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Evaluation of reference conditions for contaminants and fish health indicators in Great Rivers of the U.S.

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Biomonitoring of Environmental Status and Trends (BEST) Program: Large River Monitoring Network (LRMN)

Identify, monitor, and assess environmental contaminants and their effects in fish

Endpoints

- **Fish health indicators** *(somatic indices, health assessment)*
- **Histopathology** *(general health, gonad)*
- **Reproductive biomarkers** *(vitellogenin, steroid hormones)*
- **Contaminant concentrations** *(organochlorine pesticides, metals)*
- **Hepatic ethoxyresorufin *O*-deethylase (EROD) activity**

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BEST-LRMN Program

Many endpoint responses are species specific; therefore the program targets certain fish species

Predator:
Largemouth Bass

Benthivore:
Common carp

Endpoint data may be limited for certain species

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LRMN Dataset

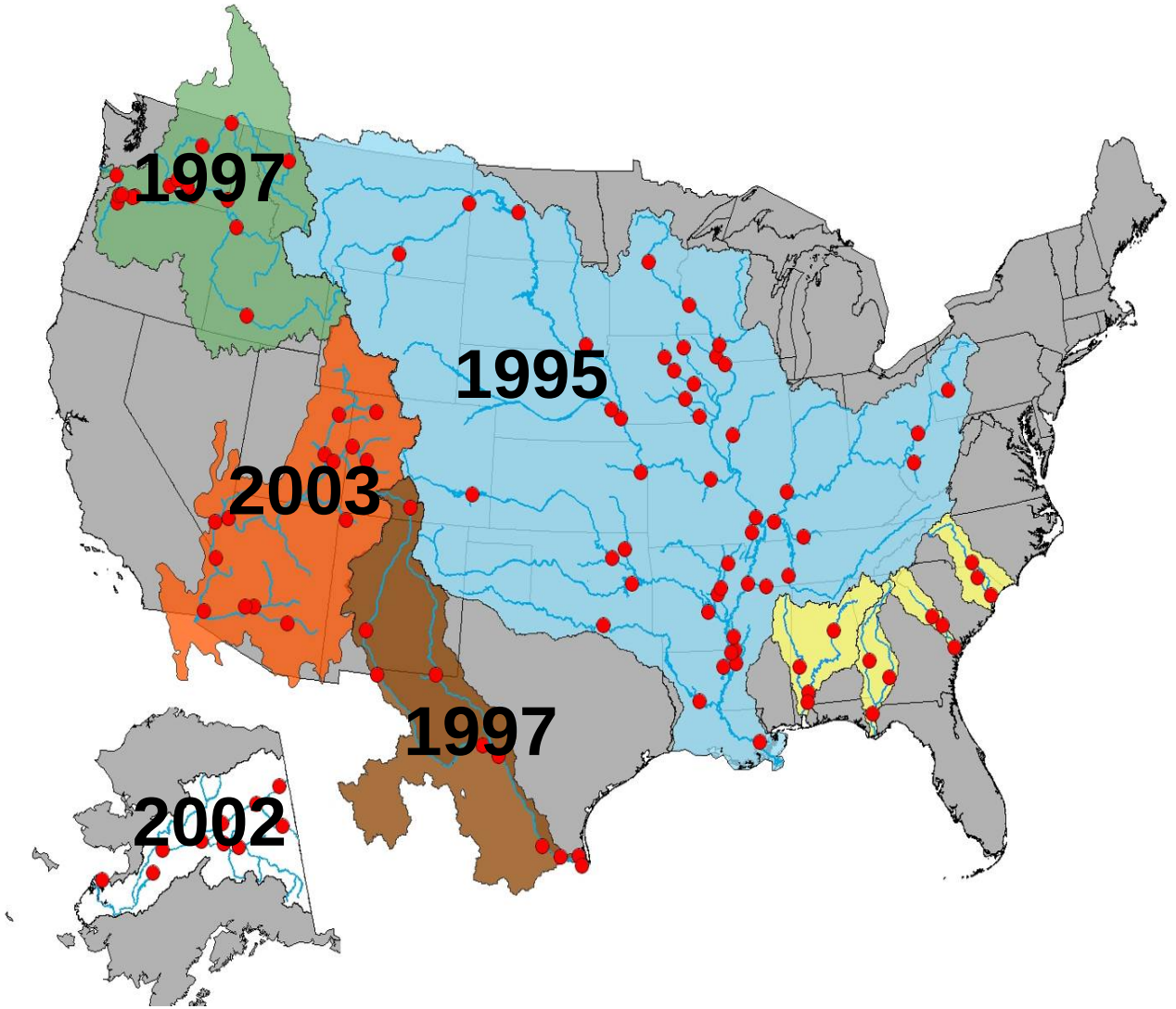
Sites: +100

Fish: +3200

Site Selection

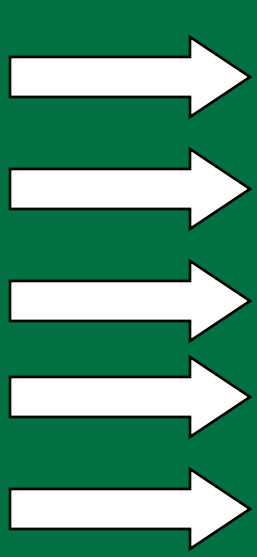
Random

Historical (NCBP)



Endpoints used by LRMN

Factors to consider	Rating
Cost	
Historical data	
Collection method	
Analytical method	
Interpretation	



Field
Laboratory
Spatial
Time
Species
Training
Expertise
Preservation
Equipment
Expertise
Time
Influencing factors

Green = good/easy
Red = bad/difficult

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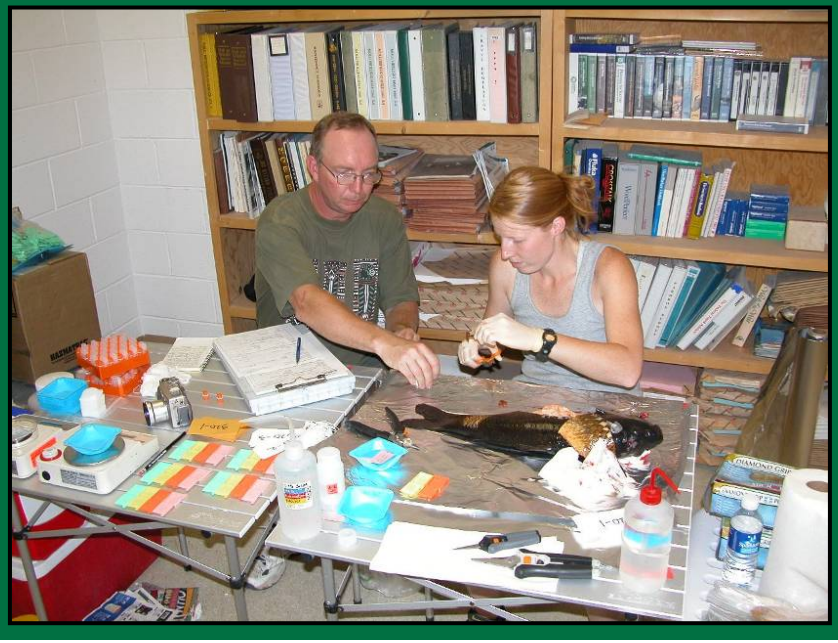
Collection logistics of LRMN



Live fish
Equipment
Min. 2 person crew

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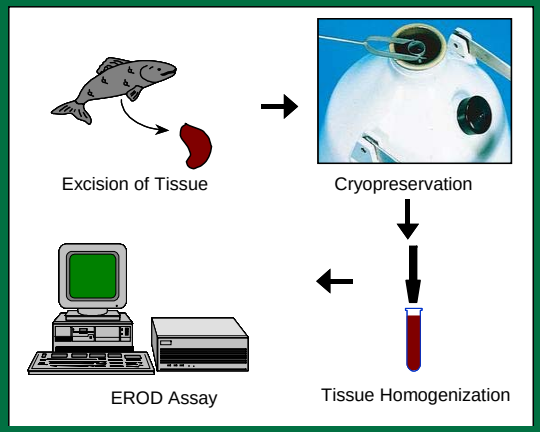
Hepatic microsomal ethoxyresorufin *O*-deethylase (EROD)



Factors to consider	Rating
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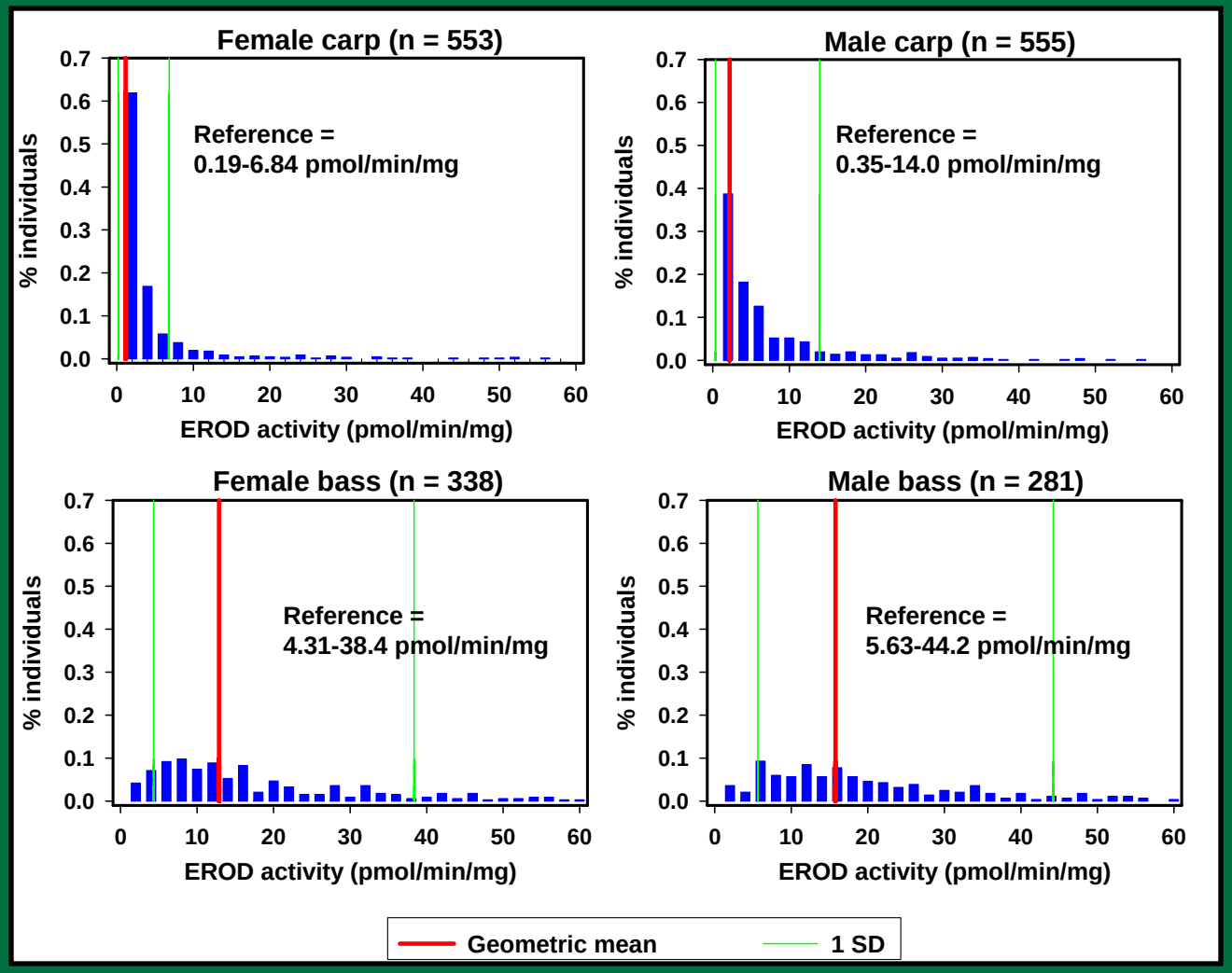
Frequency distribution of EROD

EROD activity in green area are reference or background

Influencing factors:
- Species
- Gender
- Reproductive stage



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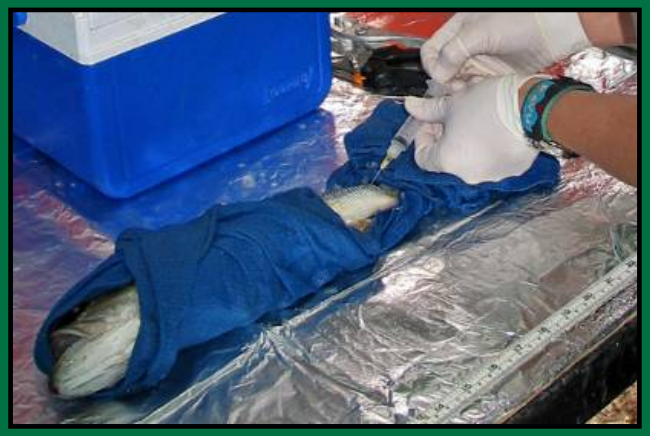
Plasma vitellogenin and steroid hormones



Factors to consider	Rating
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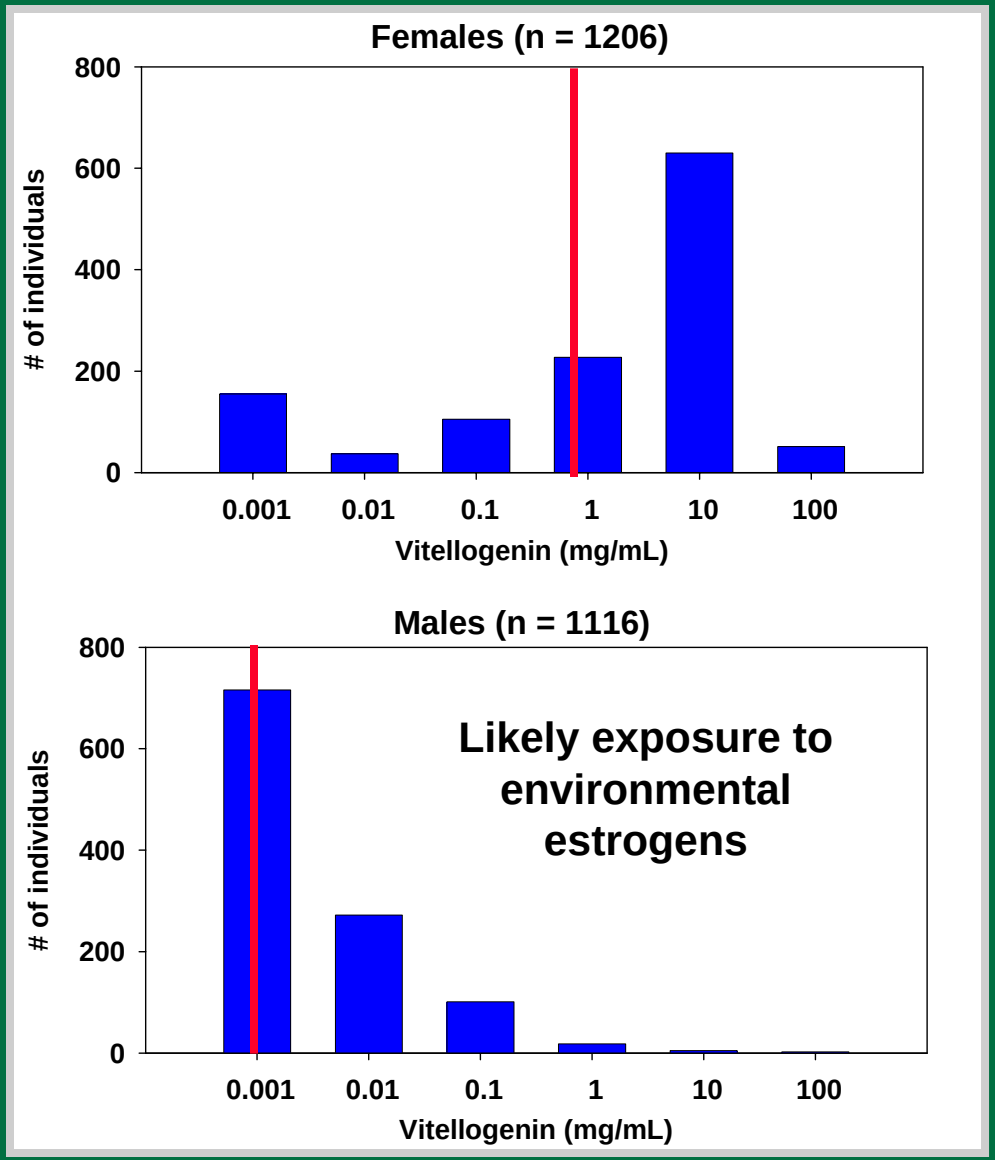
Frequency distribution of Vtg concentrations

Conc. < detection limit:
13% of females
87% of males

Conc. >0.01 mg/mL in males is anomalous



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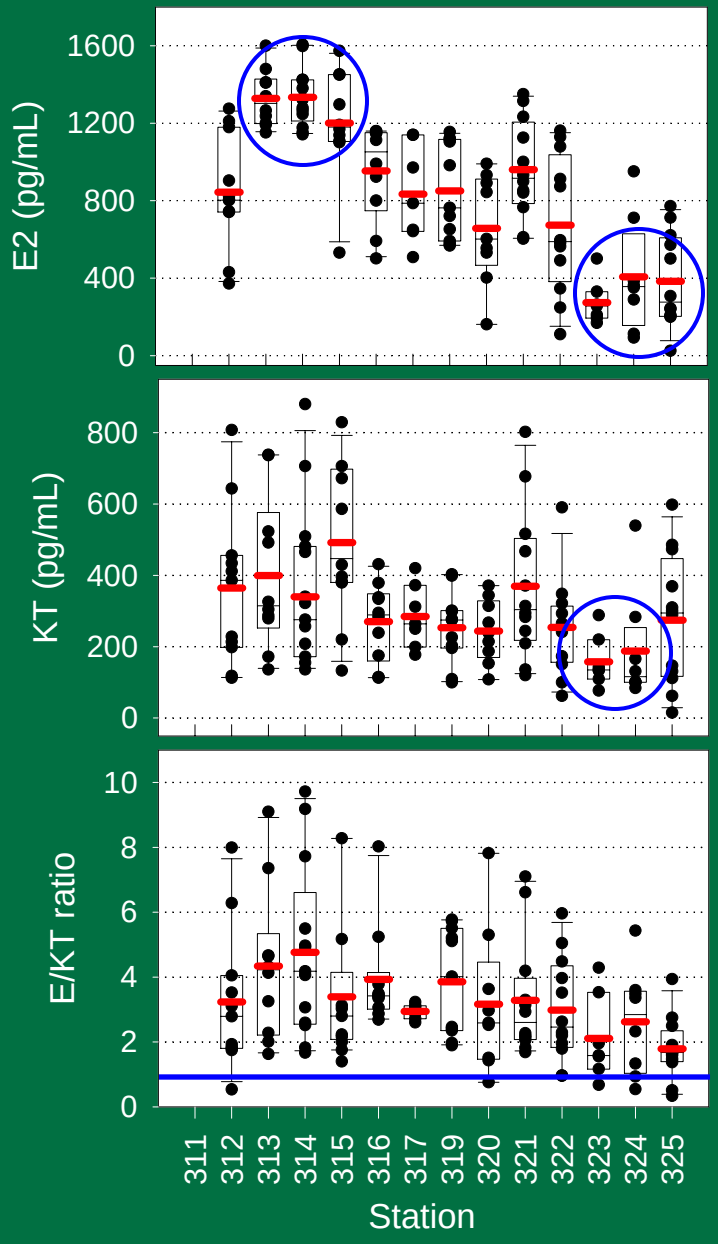
Steroid hormones in female carp

- Reference condition difficult to determine
- Samples collected Aug-Oct to minimize stage effects
- 17β –estradiol conc. differed among sites – delayed maturation (as determined by histopathology) at 323, 324, and 325
- 11-ketotestosterone conc. also relatively low at 323 and 324
- Compare hormone ratios



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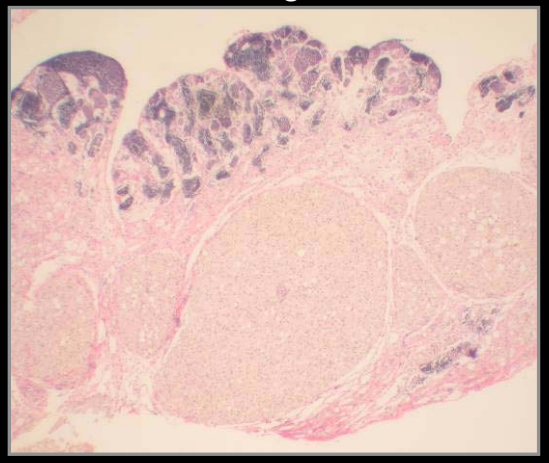
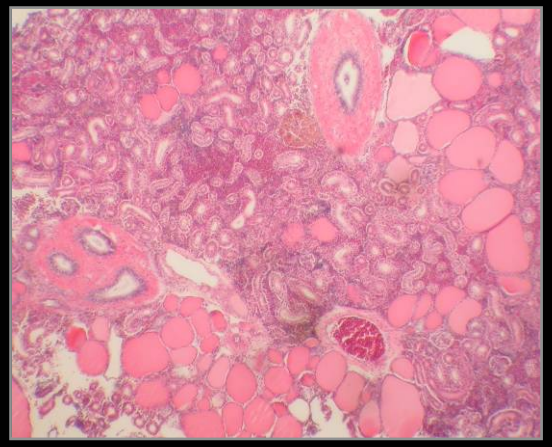
Histopathology

Testes with granulomas



Anterior kidney with thyroid follicles



Factors to consider	Rating
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Much of histopathology is qualitative analysis. However, quantitative measurements can be made.

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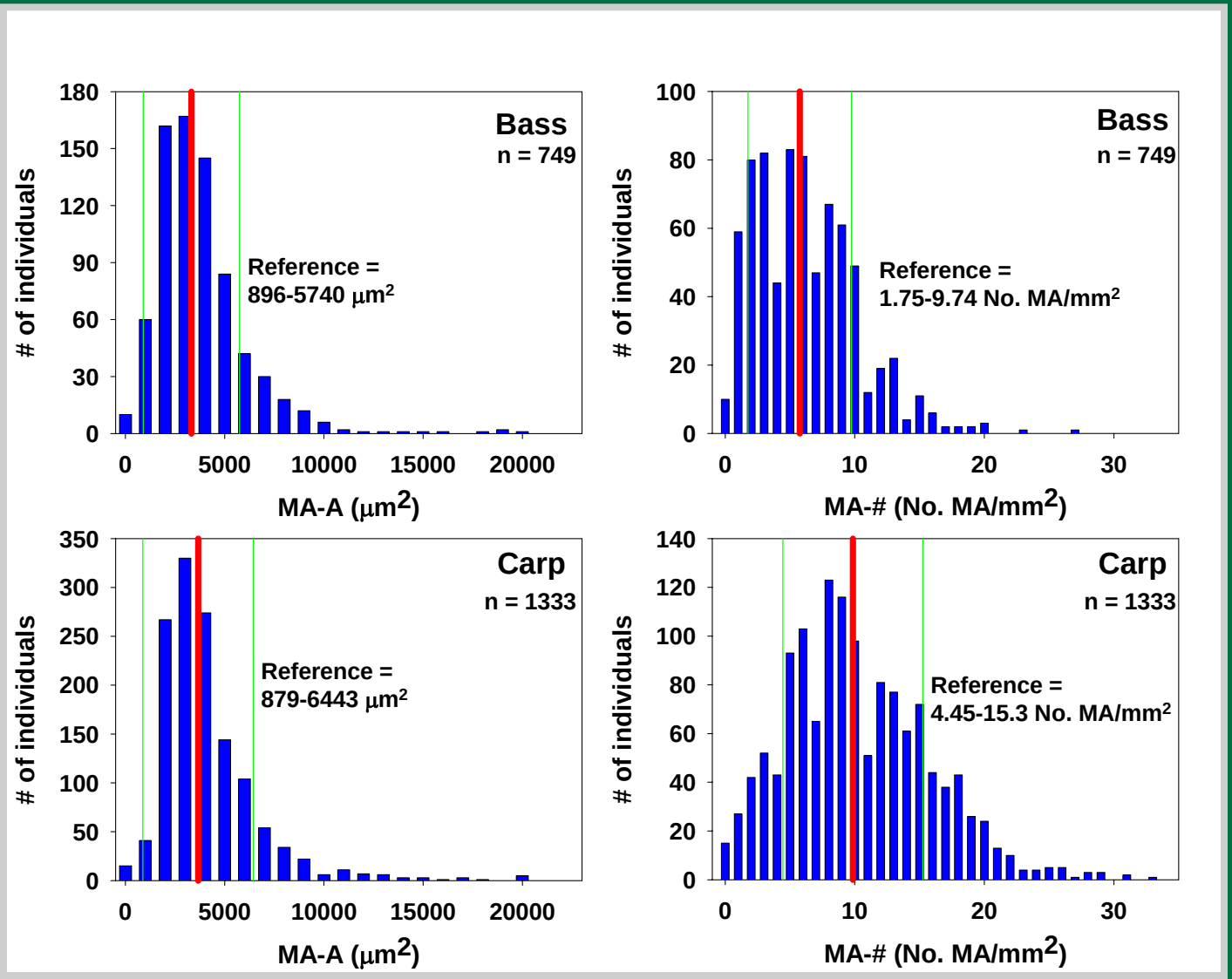
Frequency distribution of splenic macrophage aggregates



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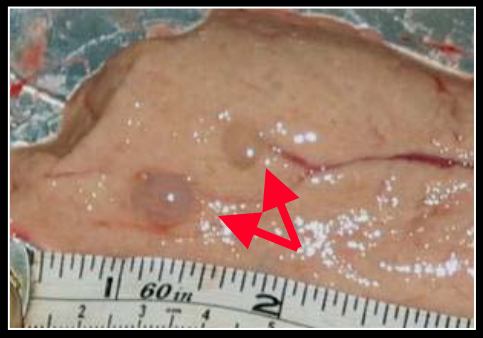
Fish Health Assessment Index (HAI)

External anomalies

Internal anomalies



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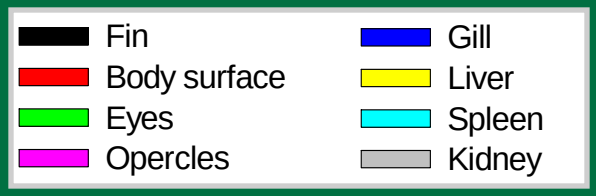
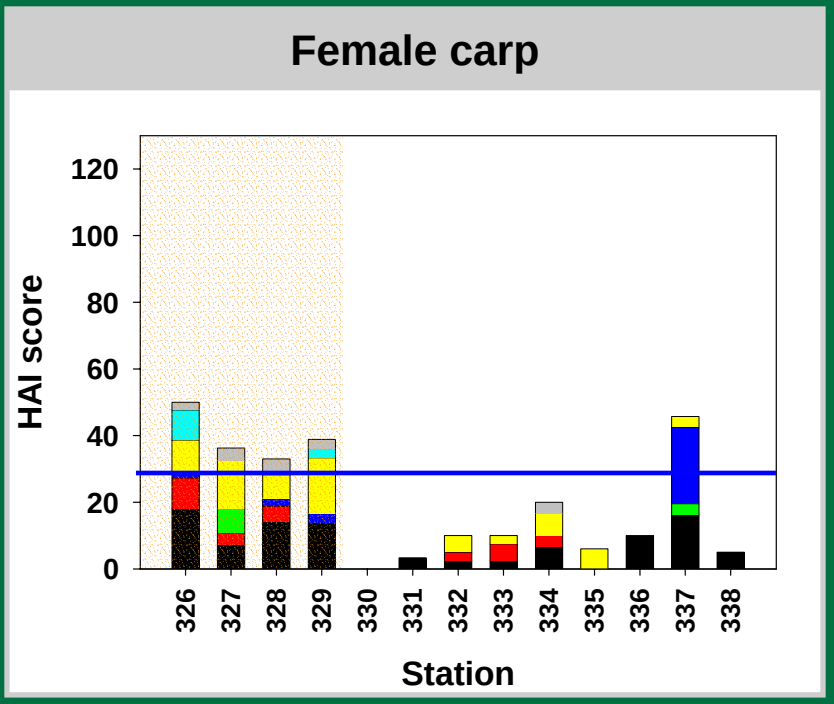
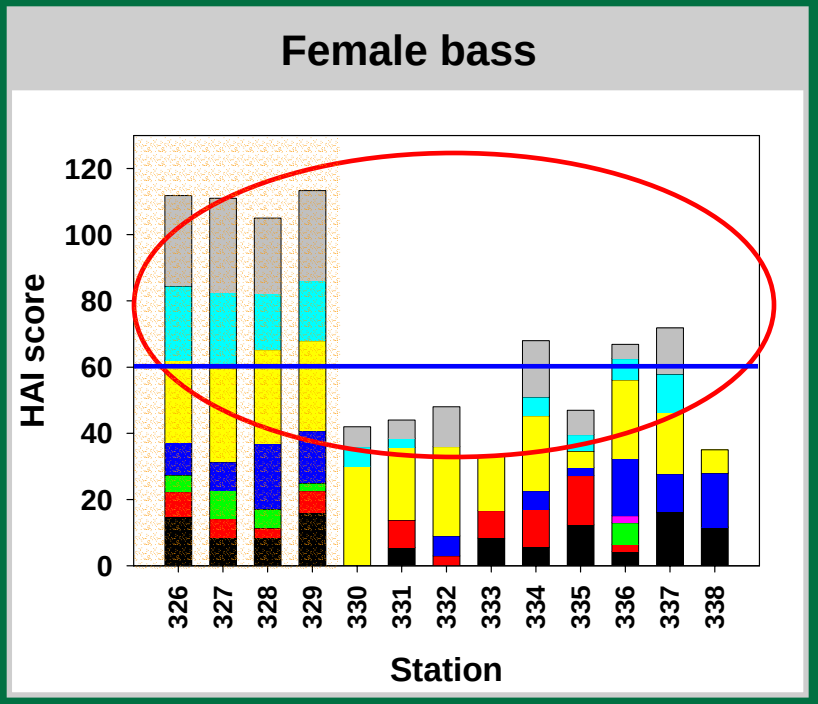
HAI scores and species differences







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Age, length, weight, somatic indices

Otoliths

Enlarged spleen

Factors to consider	Rating
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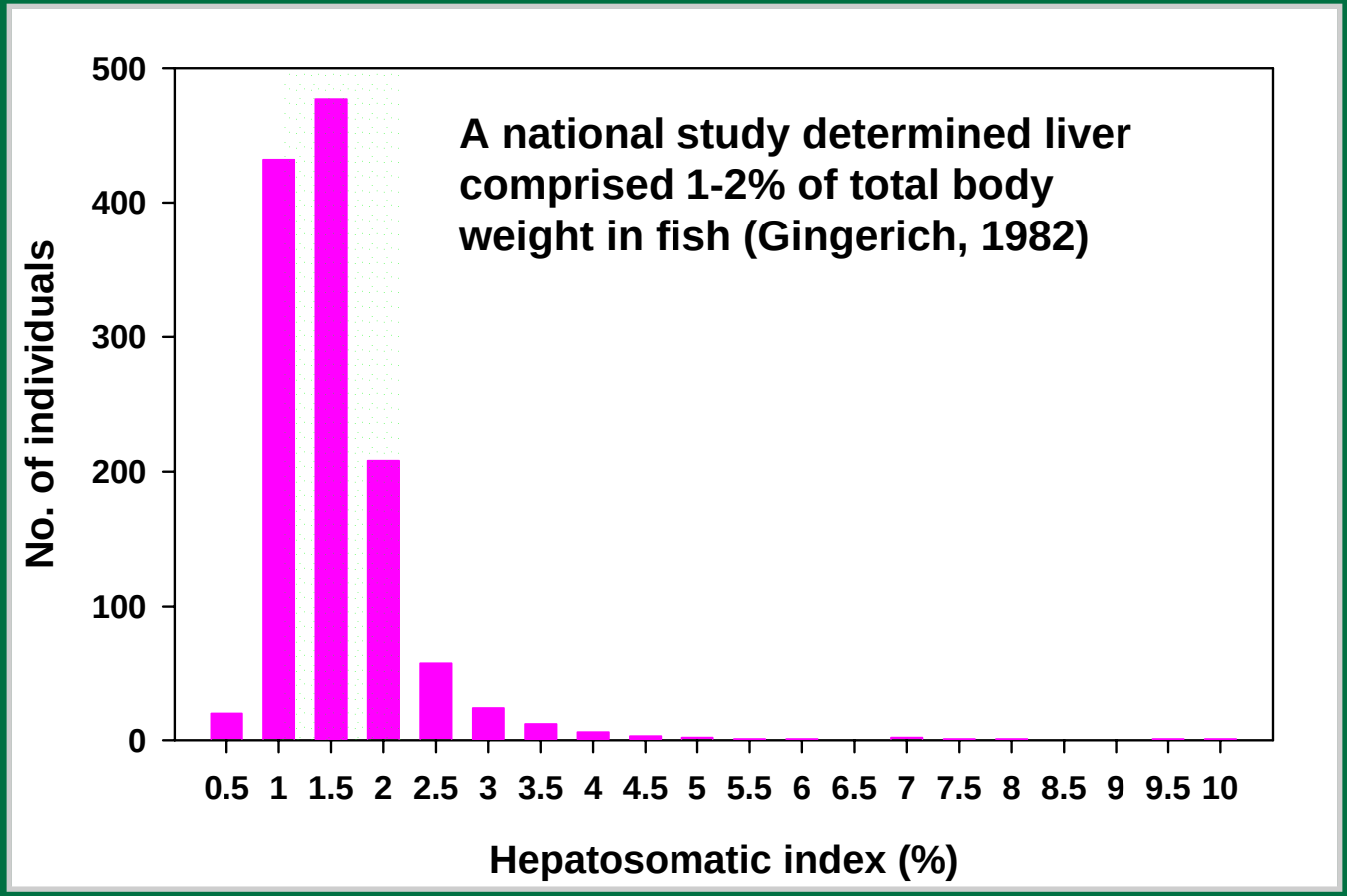
Frequency distribution of hepatosomatic index in all LRMN fish



HSI = liver weight/(total body weight – gonad weight)*100

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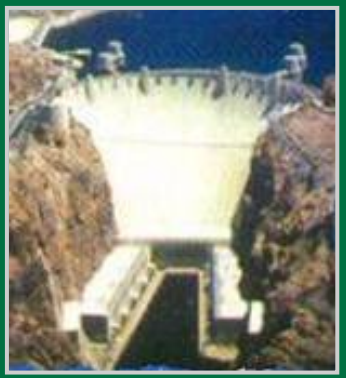
Pesticides and inorganic contaminant concentrations



Factors to consider	Rating
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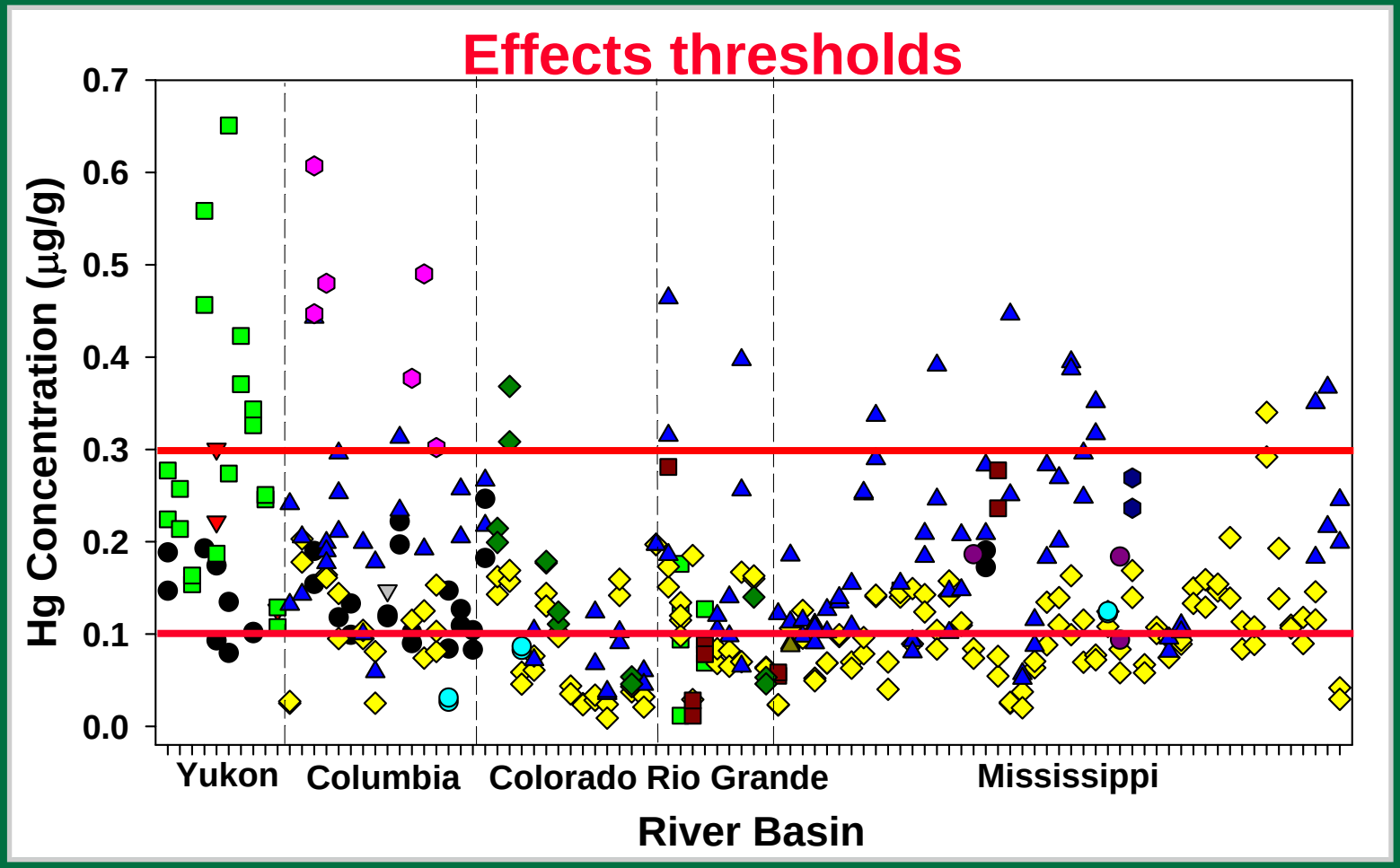
Mercury concentrations in LRMN fish



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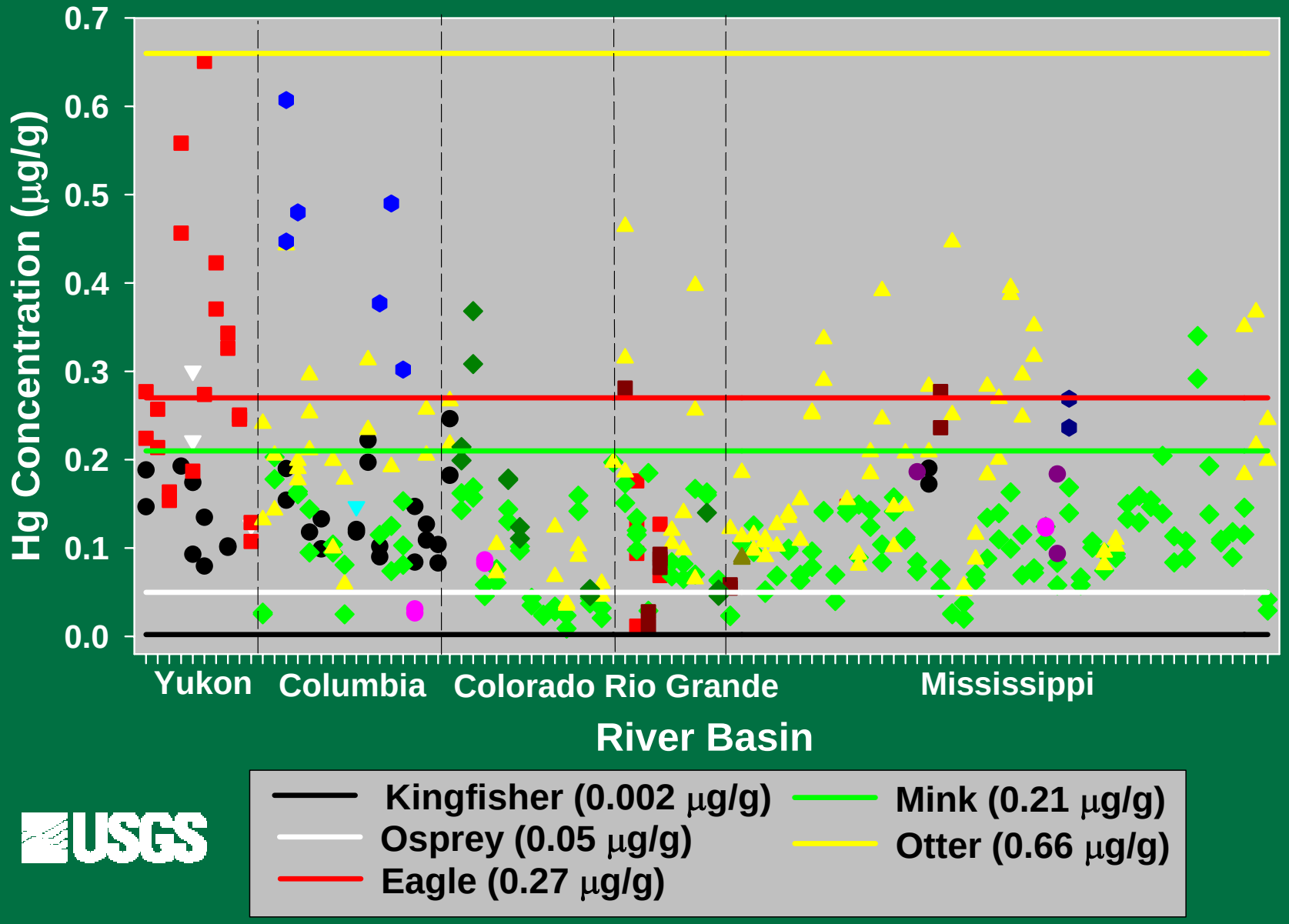
Wildlife at risk to mercury in LRMN fish



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Contaminant concentrations

Pesticides and inorganics	
Factors to consider	Rating
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Historical data	
Collection method	
Analytical method	
Interpretation	

DDT, toxaphene, Hg, Se, As

New generation chemicals	
Factors to consider	Rating
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Collection method	
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Pharmaceuticals, perchlorate

Emphasizes the importance of examining biological endpoints

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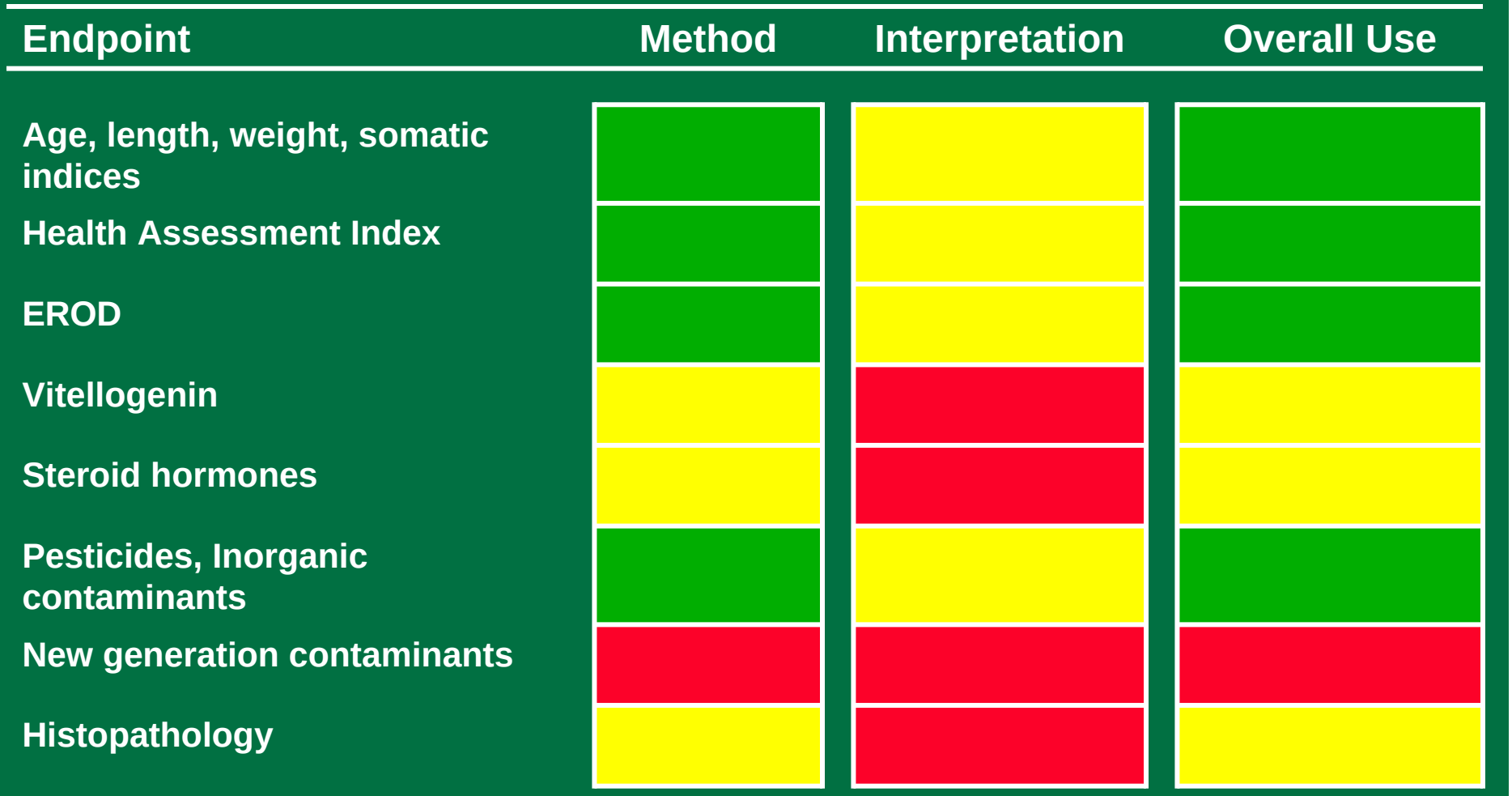
Summary of endpoint use in fish health assessment



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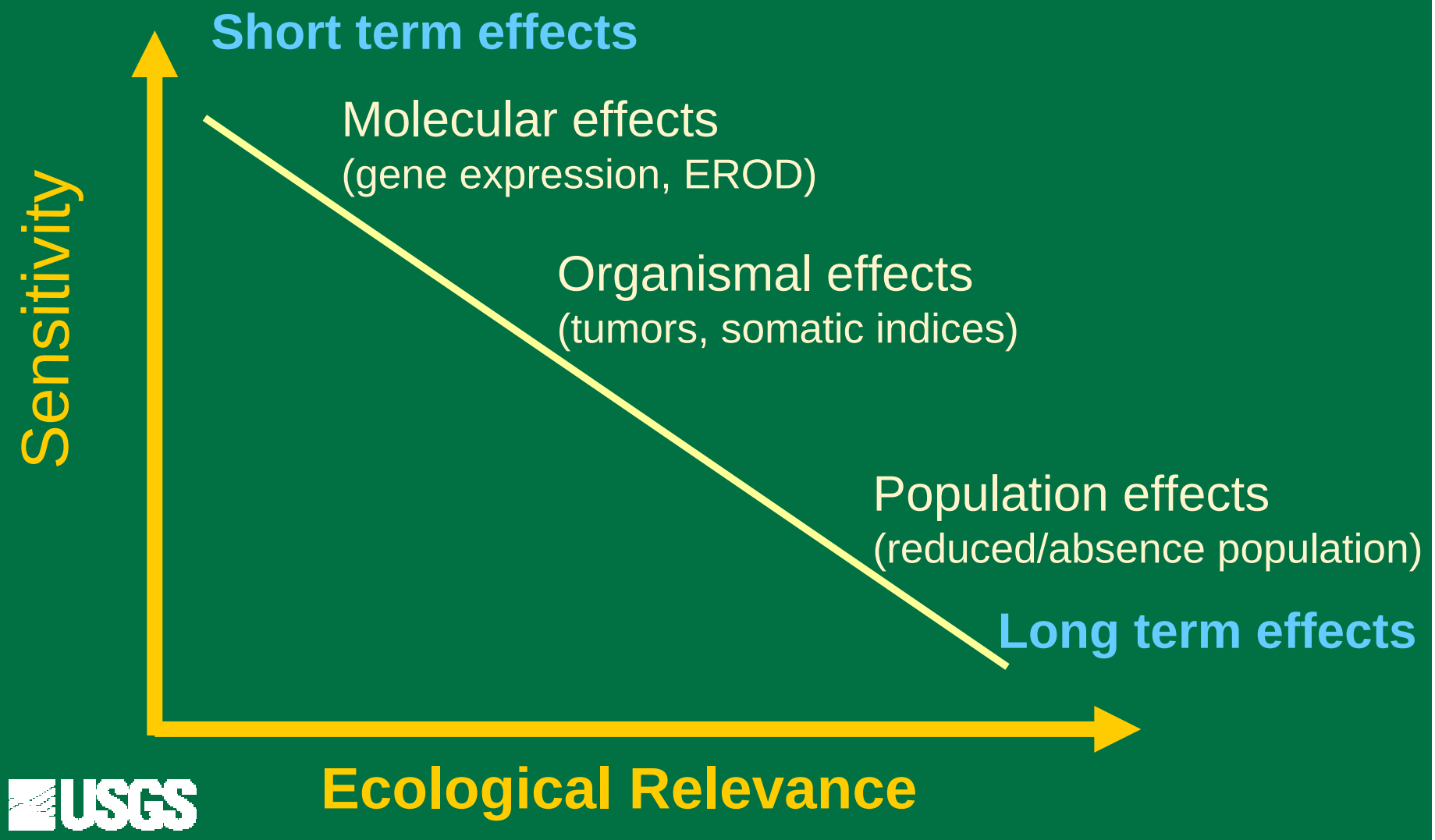
Overall use of LRMN endpoints in fish health and ecosystem assessment



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USGS BEST Program: J. Coyle, P. Anderson

University of Florida – Gainesville: N. Denslow

For more information on BEST-LRMN:

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Related publications (in pdf):

www.cerc.usgs.gov/pubs/pubs.htm

Fish health database:

www.cerc.usgs.gov/data/best/search.htm

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