Department of the Interior

Alternative Approaches to Ecotoxicological Testing and Assessment

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Mission

Protect and manage the Nation's natural resources and cultural heritage

Provide scientific and other information about those resources

Honor trust responsibilities & commitments to American Indians, Alaska Natives and affiliated island communities

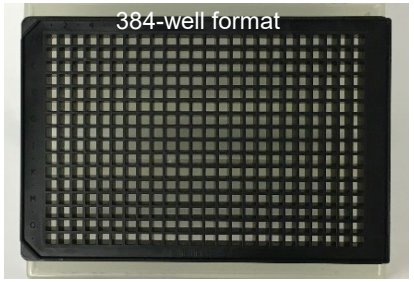
Some Applied Ecotoxicological Research

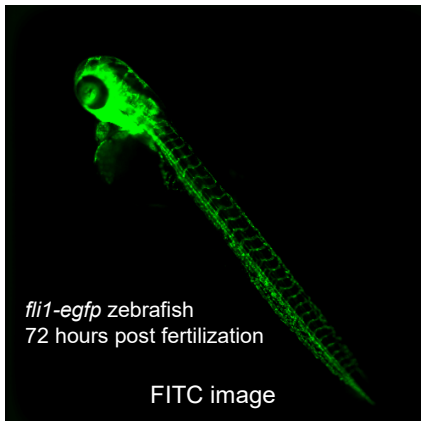
Limited regulatory authority on "chemicals"

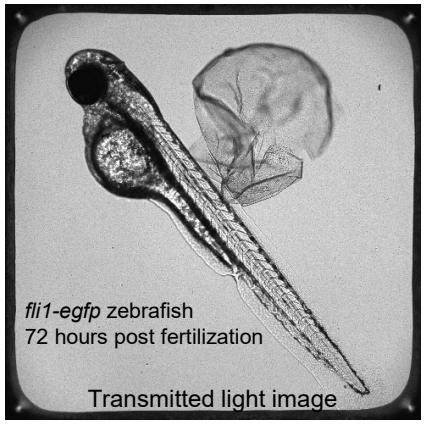
1. Research with direct application to natural resource management
2. Chemicals for invasive species control
3. Environmental contaminant biomonitoring
4. Natural Resource Damage Assessment
5. Alternatives to "lead shot" used in hunting

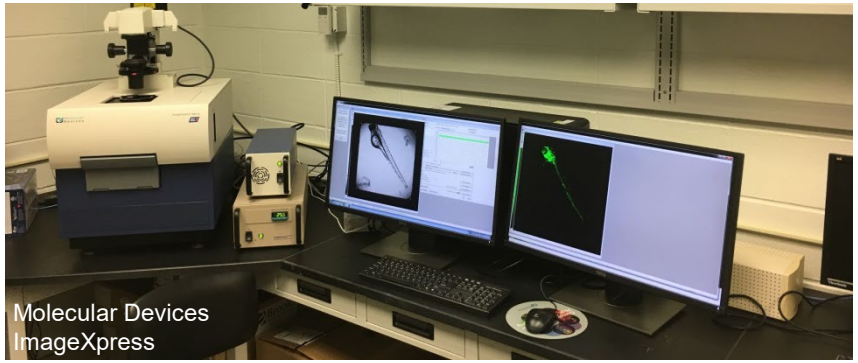
Embrace 3R's

In Silico and High Content Screening to Characterize Cyanotoxins

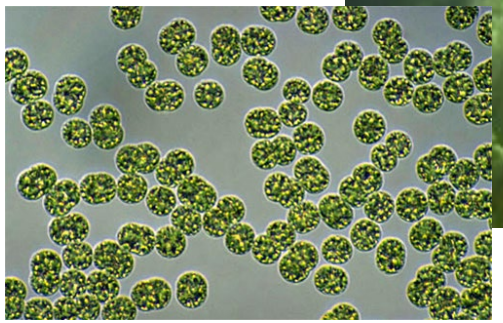








- Harmful algal blooms (HABs) contain mixtures of hundreds of toxins with characterized toxicity
  - Individual toxins and mixtures
  - Tiered testing approach
  - Scale to field application



In silico approaches
- ICE
- Precepta

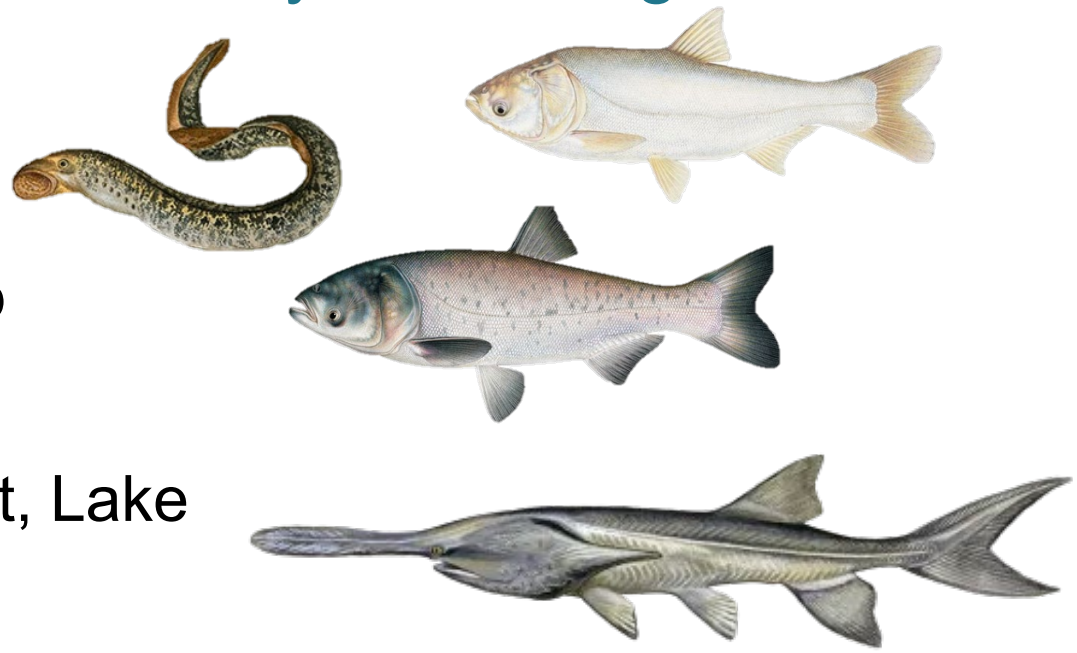
Zebrafish assays
- Developmental cardiovascular toxicity assay
  - Length, pericardial area, heart rate, blood flow
- Behavioral screening
  - Swimming behavior
  - Optokinetic response

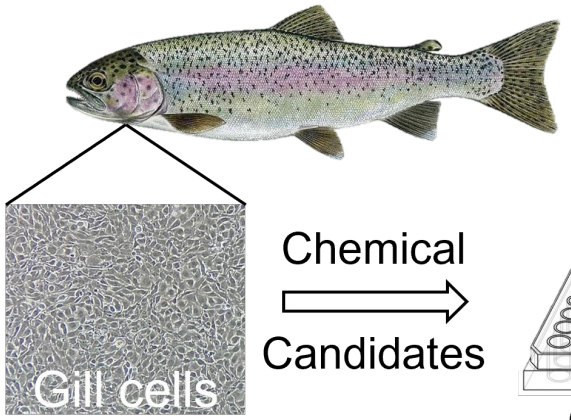
Toxicant Prioritization and *In Vitro* Toxicity Screening

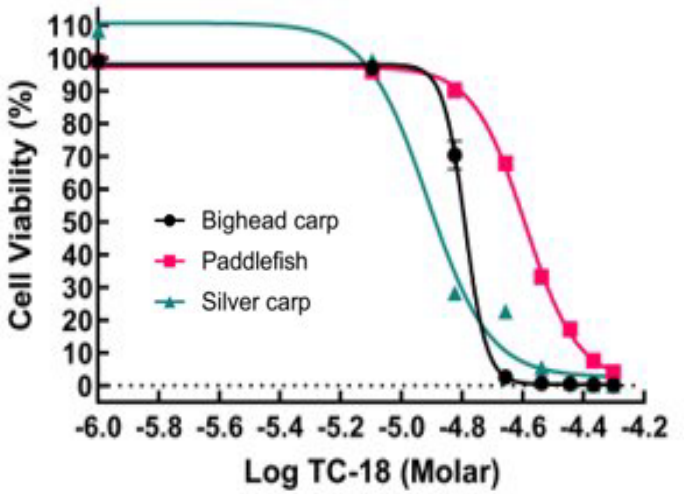
- *In vitro* to *in vivo* extrapolation
  - Target

    Sea Lamprey, Bighead and Silver Carp
  - Non-target

    Endangered Paddlefish, Rainbow Trout, Lake Sturgeon, Bluegill



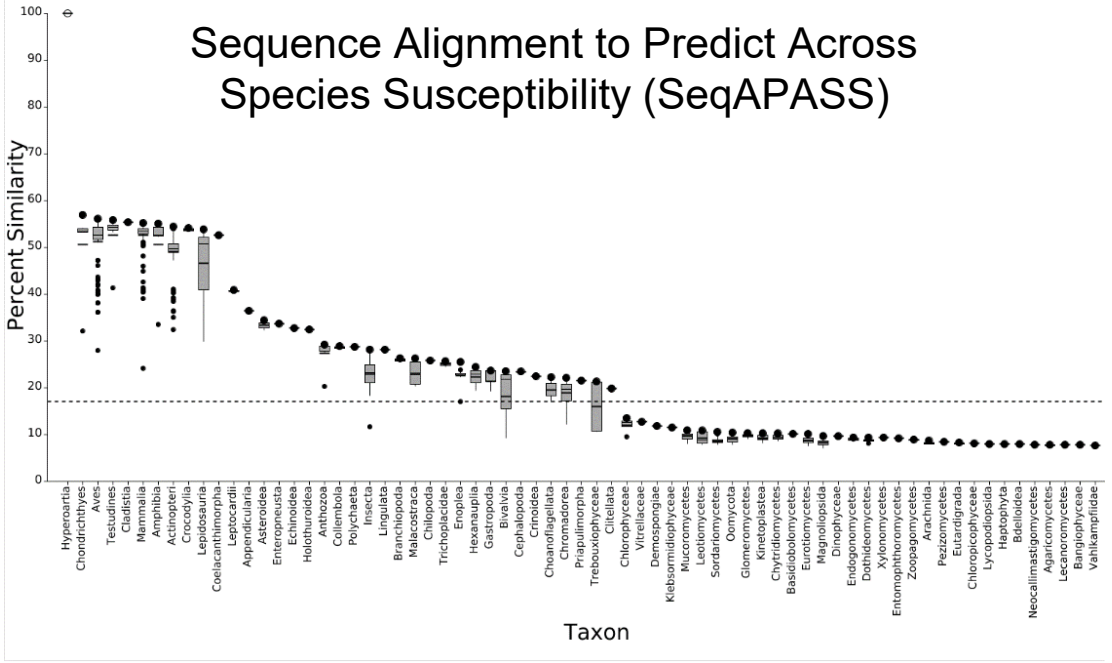




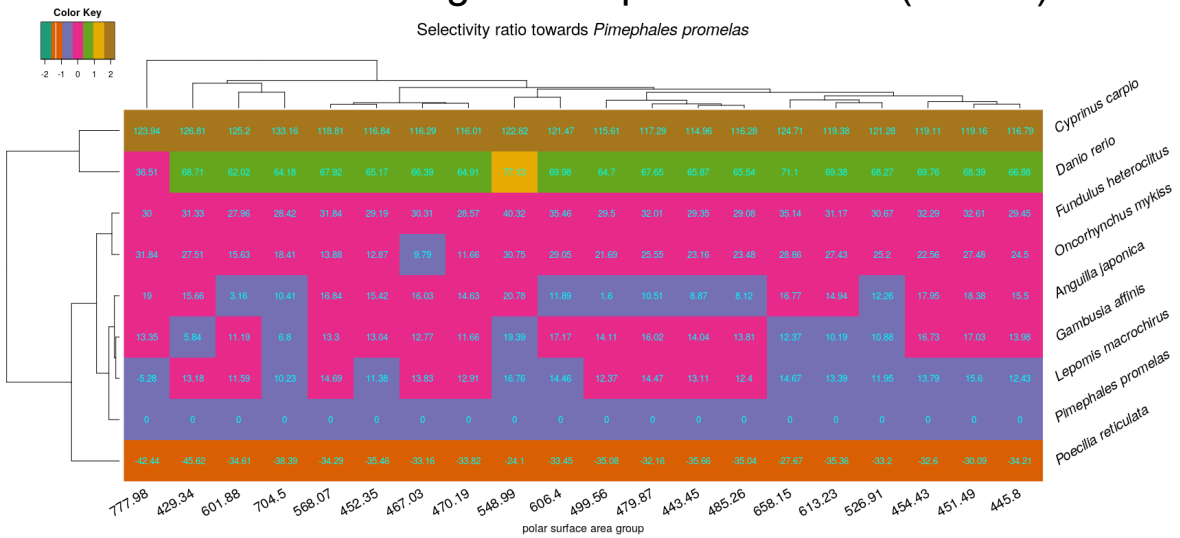
Toxicant Prioritization and *In Vitro* Toxicity Screening

- Prioritize new novel toxicants and predict susceptibility

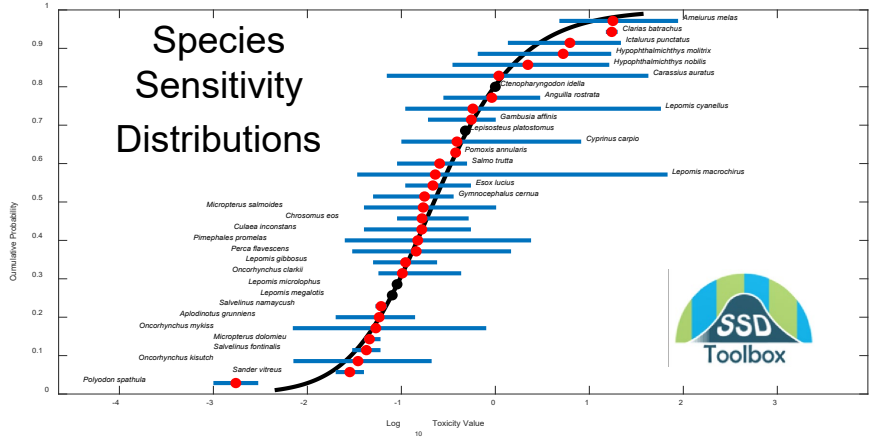
Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS)



Estimated Biological Response Models (EBRM)



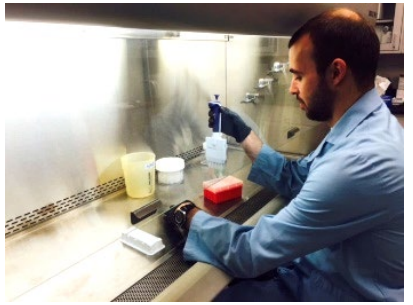
Species Sensitivity Distributions

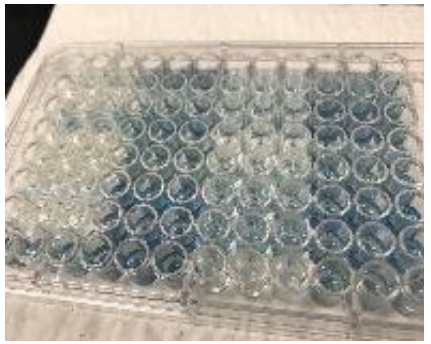
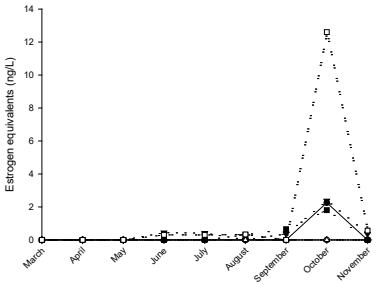


Testing Environmental Samples for Endocrine Activity *In Vitro*

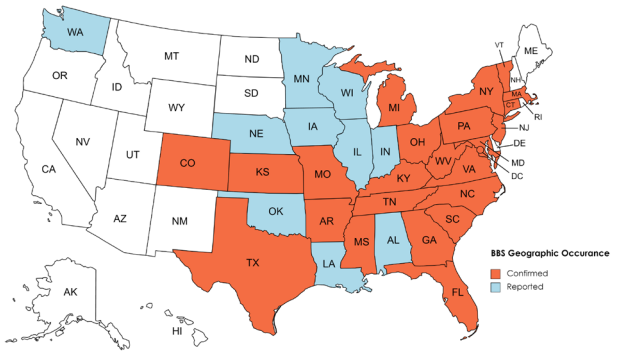
- Substrate-free bioluminescent yeast bioassays
  - Commercially available yeast strains
    - Estrogenicity
    - Androgenicity
    - Cytotoxicity
- Cost-effective screening of environmental water sample extracts
- 96-well plate format





Leveraging Citizen Science to Enhance Biosurveillance of Blotchy Bass Syndrome

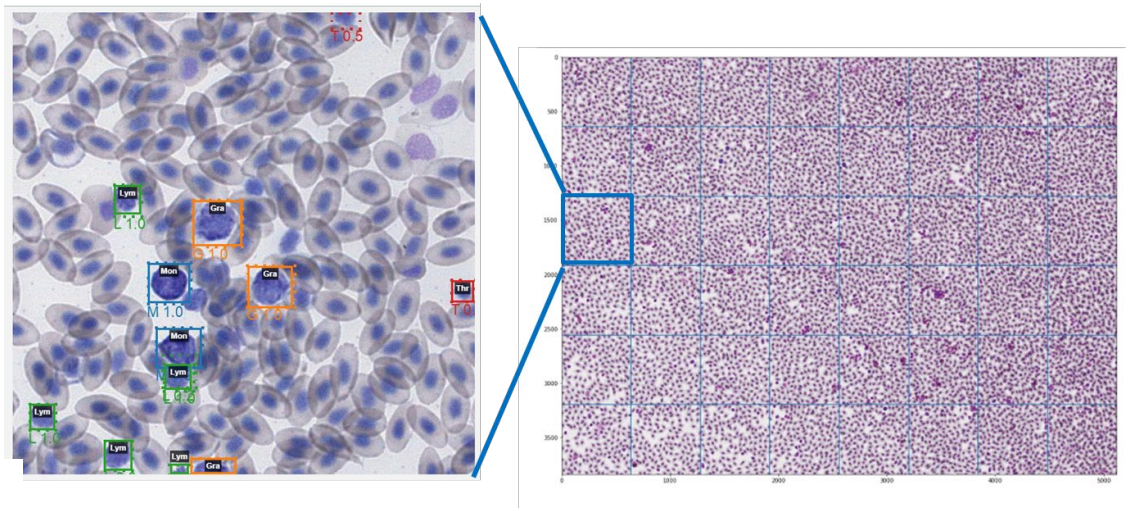


- Novel adomaviruses have recently been identified as the causative agent of blotchy bass syndrome
- USGS scientists are in the process of identifying where and when this condition this observed in North America
- In an attempt to minimize additional sampling efforts, citizen scientists have been recruited to contribute images of blotchy bass that they are catching during normal angling activity to contribute surveillance data to this effort
- This effort utilizes preexisting smartphone applications (Angler's Atlas, MyCatch) as mechanism for image documentation that include geospatial and time stamp metadata

Minimally invasive sampling

- Minimally invasive, non-lethal sampling of hyperpigmented lesions in being conducted for complete or partial viral genome sequencing to inform epidemiological efforts

- State fisheries managers conduct annual creel surveys and collect swab samples to minimize duplicative efforts



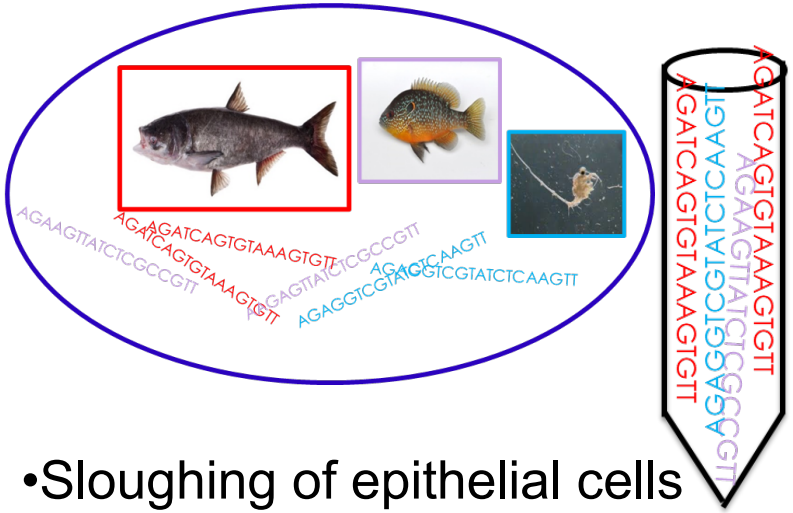
- Validating non-lethal gill sampling method

- Validating automated blood smear analysis tool

What is eDNA and How is it being used?

"The total pool of DNA isolated from environmental samples." Pawlowski et al. (2020)

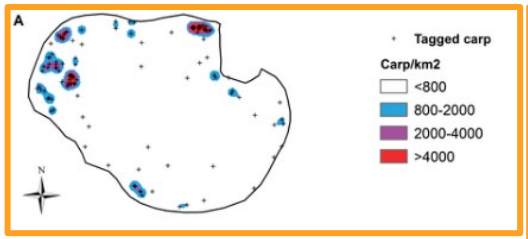
A non-invasive genetic method for surveying biotic diversity



- Sloughing of epithelial cells
- Released gametes

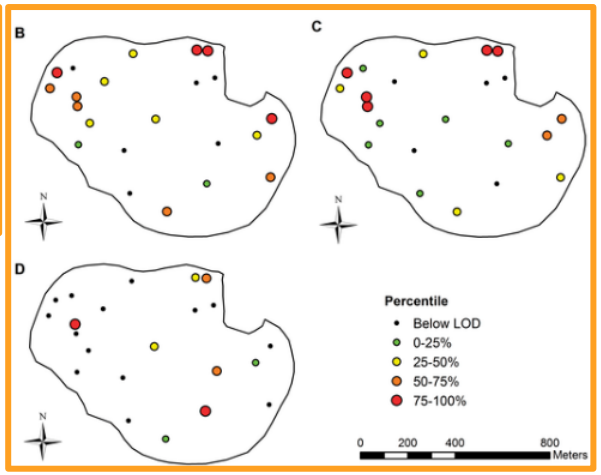
1. Species Monitoring and Surveying
2. Ecological Questions
3. Estimate Population Location and Size
4. Contaminants
5. "Ecology of eDNA" – what affects the physical state and detection of eDNA

Tagged carp

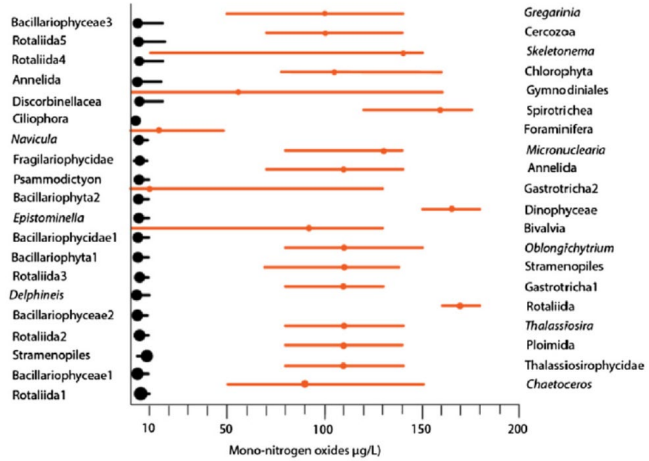


Common Carp (Eichmiller et al. 2014)

eDNA detection of carp

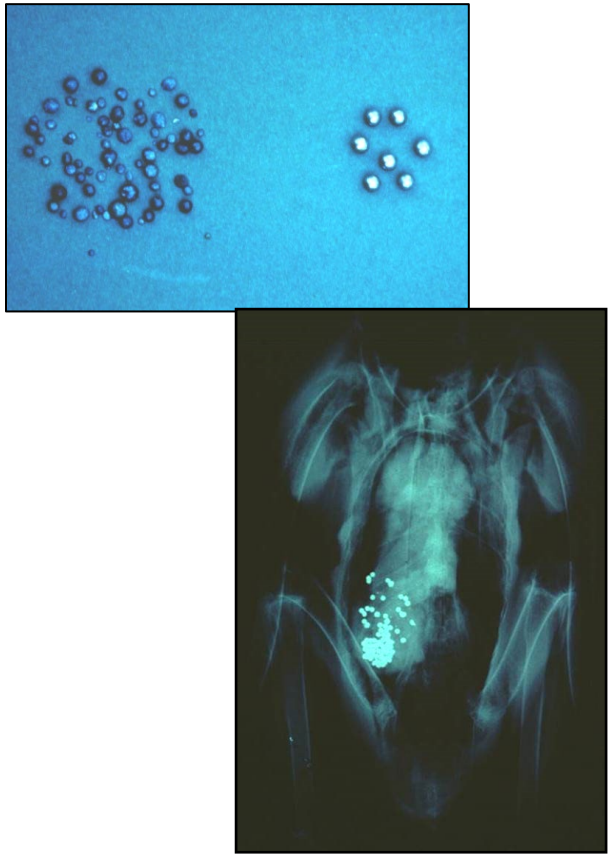


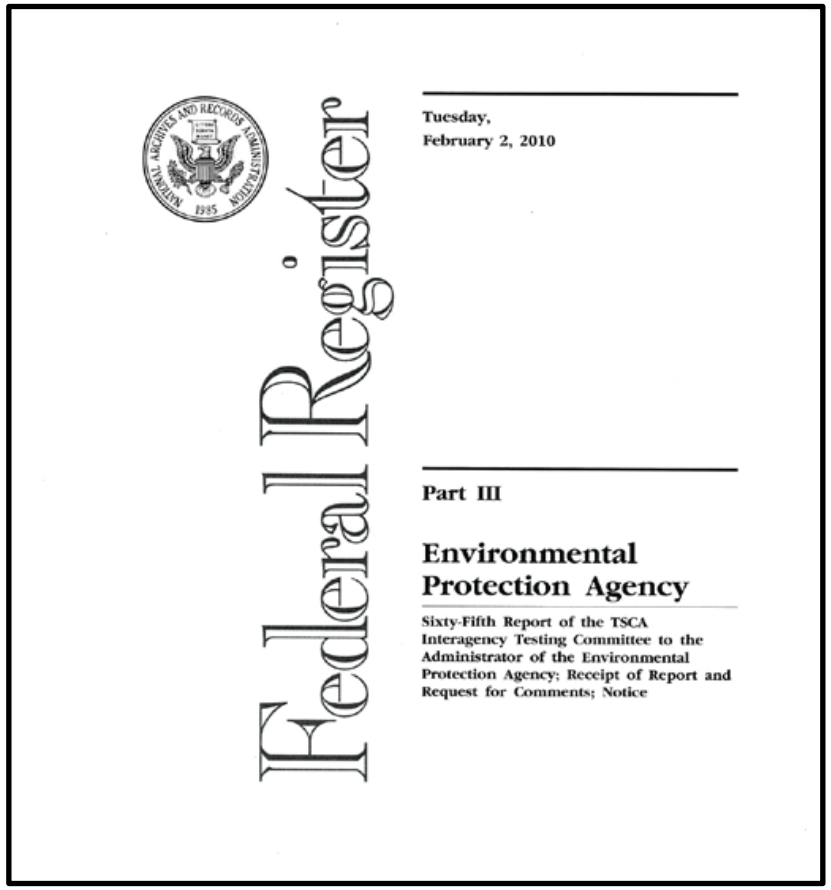
Threshold Indicator Taxa ANalysis (TITAN): Mono-Nitrogen Oxides



Benthic Metabarcoding (Chariton et al. 2015)

Registration of Non-toxic Shot





Federal Register

Tuesday,
February 2, 2010

Part III

Environmental Protection Agency

Sixty-Fifth Report of the TSCA Interagency Testing Committee to the Administrator of the Environmental Protection Agency; Receipt of Report and Request for Comments; Notice

Lead shot replacements:

- iron (steel)
- iron-tungsten
- bismuth-tin
- copper-clad iron
- corrosion-inhibited copper
- tungsten-bronze
- tungsten-iron
- tungsten-matrix
- tungsten-nickel-iron
- tungsten-polymer
- tungsten-tin-bismuth
- tungsten-tin-iron
- tungsten-tin-iron-nickel

Bottom Line

– many shot types registered using existing information, risk assessment and no toxicity test

– harmonized with Canada, and interest expressed by European Chemicals Agency