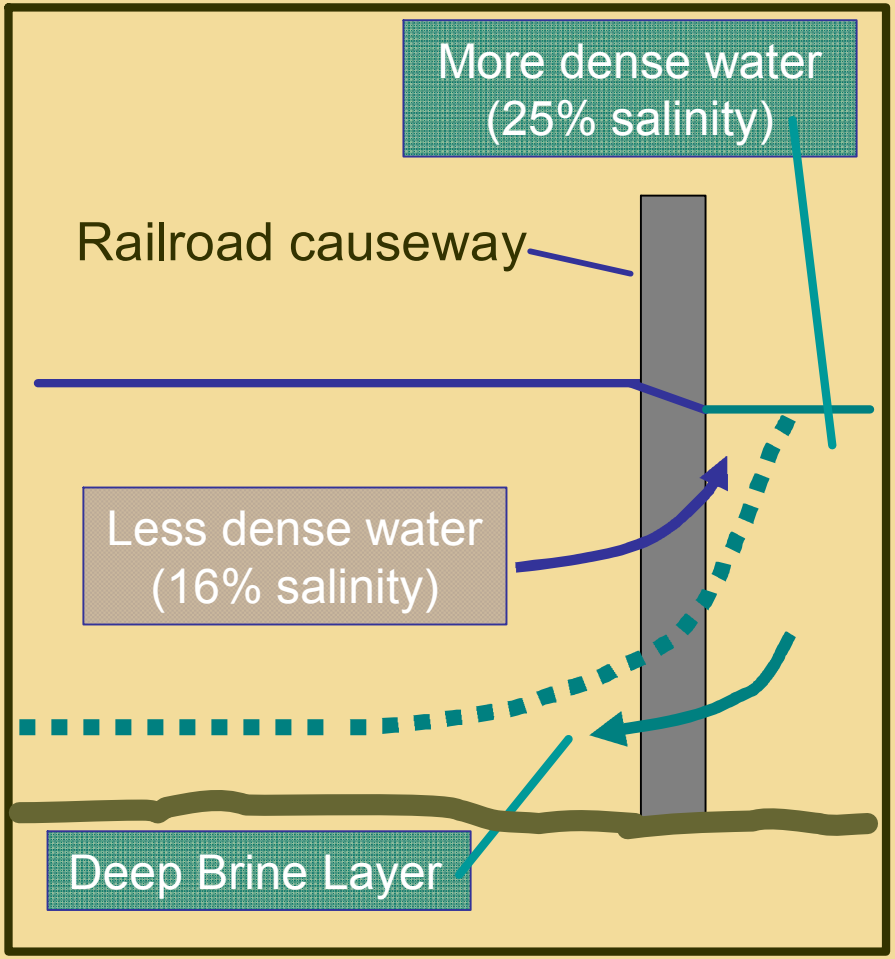
Data source: US EPA TRI, 2003; Slide: Dr. D. Naftz, USGS

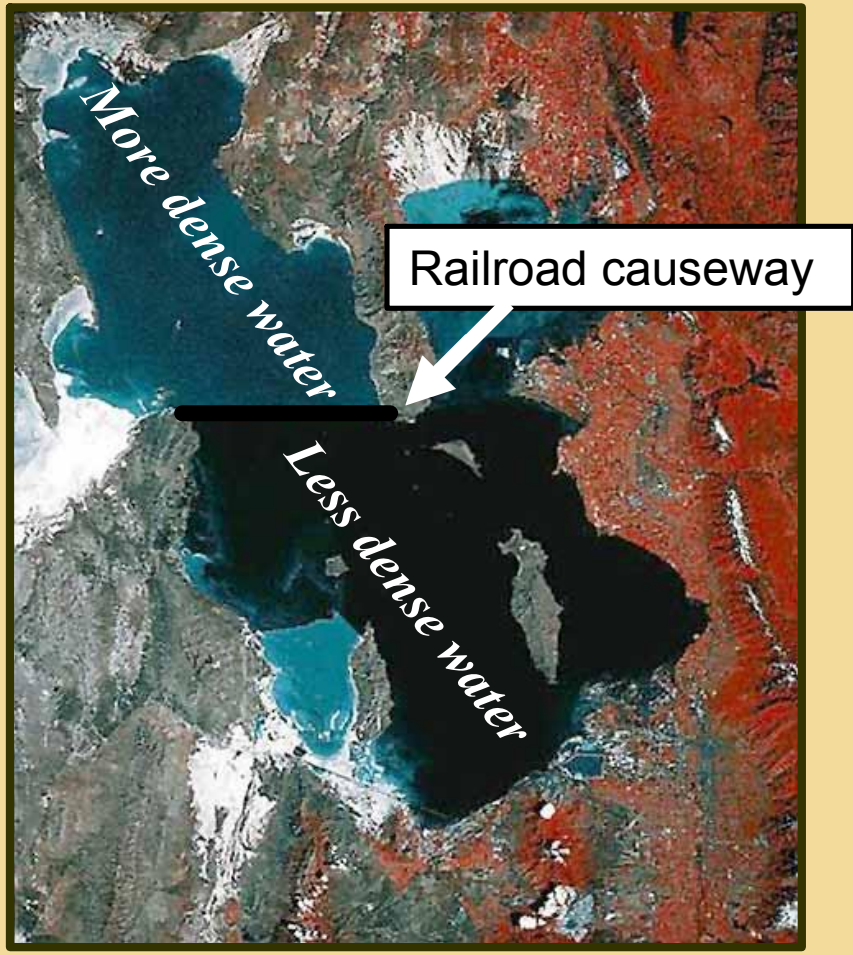
Mercury Cycling: Key Concepts



- **Deposition:** *Hg can be deposited, volatilized and re-suspended (air cycle)*
- **Methylation:** *Microorganisms can transform Hg to an organic form ("**methyl mercury**", MeHg)*
- **Biomagnification:** *MeHg is accumulated in **increasing concentrations** in the food chain*

The "Deep Brine Layer"





Slide: Dr. D. Naftz, USGS

Hg in the GSL compared to other Lakes

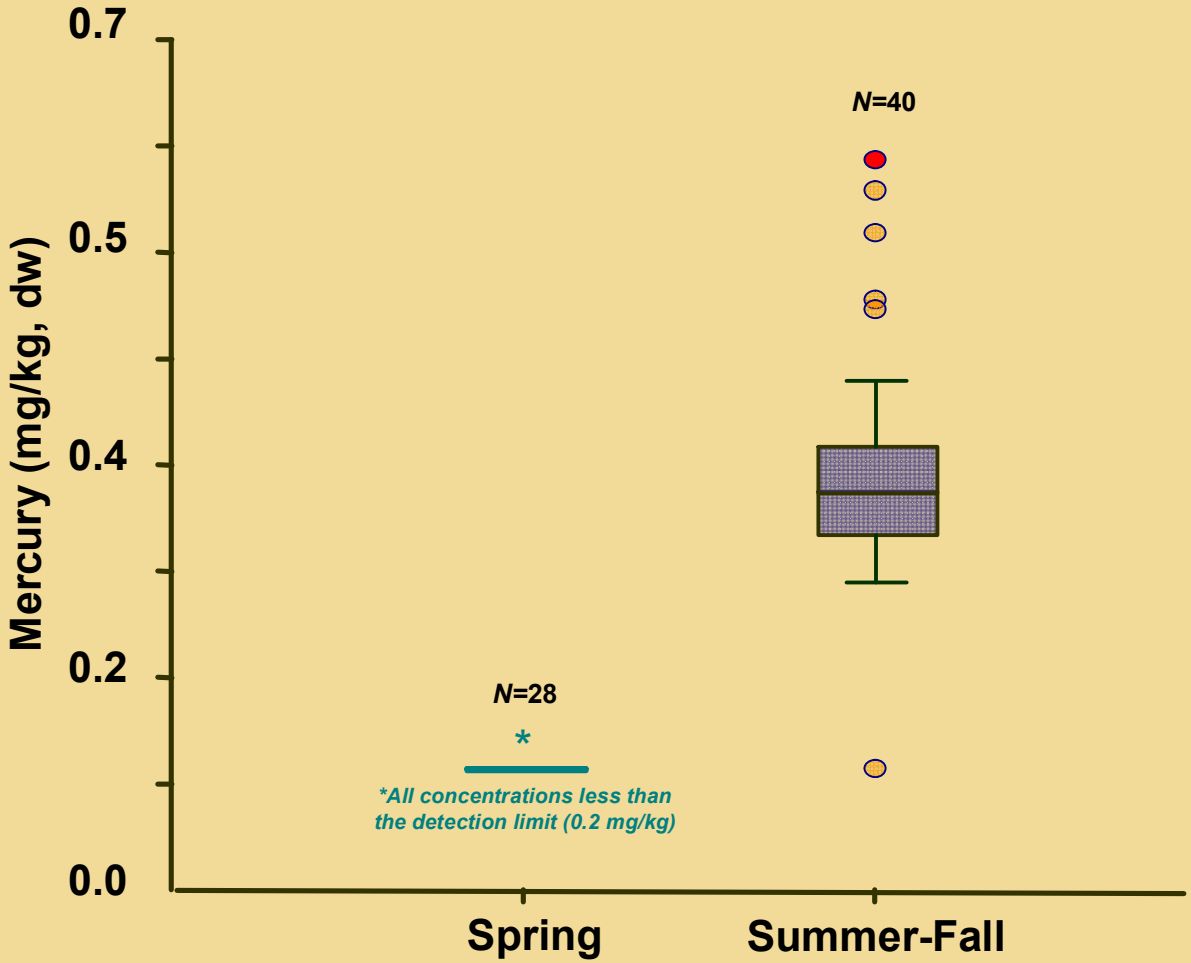
- **Generally, Hg in GSL is *10-100 times* higher than in other lakes that have been measured.**

	Total-Hg	%Methyl-Hg
– **GSL:**	**2.0 - 8.0 ppb**	**31-60%**
– Idaho:	0.50 – 1.80 ppb	--
– Maryland	0.05 – 0.38 ppb	1.2-27%

Data provided by Dr. Dave Naftz, USGS

Mercury Accumulation in the GSL open-lake Food chain

- **Hg accumulates throughout the year**
  - As brine shrimp feed & grow
- **Peak Hg concentrations at the same time fall-migrating birds arrive**



Mercury in Brine Shrimp, GSL

Data: USFWS Utah Field Office

Mercury in Ducks on the GSL- a Risk to Hunters

- **Utah DWR issued "do not eat" advisory issued for GSL ducks in 2005**
  - First in the nation
  - Northern Shoveler
  - Common Goldeneye
- **Additional data collected since then have confirmed & refined the advisory**
  - Guidelines based on population
  - For example, lower limits for pregnant/nursing mothers, women planning to become pregnant
- **Cinnamon Teal added to the list in 2006**
  - Is the only species that also breeds on the GSL
  - Is more of a "wetland" species than an open-water species

Data & graph: Utah DWR

FWS-UDWR Cinnamon Teal Study

- **Is Hg an issue in the GSL Wetlands, also?**
  - 3 areas
    - Bear River, Ogden Bay, Farmington Bay
  - Eggs--can tell us about risks to reproduction
  - Juveniles & adults-- can tell us about risks during growth

Photo credit: Associated Press, 2008

Why is this important?

- **Mercury in the GSL ecosystem could impact bird populations elsewhere in North & South America**
- **Regulatory Implications**
  - "Impairment" under the Clean Water Act
- **Degree of risk/harm determines how much effort (and $$) needed to address the problem**
  - To protect our resources
  - To protect their values
  - To protect our health

Complicated Questions- Exemplary Cooperation

- Utah Department of Environmental Quality
- Utah Division of Wildlife Resources & GSL Ecosystem Project
- U.S. Fish & Wildlife Service
- U.S. Geological Survey
- U.S. Environmental Protection Agency
- Utah State University
- *MANY* others…

Photo credit: Utah DWR