Preliminary investigation of selenium in water, bottom sediment, and biota, Great Salt Lake, Utah

Bruce Waddell, USFWS, Salt Lake City, UT

David L. Naftz USGS, Salt Lake City, UT

Briant A. Kimball, USGS, Salt Lake City, UT

John R. Garbarino, USGS, Denver, CO

Data collection, analysis, and graphic support: *Rex Sohn, Elise Boeke, Nathan Darnall, Doyle Stephens, Rob Baskin, and Melanie Markin*

Great Salt Lake Study Team

GSL ISSUES

- **Closed basin: Salinity is 3 to 5 X higher than seawater**
- **Runoff from urban, agriculture, and mining**
- **Currently (2002)--No numeric standards for Se or other trace contaminants**
- **<u>R317-2-6. Use Designations.</u>**

6.5 Class 5 -- The Great Salt Lake. Protected for primary and secondary contact recreation, aquatic wildlife, and mineral extraction.

Photo courtesy of Don Paul

GLOBAL IMPORTANCE OF GSL

- Area of Hemispheric Importance
- > 85 million bird-use days
- 30 percent of world's population of Wilson's Phalarope
- 0.5 to 1.5 million Eared Grebes
- 15.5 M lbs of BS cysts harvested this year

Statistics courtesy of GSL Ecosystem Project

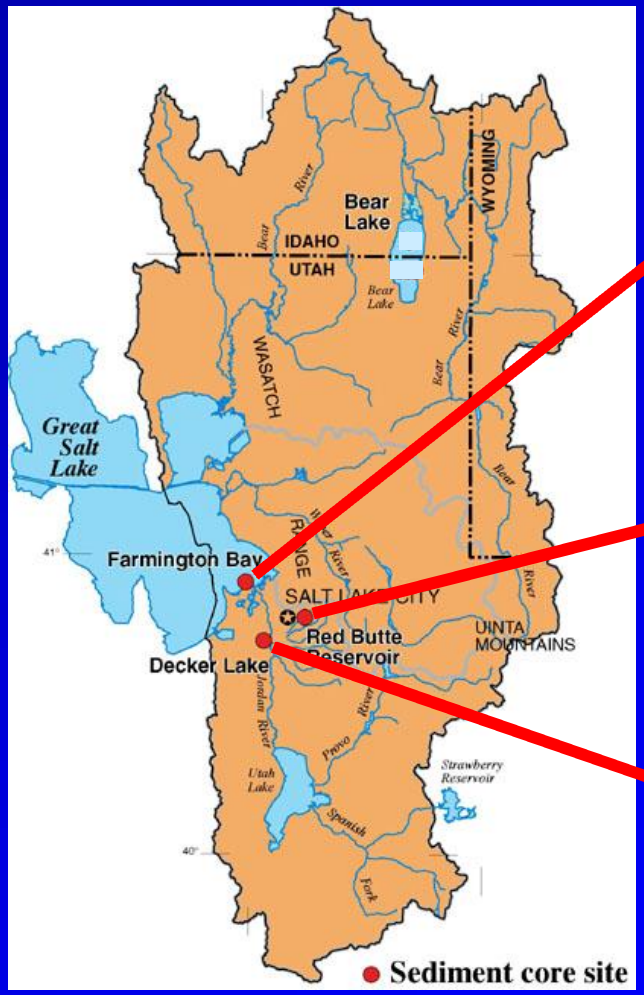
Photo courtesy of Don Paul

PRELIMINARY INVESTIGATIONS BY USFWS AND USGS

- Establishing historical trends in trace element loadings
- Refining methods for trace element analysis in high saline matrices
- Establishing trace element concentrations in biota (eared grebes and brine shrimp)

LAKE CORES FROM GSL PROVIDE HISTORICAL ARCHIVE

UTAH

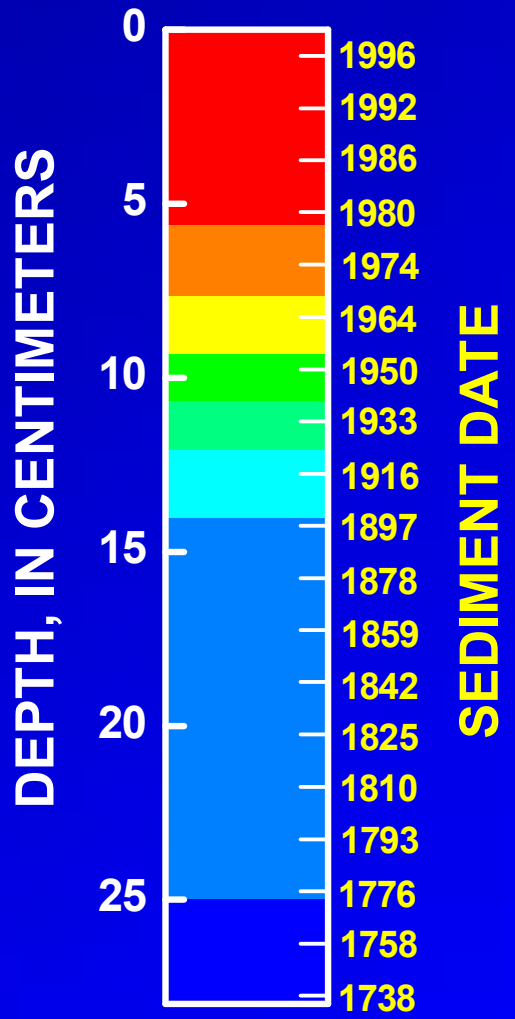


Great Salt Lake Study Team

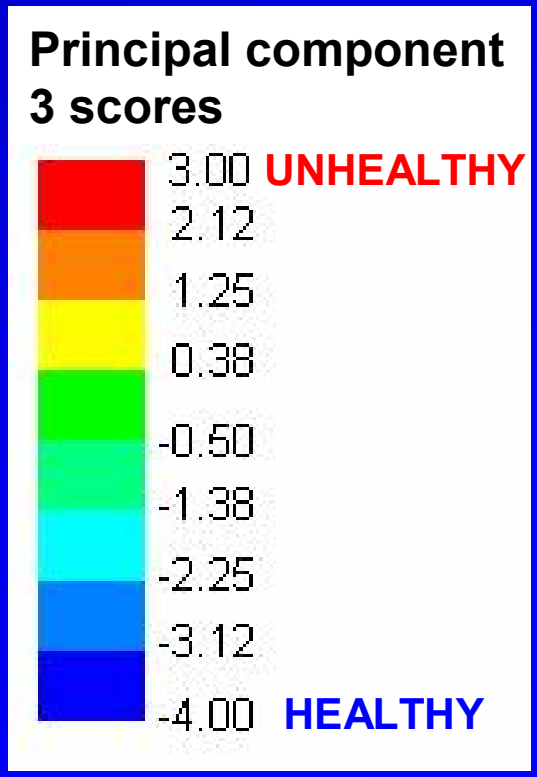
PATTERN RECOGNITION ANALYSIS

- PCA is used to reduce the dimensionality of the data set
- New plotting axis are combinations of original variables
- View geochemical process instead of concentration

VERTICAL PROFILE OF PC SCORES IN GSL



EXPLANATION



Great Salt Lake Study Team

USGS National Lab, Denver, CO

ANALYTICAL METHODS FOR TRACE ELEMENTS

Arsenic

As separated saline matrix before quantitation using IC
Cl interference with ICPMS is eliminated using IC separation
Detection limits enhanced using arsine generation

Transition metals

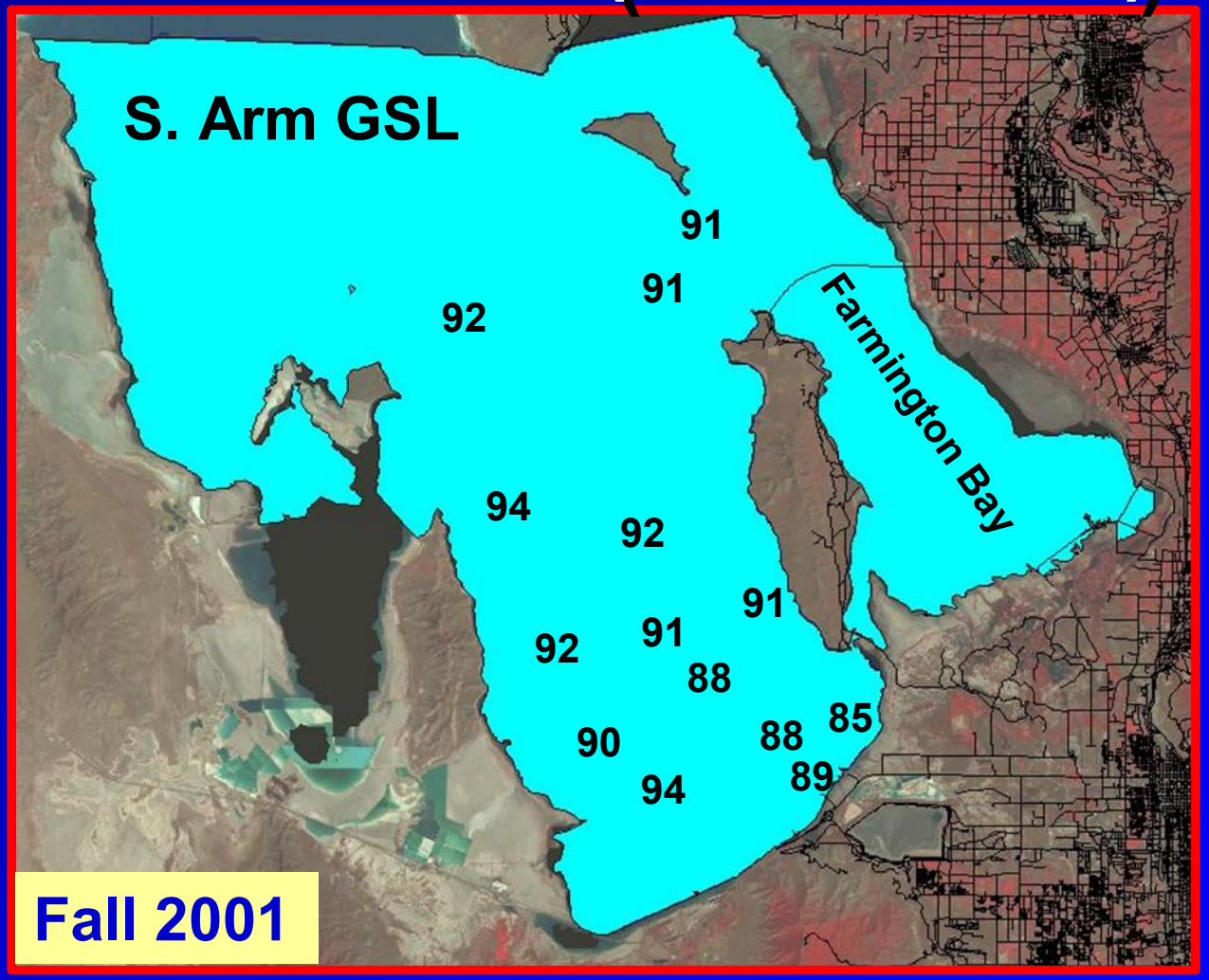
Metals separated from saline matrix using ion chromatography
Metals can be preconcentrated

Selenium

Determined by GFAAS

Jones, S.R., and Garbarino, J.R., 1999, USGS OFR 98-639, 39 p.

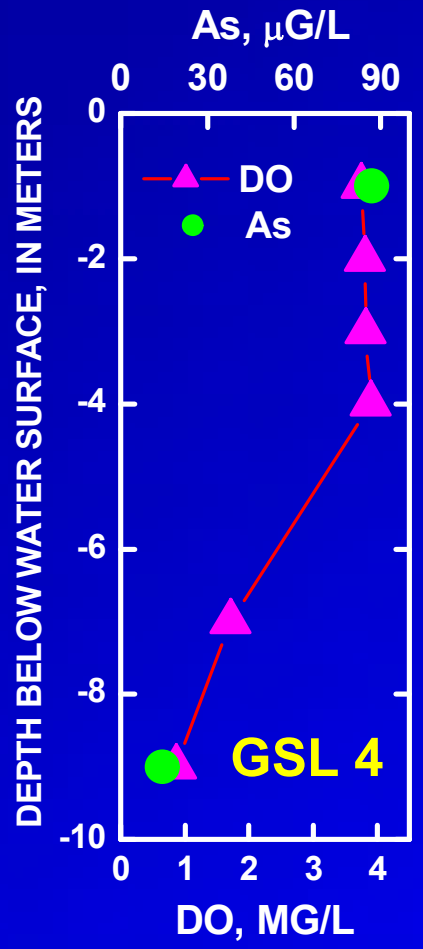
Dissolved As, in μg/L Shallow depth (0.5 to 1.0 m)

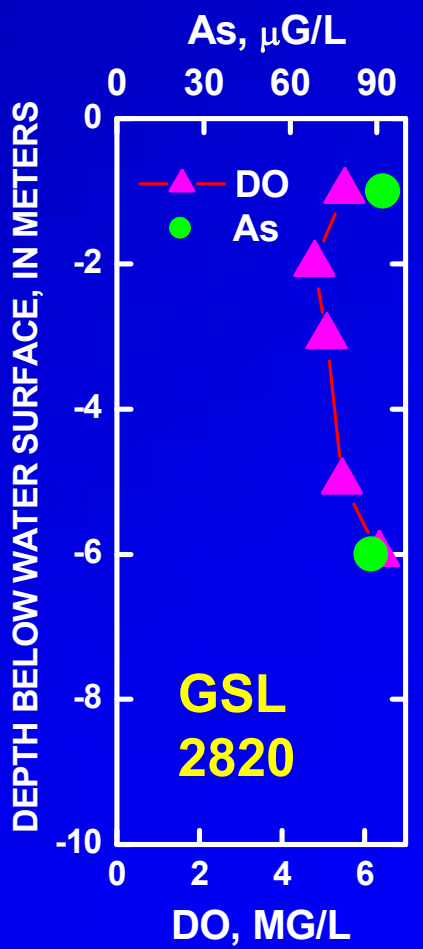


Mean As in GSL (Tayler, 1980)

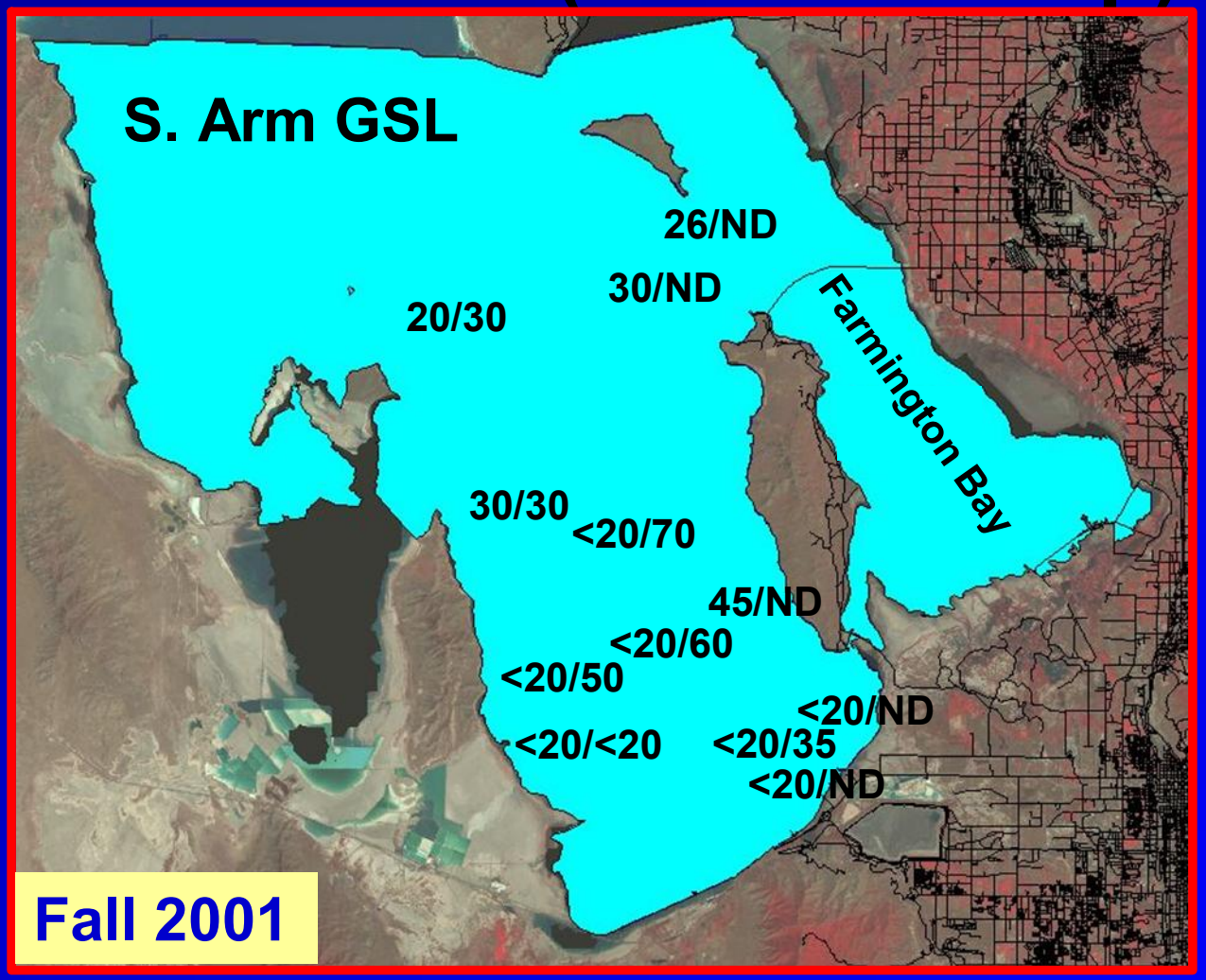
Upper brine (ppb)	Lower brine (ppb)
100	205

Redox controls As with depth



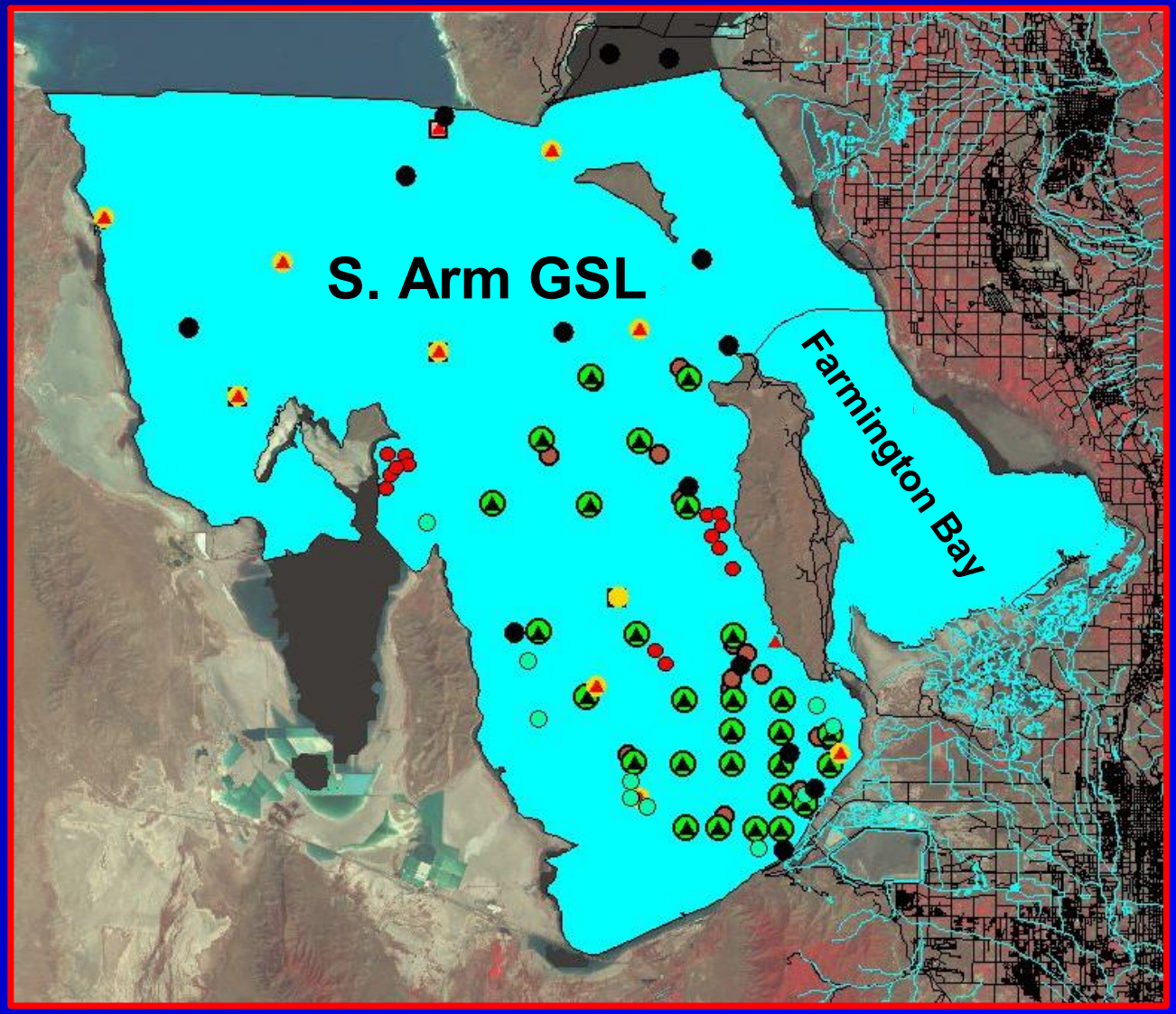


Dissolved Se, in µg/L (shallow/deep)



5 µg/L Se is Water Quality Criteria in freshwater

USFWS SAMPLING SITES

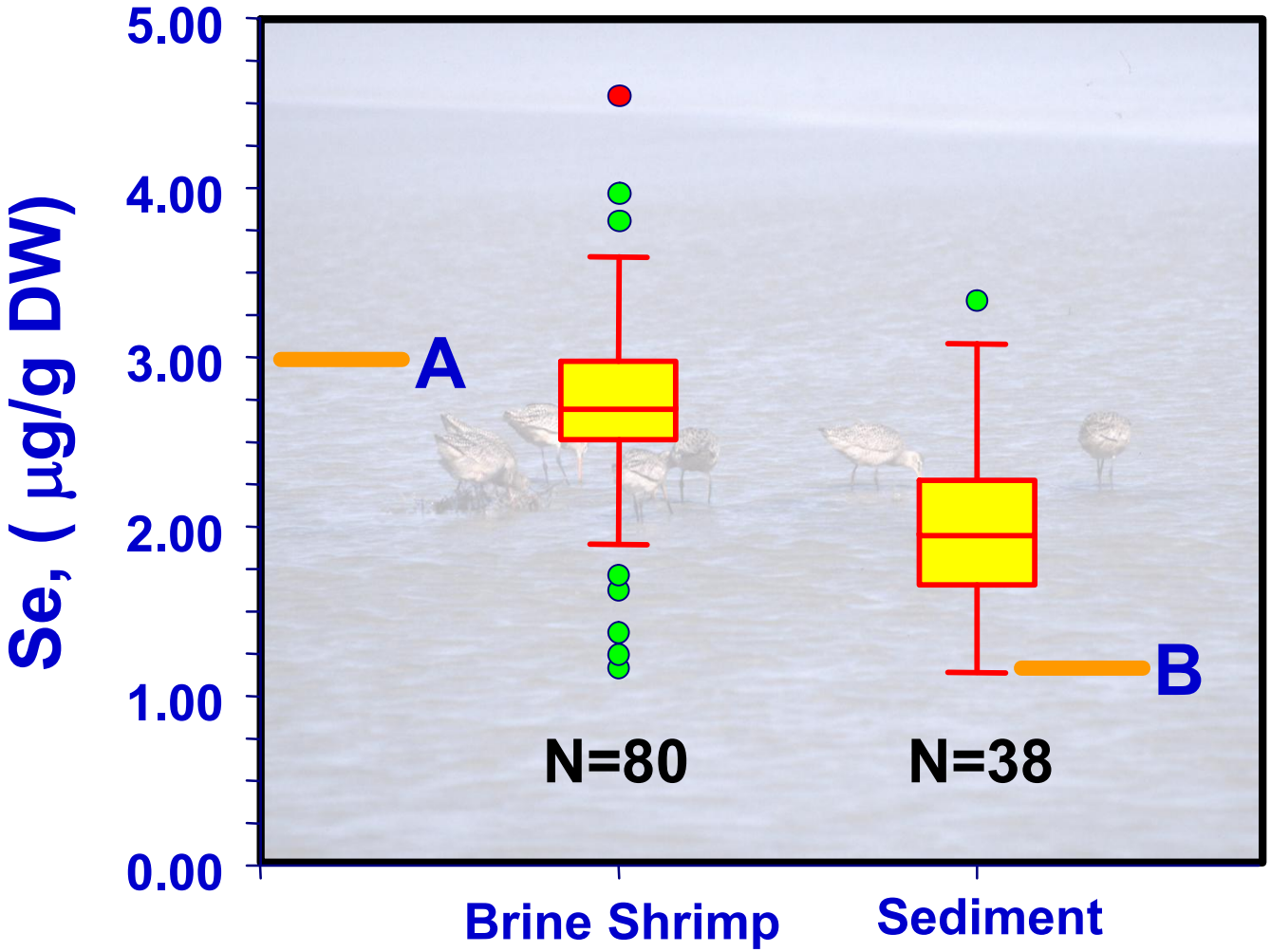


EXPLANATION

- Sediment 1996
- Sediment 1999
- Brine Shrimp 1994
- Brine Shrimp 1996
- Brine Shrimp 1999 and 2000
- Grebe Livers 1997
- Grebe Livers 1998
- Grebe Livers 2000
- Cysts 1996

Great Salt Lake Study Team

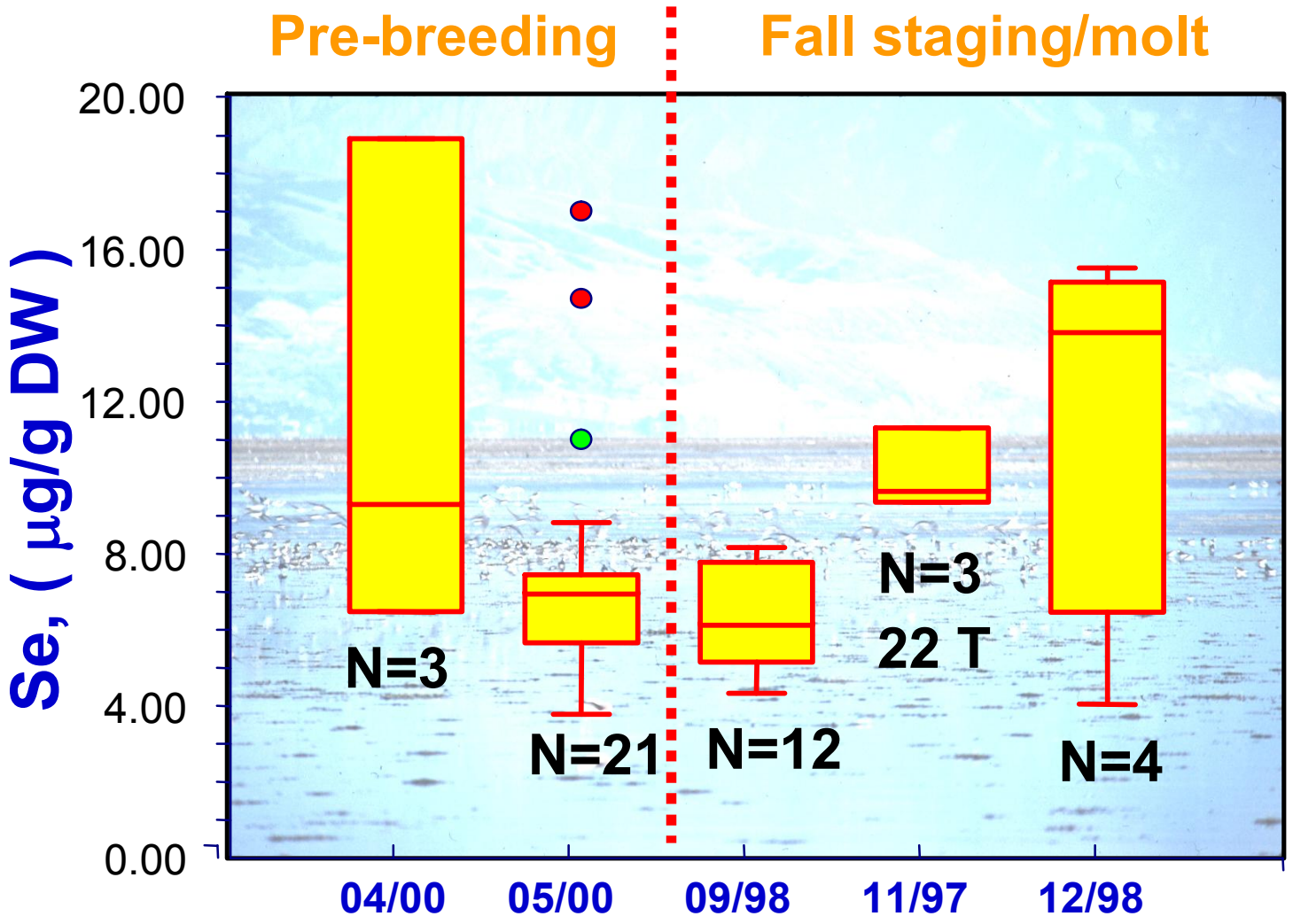
Se IN S. ARM BRINE SHRIMP AND SEDIMENT (synoptic samples)



A Bird repro-ductive threshold 3-8 ppm DW

B Average Se in freshwater environments = 0.2–2.0 ppm

Se IN EARED GREBE LIVERS



CONCLUSIONS

- Sediment core indicates increasing anthropogenic influences in recent sediments (after mid-1900s)
- Se in water column ranges from < 20 to ~ 70 μg/L
- Lake turnover could impact trace metal cycling
- Se in brine shrimp are low, but approaching dietary level of concern for bird reproduction
- Apparent doubling of Se in livers from eared grebes between September and December

CURRENT AND NEEDED WORK

UDNR/USGS

- Detailed bathymetry of south arm
- Areal and vertical distributions of nutrients, trace elements, and N, C, and S isotopes in south arm

USFWS

- Finalize and publish report
- Hg and PAHs issues in Farmington Bay tributaries
- Biological effects of trace metals on Eared Grebes