A Selenium Tissue Based Water Quality Standard for Great Salt Lake

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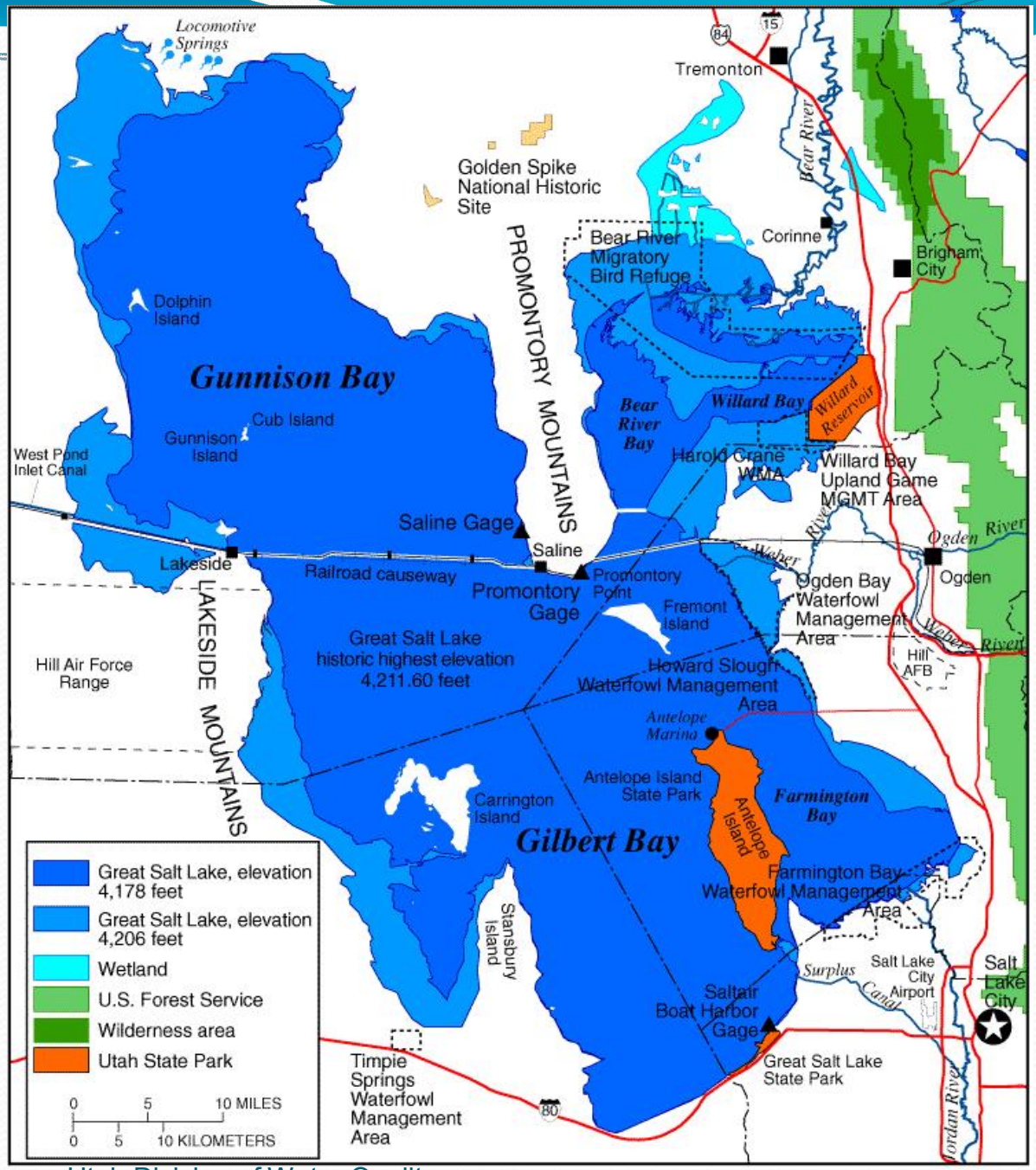
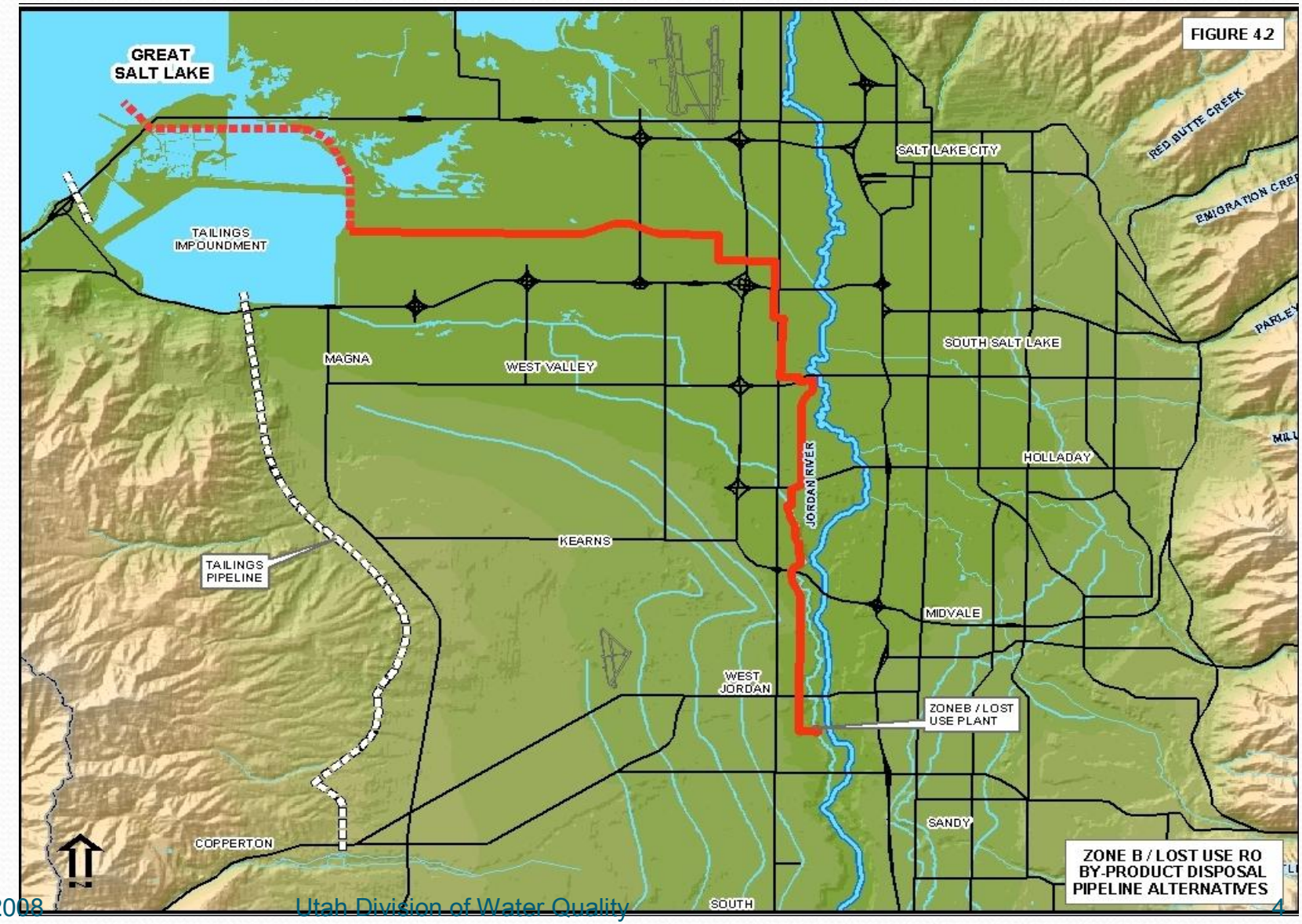
The Great Salt Lake - Utah



Utah Division of Water Quality

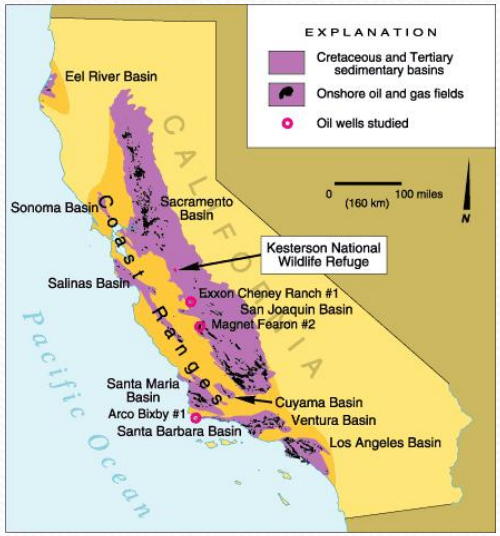
Reverse Osmosis Brines Pipeline



Wildlife Selenium Problem

Kesterson Reservoir California – 1980's

- Subsurface agricultural drainage water was used for marsh management in Merced County, CA.
- Selenium-induced effects, including dead or deformed embryos or chicks, were found in 39% of the nests.
- Many dead birds were found.



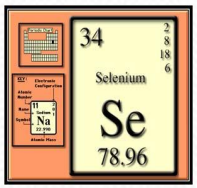
Biomagnification up the GSL Food Chain

[Might this be happening here?]

Reduced Hatchability

Birds

Deformities
[Teratogenesis]

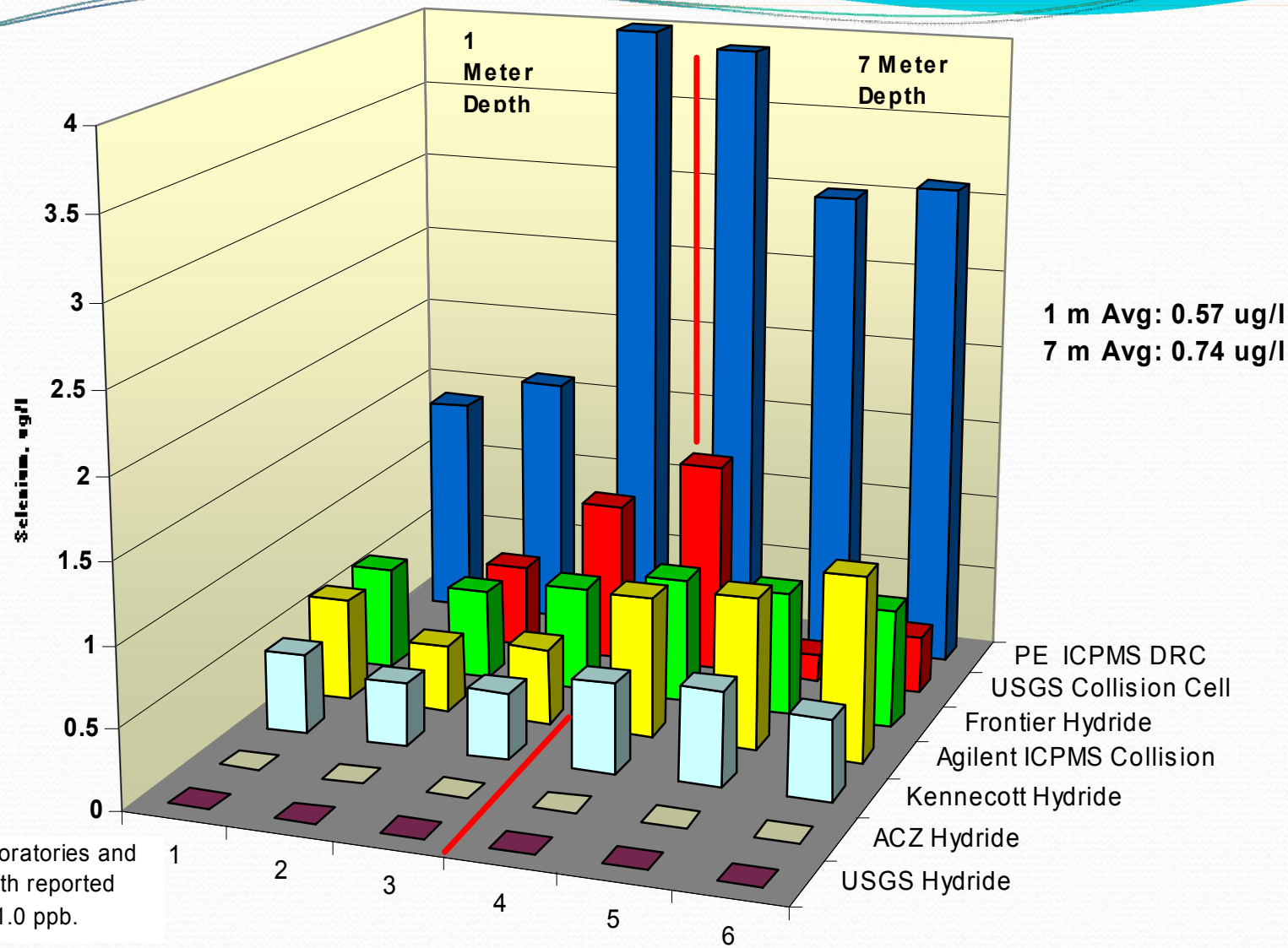


Brine Flies & Brine Shrimp

Concentration of Se in GSL

- It all starts with the water.
- **What is the concentration of Se in Great Salt Lake?**
- Data was very scattered and unreliable.
- Instrumentation was improving.
- Samples taken and sent to ERA Aurora, CO for:
  - Spiking
  - Round Robin (EPA $15,000 grant)
    - Concentration
    - Instrument

Concentration of Se in Gilbert Bay @ USGS Site



ACZ Laboratories and USGS both reported values <1.0 ppb.

USGS Hydride | ACZ Hydride | Kennecott Hydride | Agilent ICPMS Collision | Frontier Hydride | USGS Collision Cell | PE ICPMS DRC

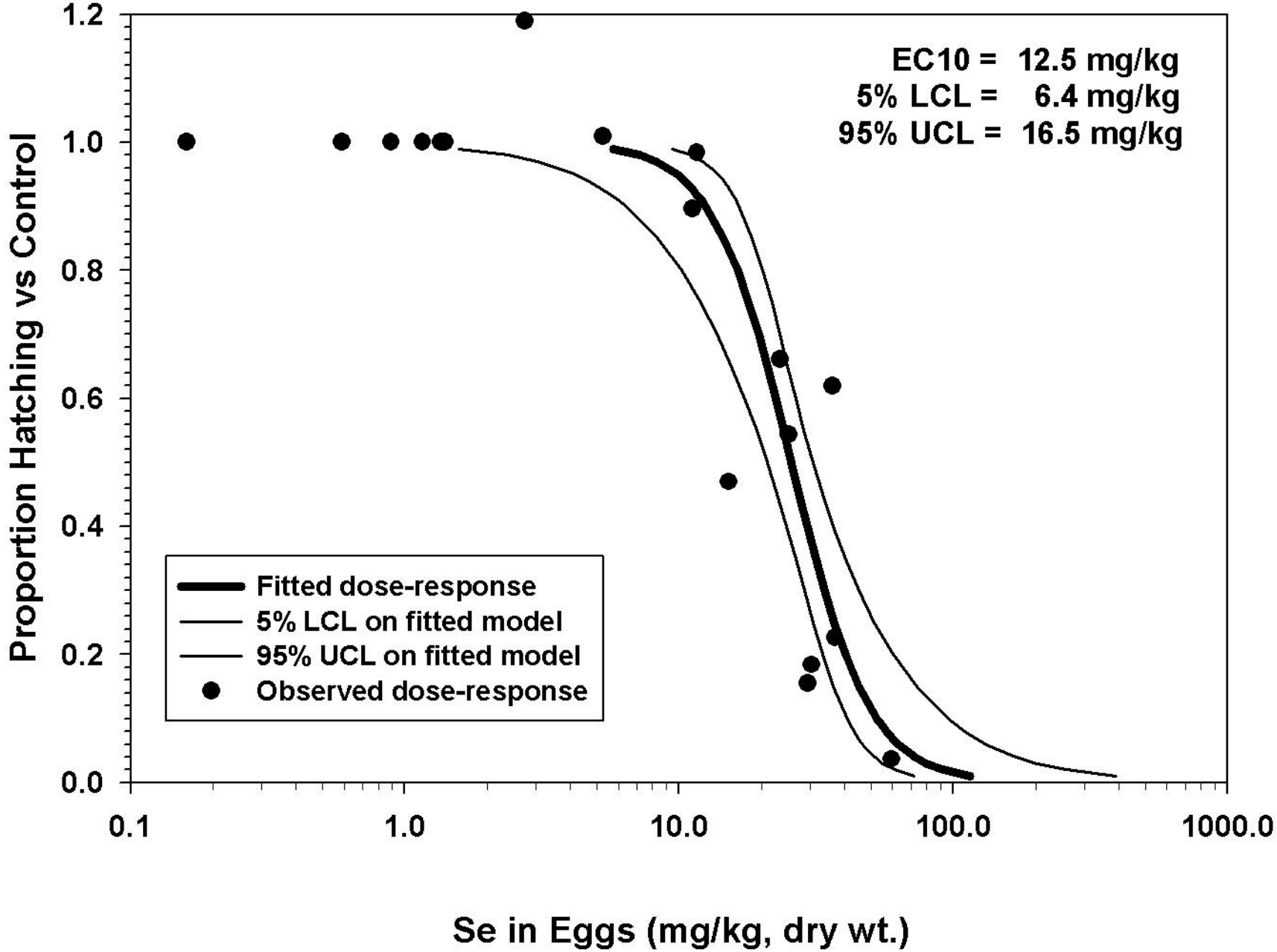


Figure 2. Mallard egg hatchability vs control as a function of selenium concentration in eggs.

Evaluating the Toxicity Curve for the Mallard Duck [non-GSL feeder]

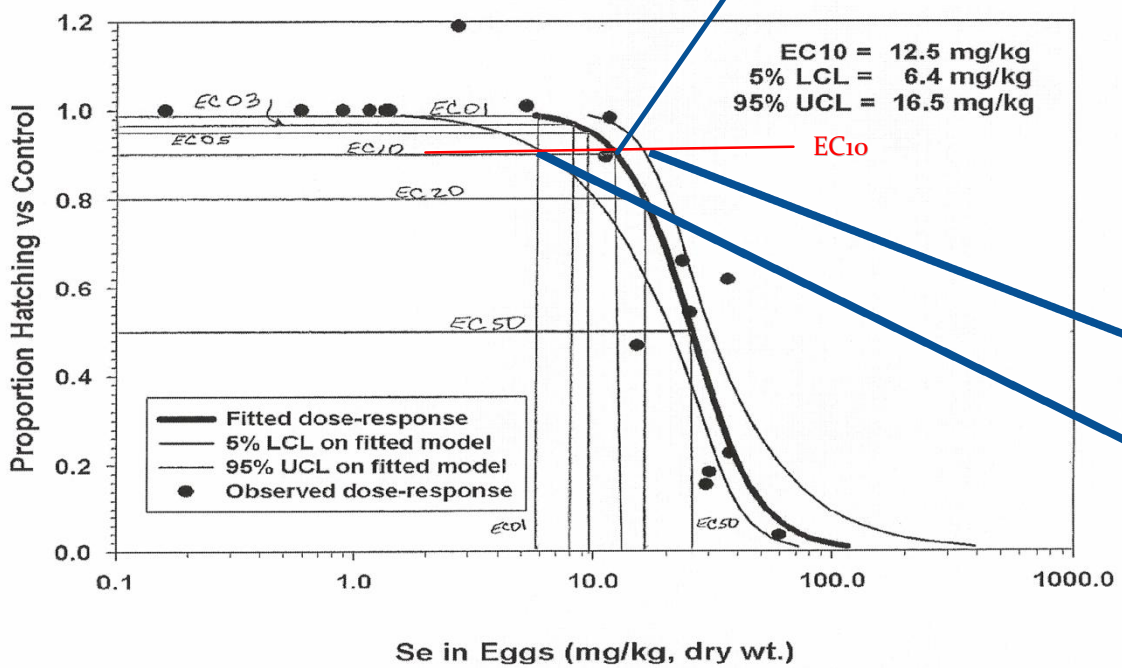
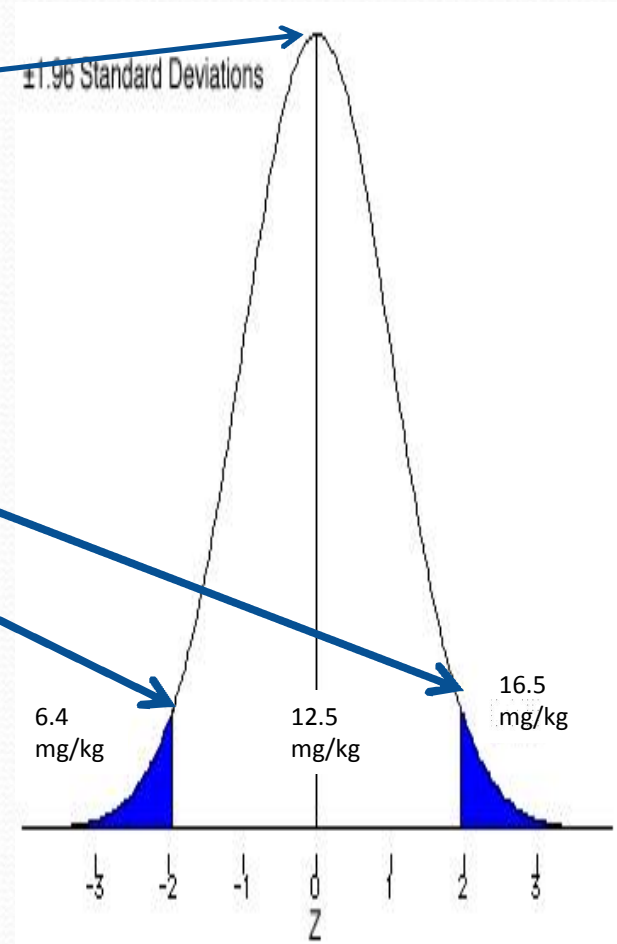
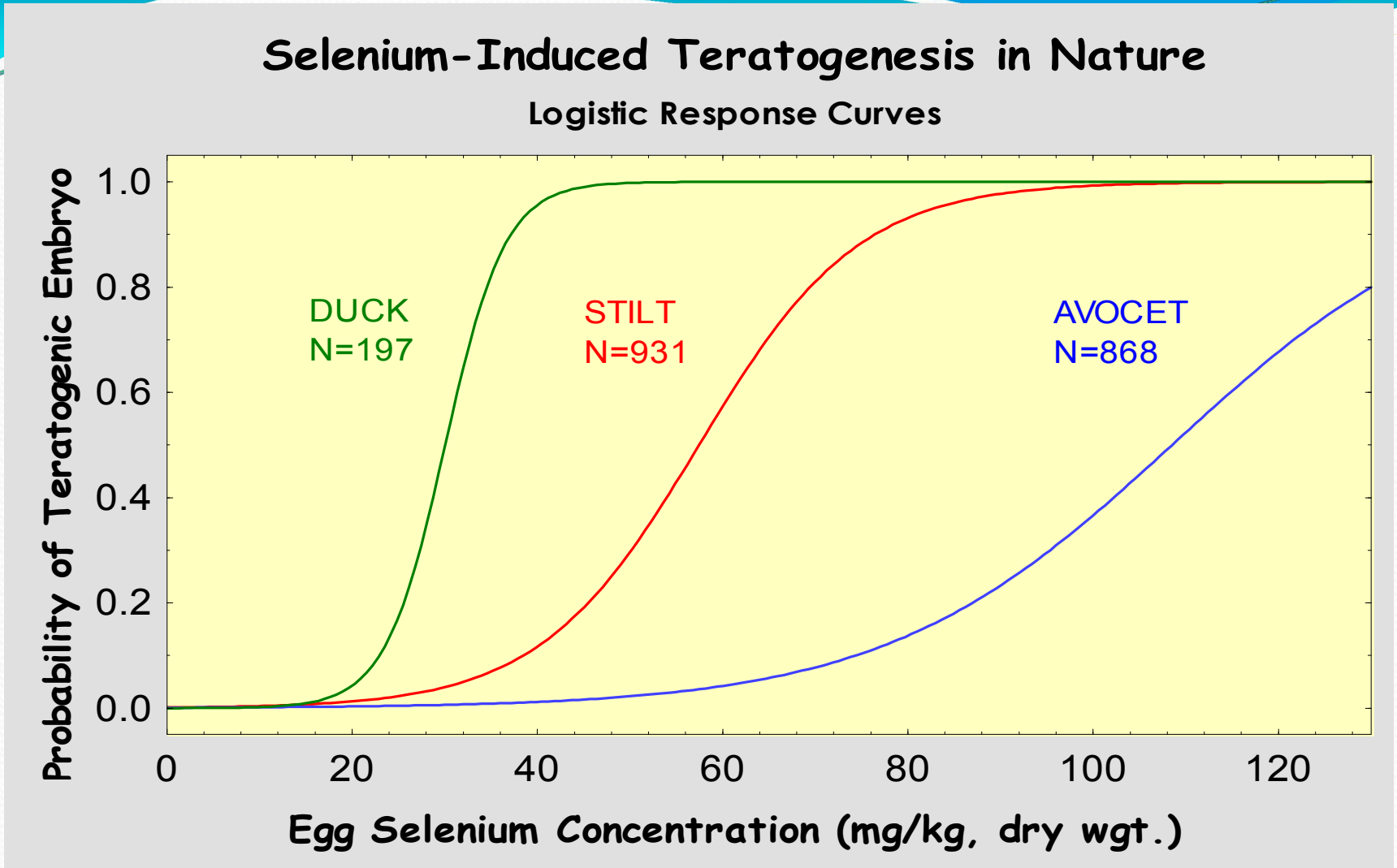


Figure 2. Mallard egg hatchability vs control as a function of selenium concentration in eggs.



Poster 7



Logistic response curves for selenium-induced teratogenesis among black-necked stilt, American avocet, and duck eggs exposed to agricultural drainage water.

Using a Mathematical Model to Predict Bioaccumulation

If the water in GSL were at "x" ug/L what does the model predict the concentration of selenium would be in the egg?

Water: ug/L (ppb)	Bird Egg: mg/kg (ppm)
0.60	2.53
1.0	4.32
2.0	8.80
3.0	13.3

Black-Necked Stilt

ppb = parts per billion ppm = parts per million

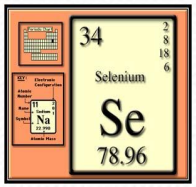
GSL Se Numeric Tissue-Based Water Quality Standard to protect Aquatic Wildlife

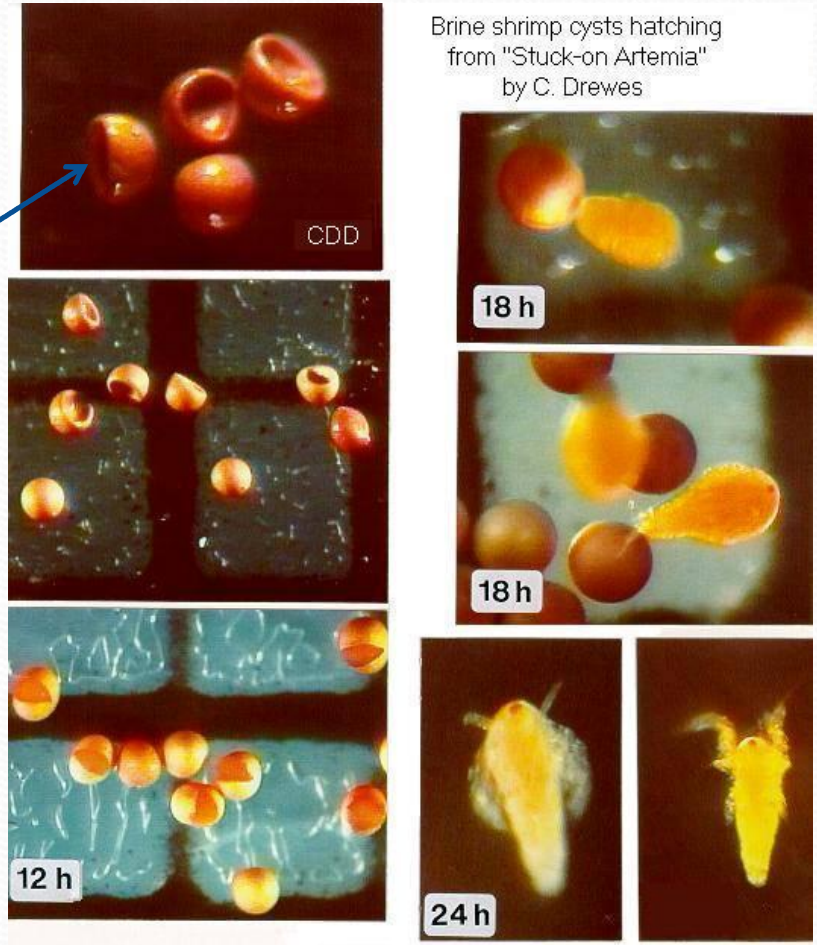
- 12.5 mg/kg (ppm) was chosen as the Standard
  - Tissue based whole egg
  - Shorebird egg
  - Dry weight
  - Over the nesting season
- Assessment / Monitoring Strategy
  - Included as a part of the standard
  - Developed by the Division of Water Quality

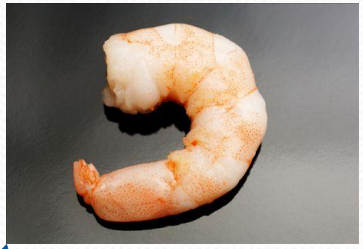
Assessment/Monitoring Procedure

Egg Conc.	DWQ Response
Below 5.0 mg/kg	Routine Monitoring with sufficient intensity to determine if selenium concentrations within the Great Salt Lake ecosystem are increasing.
5.0 mg/kg	Increased Monitoring to address data gaps, loadings and areas of uncertainty identified from initial Great Salt Lake selenium studies.
6.4 mg/kg	Initiation of Level II Antidegradation review by the State for all permit renewals or new permits to Great Salt Lake. May include loading reductions.
9.8 mg/kg	Initiation of preliminary TMDL studies to evaluate selenium loading sources.
12.5 mg/kg	Declare impairment. Formalize and implement TMDL.

Biomagnification up the GSL Food Chain: Brine Shrimp Industry







Prawn

Tilapia

Does the Se concentration in the first instar stage of the nauplii cause a potential problem for the brine shrimp industry?

Conclusion of DWQ Presentation