ERED, BODY BURDENS, BIOACCUMULATION TESTING AND MODELING (28 Jan 2010)

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Environmental Residue Effects Database ERED

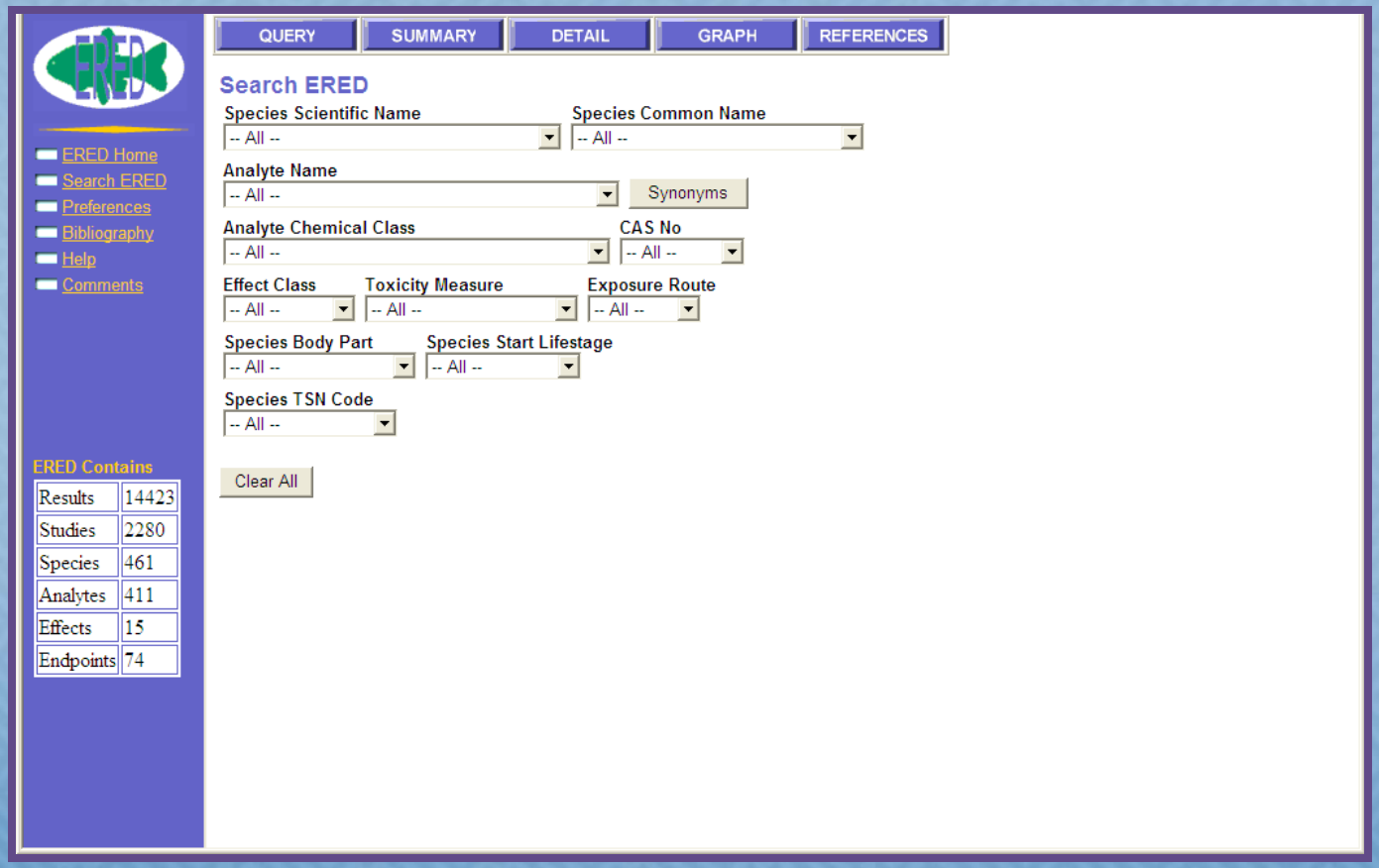
Contains biological effect data paired with tissue concentration of contaminants (EC_X for mortality, growth, physiological or biochemical responses, including LOED and NOED)

- 413 Analytes
- 2329 References reviewed
- Database contains 14,802 data records (literature ranges from 1964 to present – intensity of coverage varies per year)
- ~300-400 data records added/year – quantity based on available ERED funds provided by ERDC for each year.

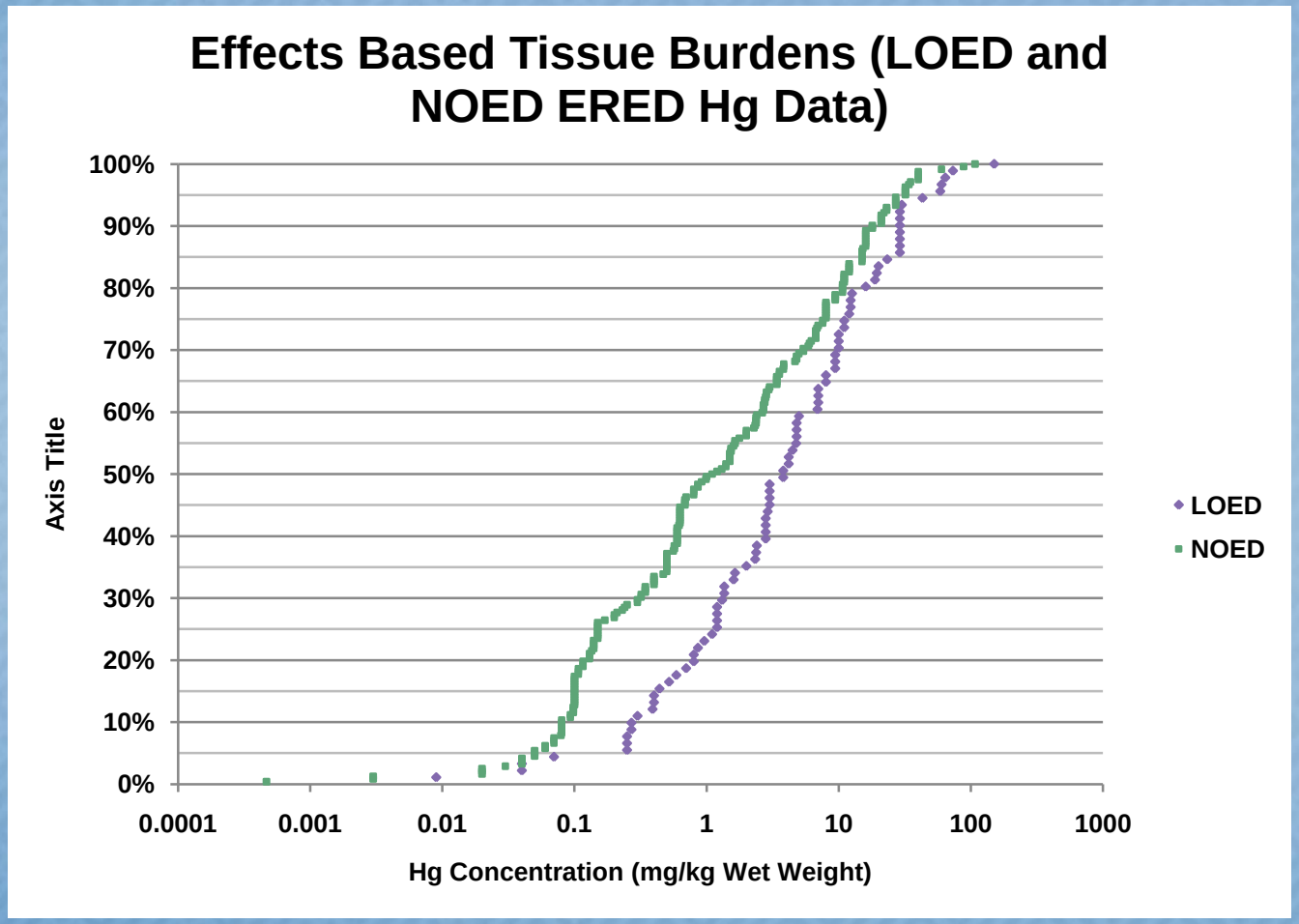
Managed by USACE/USEPA

- Available on-line with search engine

http://el.erdc.usace.army.mil/ered/index.html



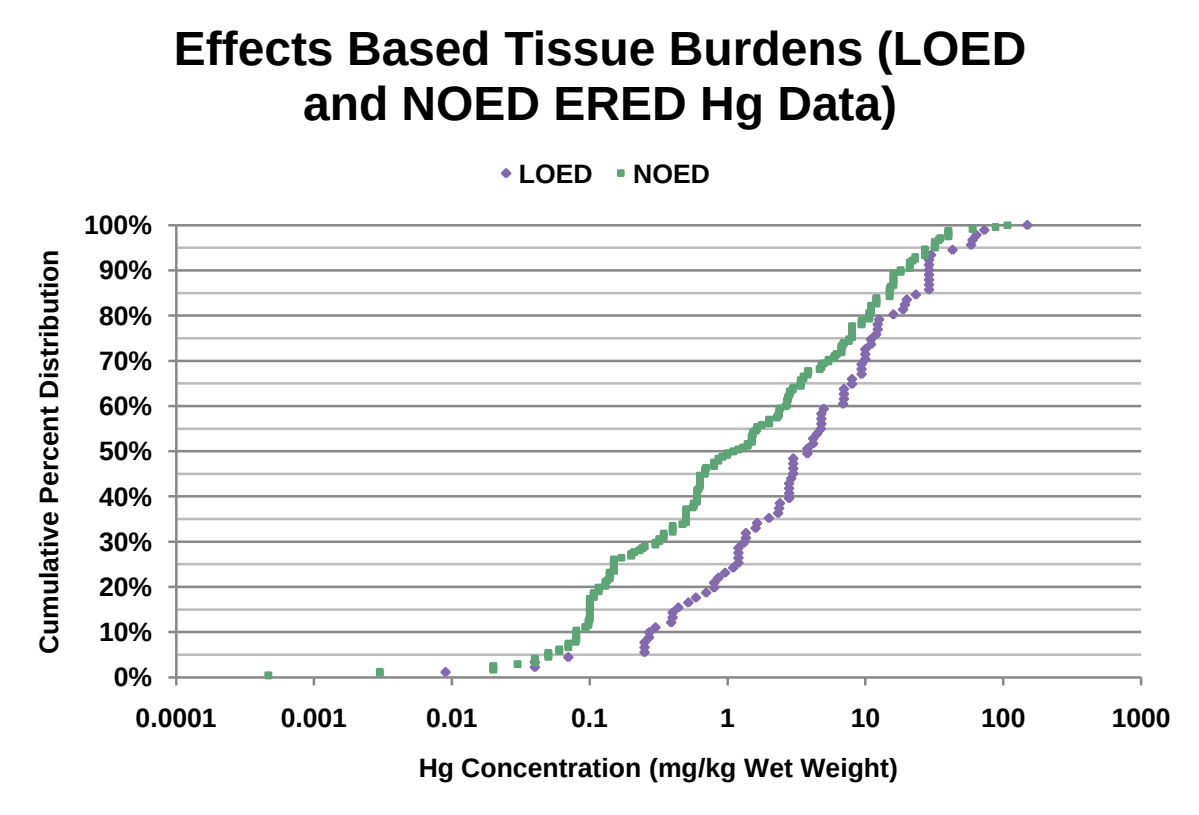
Example of Data in ERED (Hg)



Total data = 772
LOED = 91
NOED = 242

All NOED and LOED Effects data including acute, chronic, reproductive, behavior, physiological and biochemical endpoint assessments

Example of Data in ERED (DDx)



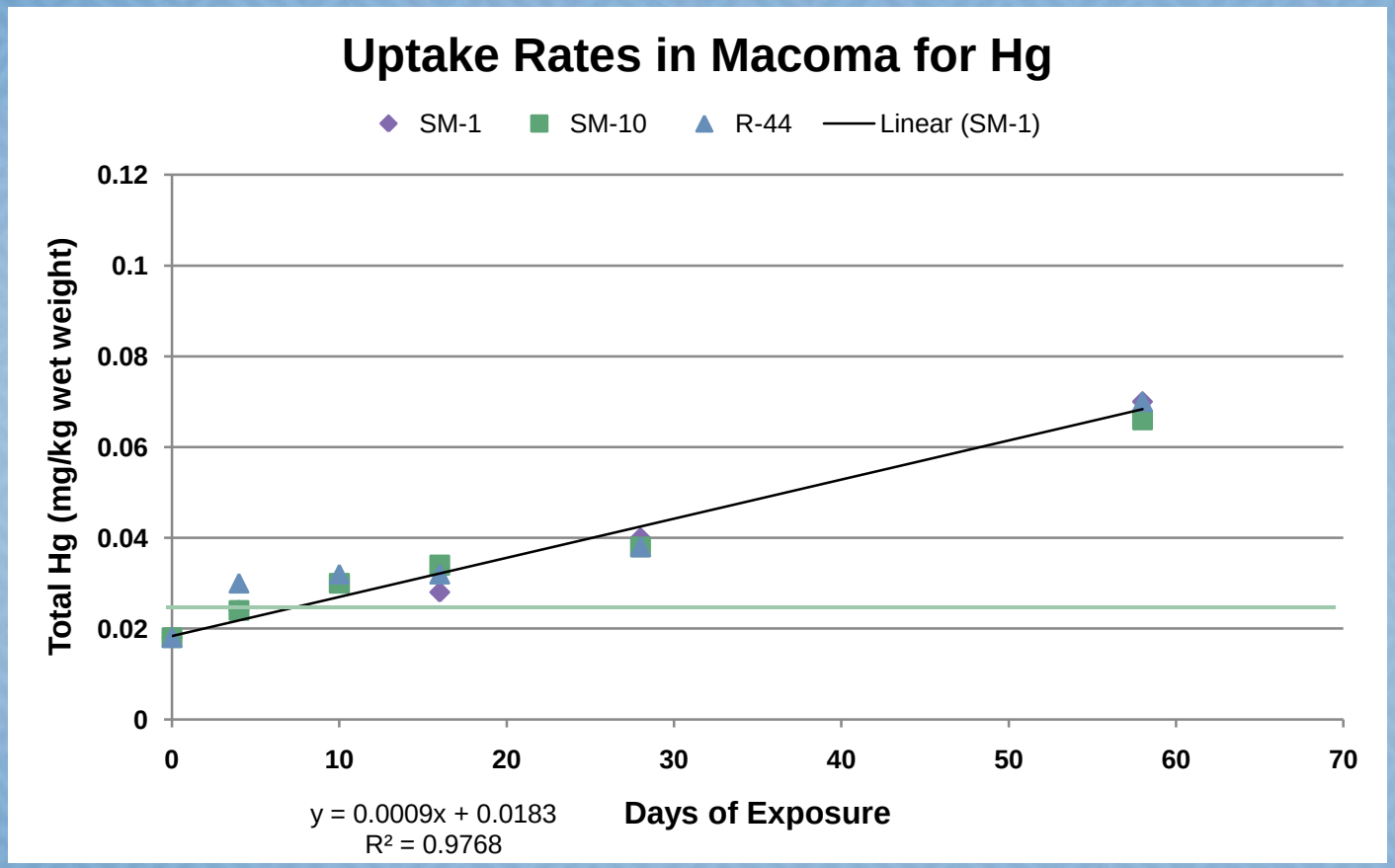
Total = 376
NOED =167
LOED = 83

Data pairs in ERED reflecting LOED or NOED for acute, chronic assessment of survival, growth reproductive, physiological and biochemical endpoints

Laboratory and Field Data

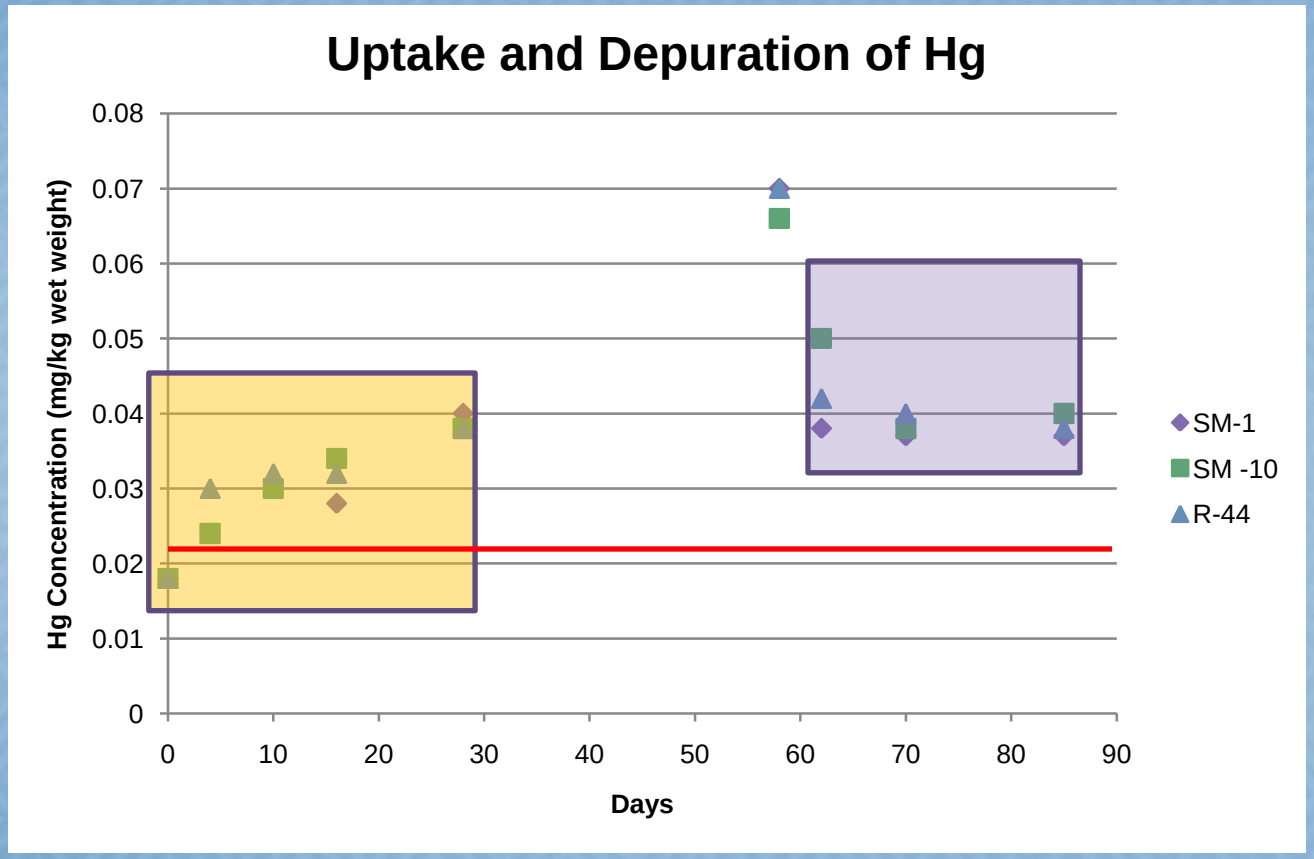
- ERED contains both
- Represents specific responses relative to tissue levels of a single contaminant.
  - Where multiple contaminants are present the response to any individual contaminant is also influenced by other contributing contaminants so the values per chemical are conservative.
- Relationship to laboratory uptake studies (e.g., USEPA/USACE Bioaccumulation Guidance)?
  - Uptake needs to attain a steady state concentration under laboratory exposure that **also** mirrors observations of steady state for field organisms that have a direct relationship to the local conditions.
- If laboratory is a good estimator for organisms exposed to field derived sediment contaminants using organisms that are relatively non-mobile then the models for foodweb uptake (Trophic Trace or Gobas) becomes the best assessment of the contribution of sediment bound contaminants to tissue burdens for organisms that have larger home ranges.

Steady State (Lab and Field)



Uptake in lab environment exceeds steady state field value after ~10 days of exposure

Uptake and Depuration (Lab and Field)



Uptake of Hg over the first 28 days and depuration for 4 to 85 days after uptake results in same concentrations in tissues

Uptake at 28 days and depuration over short to long terms results in higher concentration of Hg in laboratory tissue than steady state achieved by field-captured organisms.

Conclusions

- ERED provides information on body burdens and effects that can raise confidence in assessing potential adverse effects to aquatic organisms.
- The nearness of the LOED and NOED values lends confidence that the threshold for body burdens with and without effects is becoming strong.
- ERED could be expanded with additional support – for specific chemicals of concern, journal types, selected organisms.
- UDMEED is a similar data base that deals with terrestrial and wetland species in a similar manner.

Conclusions (cont)

- Standard bioaccumulation tests provide the first link between sediment contamination and trophic level 2.
- The advantage: these test organisms cannot move away from the sediment and provide a site-specific BSAF.
- In the example: Uptake of Hg into the tissues of *Macoma nasuta* over the 28 day exposure period **and** the body burden after gut purging for as little as 4 days and as long as ~30 days after exposure are equal in concentration.
- That concentration is higher than the steady state condition of a similar clam (*Modiolus* sp.) taken from the field from the same environment and is a conservative estimate of expected body burden.

Conclusions (cont)

- Establishing site-specific uptake into trophic level 2 provides stronger input parameters to food web models for higher trophic levels (e.g., Trophic Trace or Gobas).
- Modeling between trophic levels using this site-specific BSAF for the first step provides a better estimate of the potential effect of sediment associated contaminants on tissue contamination is highly mobile species.
- This is a better estimate than assuming all of a contaminant in a particular mobile species is due to the area-wide or site-wide sediment contaminant level.
- *This is a recognized weakness in the SF Bay assessments because the majority of assessed species travel widely throughout the Bay, outside of the Bay in local and remote environments (e.g., salmon species, striped bass, green and white sturgeon, white croaker, and various shark species).*

Recommendations

- Use ERED to establish tissue burden and NOED/LOED concentrations that are safe for 95% of all end-points.
- Use bioaccumulation testing to establish site-specific BSAF relationships for Trophic Step 2 linkages.
- Model tissue burdens obtained from sediment for Trophic Step 2 into higher trophic.
- Compare uptake from sediment (sites or areas) predictions to observed tissue burdens for species of concern.