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Minnesota River Selenium Site-Specific Standard

Need for a site-specific standard

- Site-specific standards are allowed if “site-specific information is available that shows that a site-specific modification is more appropriate than the statewide or ecoregion standard for a particular water body...”
- Statewide standard is outdated – based on protective values developed in 1987; additional research has been conducted since that time
- Updated research indicates that site-specific uptake of selenium should be considered
- Site-specific information is available – data collected from 2012-2017

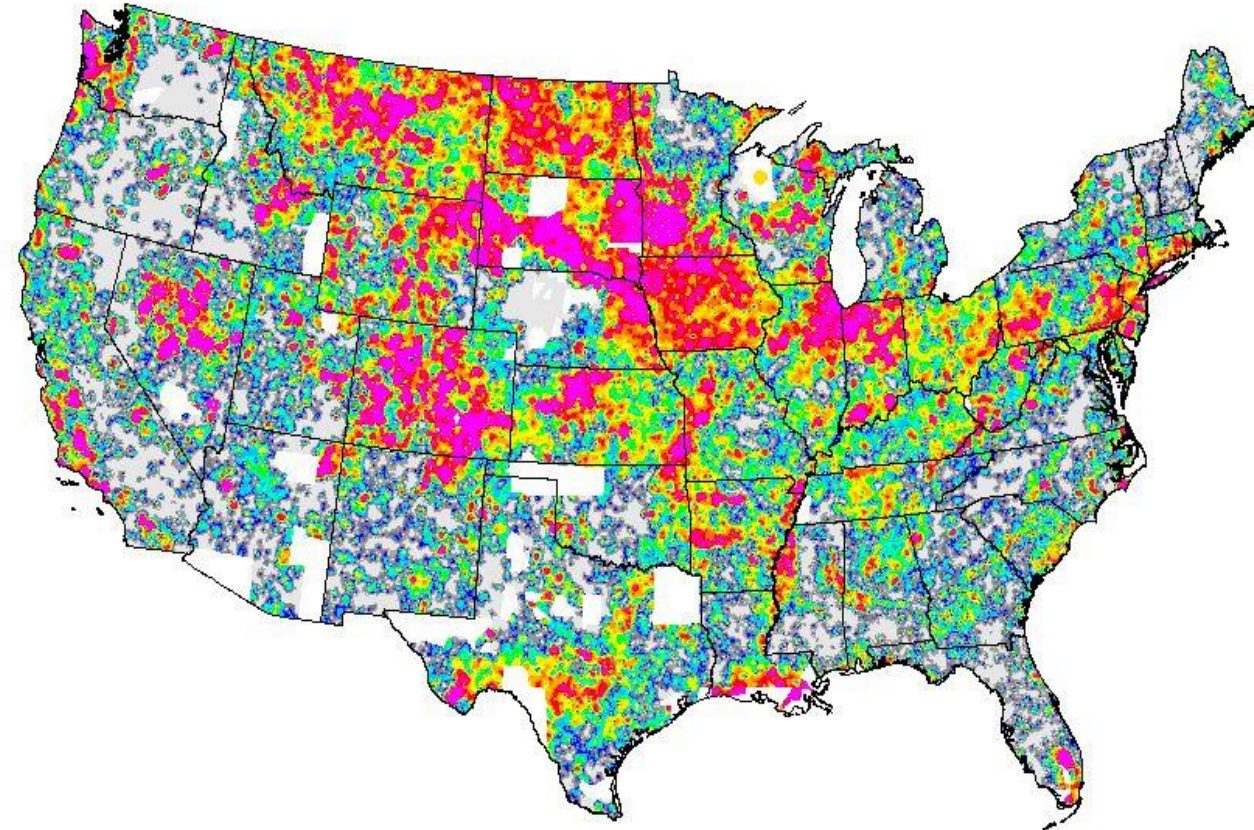
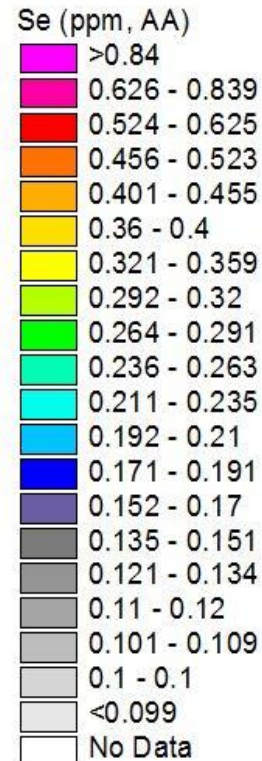
Need for site-specific standard

- Gopher Resources
 - Battery recycler, discharges selenium
- Met Council's Seneca WWTP
 - Receives Gopher's discharge and is required to comply with all WQS
- Selenium discharge
 - Seneca assigns limits to Gopher
 - Challenging to meet limits without expensive updates
- Wenck
 - Evaluated updated science
 - Collected and analyzed data for SSS



Selenium (Se)

- Naturally occurring in rocks and soils
- Element necessary for human health, but can be toxic to humans and aquatic life
- Can occur in waters from natural weathering of rocks/soils, or runoff from irrigation of Se-rich soils
- Se is not widely discharged in Minnesota



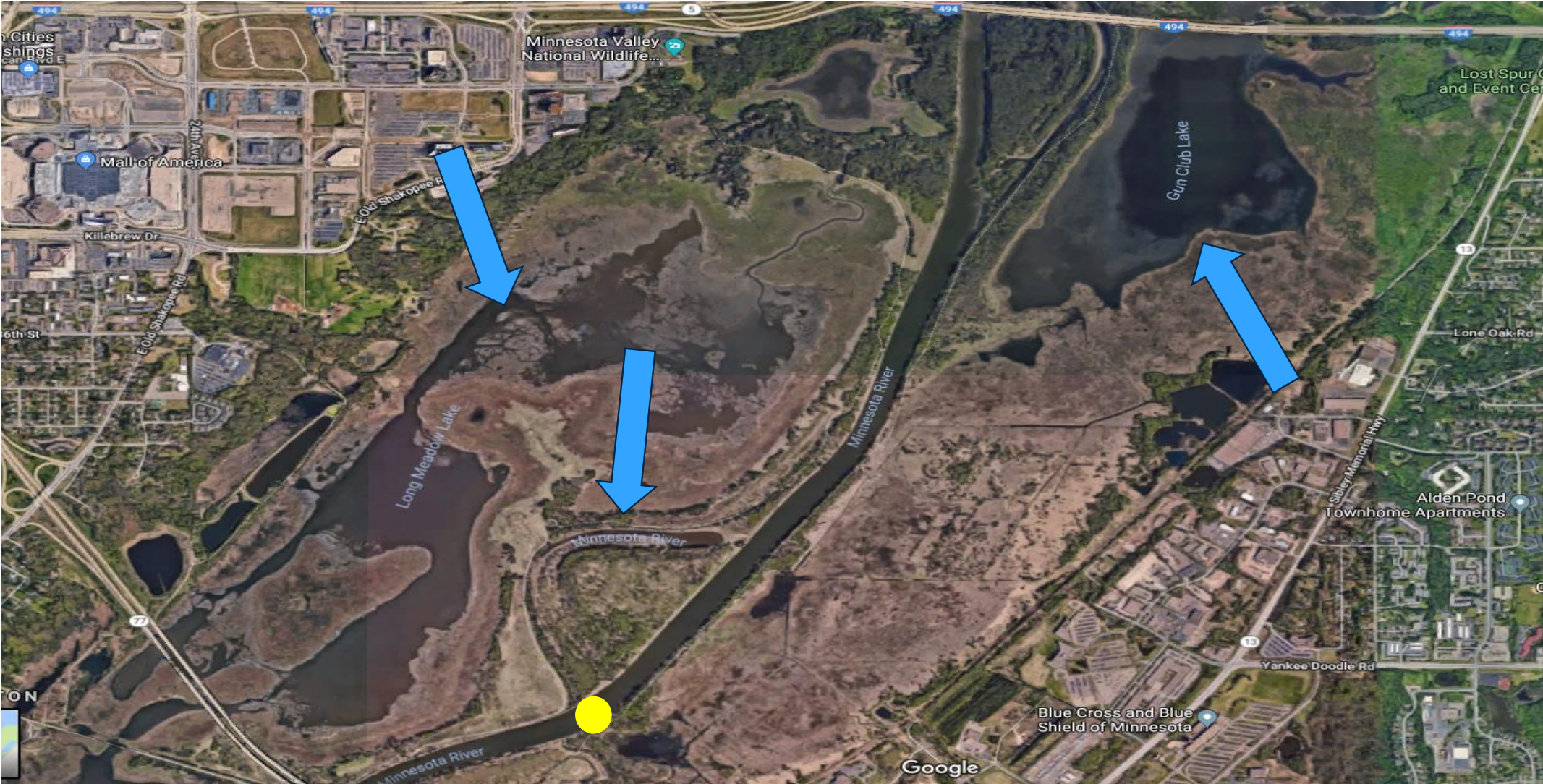


MSP

Seneca WWTP

Site of standard

Site specifics



Minnesota and EPA criteria

- Minnesota's current standard:
 - 20 $\mu\text{g/L}$ for short-term exposure (acute)
 - 5.0 $\mu\text{g/L}$ for long-term exposure (chronic)
- EPA's 2016 criterion updated knowledge on dietary vs. water exposures
- Bioaccumulative
- Effects = reproduction and malformation; based on tissue concentrations
- Criterion document provides guidance on developing site-specific standards, including translation to water column value

EPA criterion

Media Type	Fish Tissue		Water Column	
Criterion Element	<i>Egg/Ovary</i>	<i>Fish Whole Body or Muscle</i>	<i>Monthly Average Exposure</i>	<i>Intermittent Exposure</i>
Magnitude	15.1 mg/kg dw	8.5 mg/kg dw <u>whole body</u> or 11.3 mg/kg dw <u>muscle</u> (skinless, boneless filet)	1.5 µg/L in <u>lentic</u> aquatic systems 3.1 µg/L in <u>lotic</u> aquatic systems	$WQC_{int} = \frac{WQC_{30-day} - C_{bkgnd} (1 - f_{int})}{F_{int}}$
Duration	Instantaneous measurement	Instantaneous measurement	30 days	Number of days/month with an elevated concentration
Frequency	Not to be exceeded	Not to be exceeded	Not more than once in three years on average	Not more than once in three years on average

Scientific basis of standard

<i>Egg/Ovary</i>	<i>Fish Whole Body or Muscle</i>	<i>Monthly Average Exposure</i>
15.1 mg/kg dw	8.5 mg/kg dw <u>whole body</u> or 11.3 mg/kg dw <u>muscle</u> (skinless, boneless filet)	1.5 µg/L in <u>lentic</u> (still water) aquatic systems 3.1 µg/L in <u>lotic</u> (flowing water) aquatic systems

Scientific basis of standard

- Protective tissue values calculated from toxicity tests with various fish species
- Determined the concentration of selenium built up in reproductive tissues that caused effects on reproduction and malformations
- Does not consider site-specific conditions, only describes the levels in tissue protect from adverse effects
- Site-specifics are related to how much selenium is accumulated into tissue from the water/food chain

Scientific basis of standard

<i>Egg/Ovary</i>	<i>Fish Whole Body or Muscle</i>	<i>Monthly Average Exposure</i>
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Scientific basis of water column values

- Need to translate the protective tissue value to a water concentration

- Water column value =
$$\frac{\textit{protective fish tissue concentration}}{\textit{BAF}}$$

- Bioaccumulation Factor (BAF) =
$$\frac{\textit{fish tissue concentration}}{\textit{water column concentration}}$$

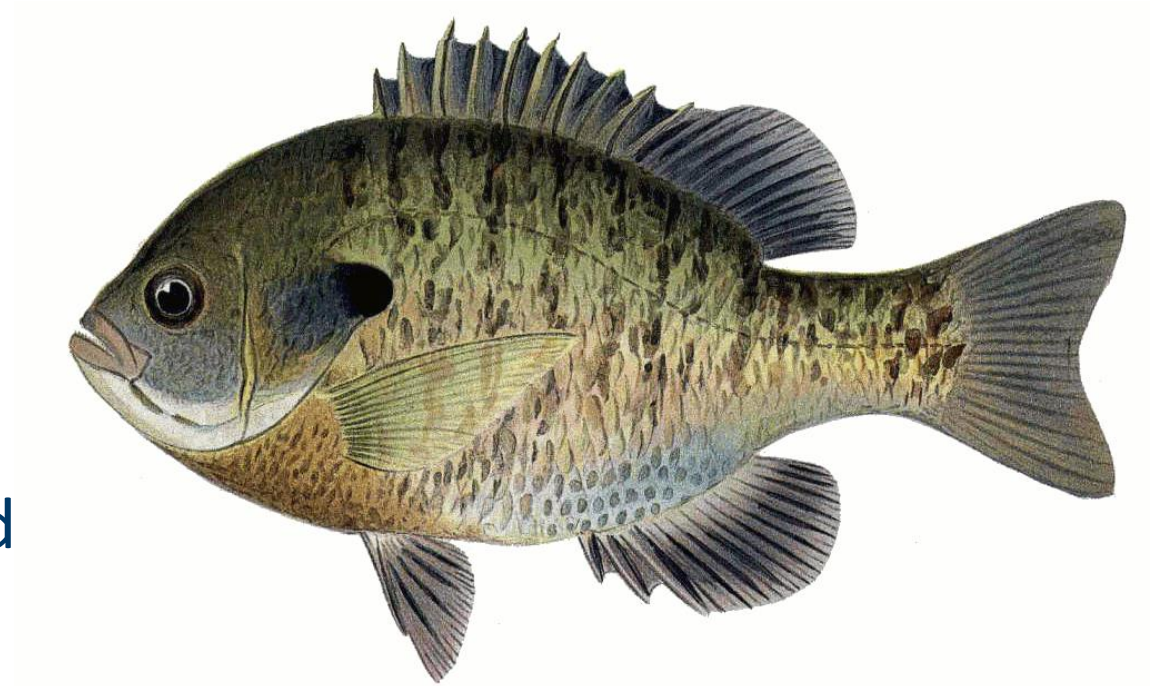
Considerations for sampling

- Adequate sample size
- Seasonal differences
- Habitat differences
- Target species



Target species for BAF

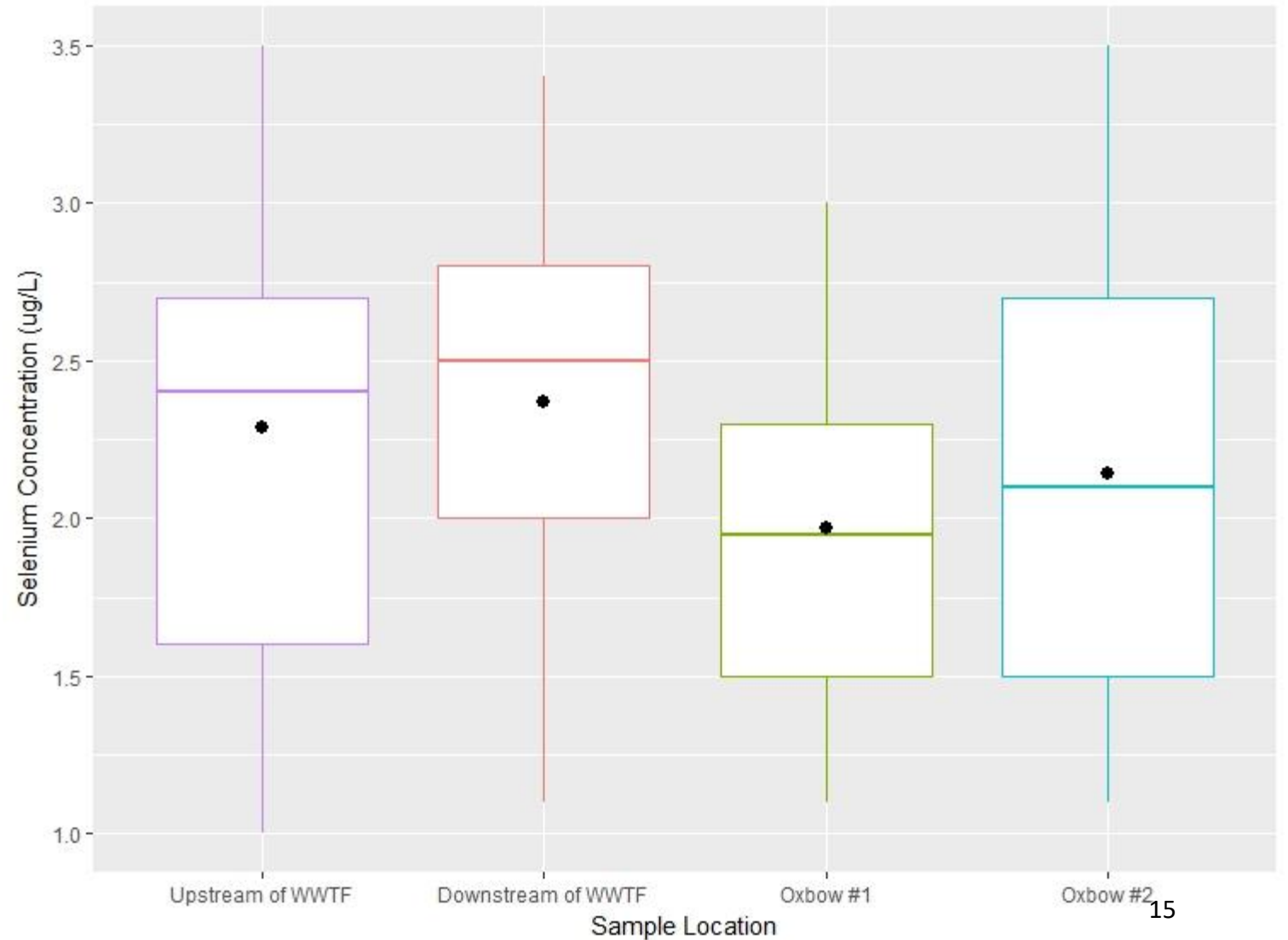
- Bluegill as target species
 - Sensitive to selenium
 - Readily found in lower MN River
- Sturgeon and salmonids
 - More sensitive, but not readily found



Results – water concentrations

Water concentrations in $\mu\text{g/L}$

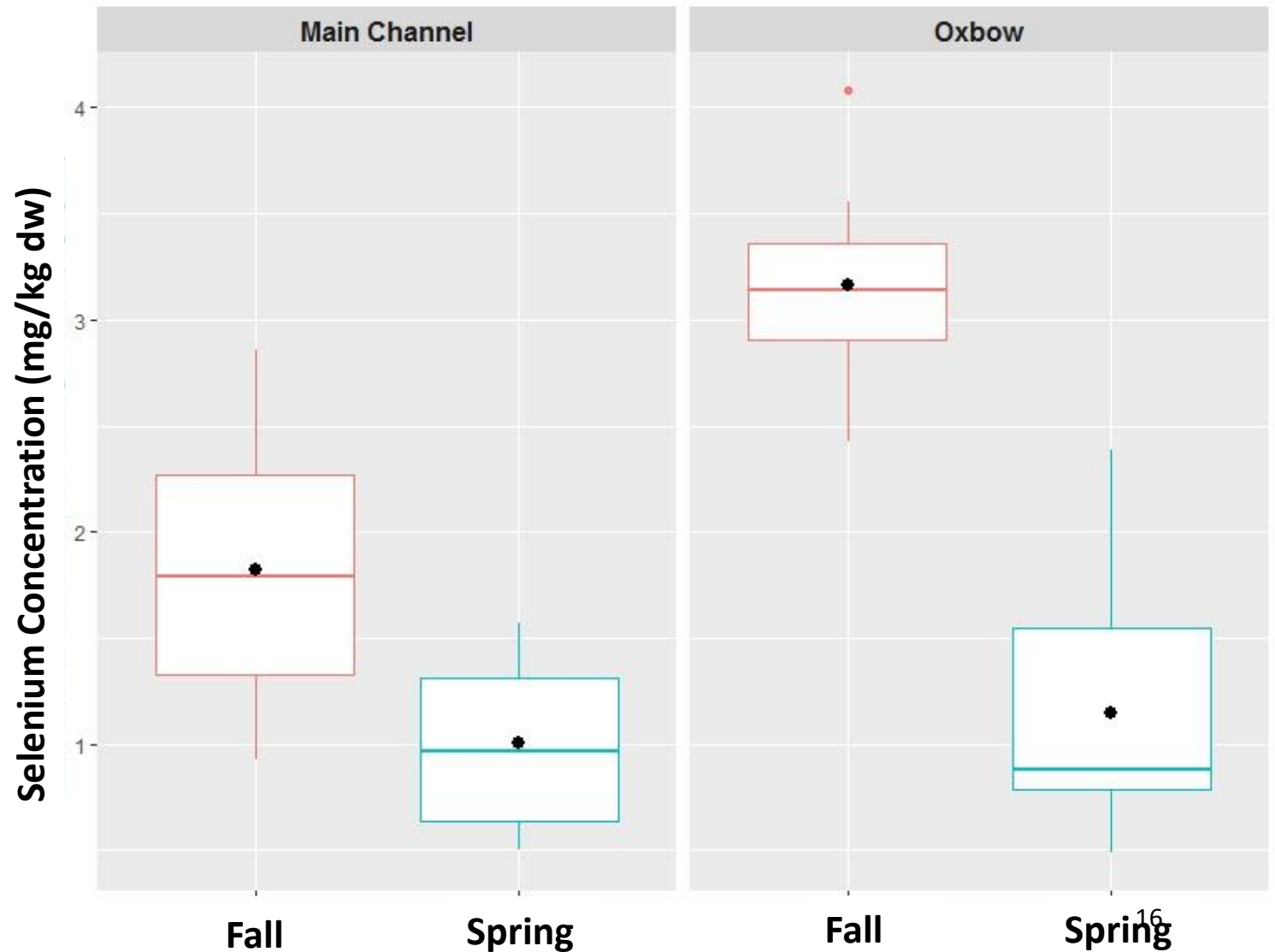
	Main Channel	Oxbow
Average	2.4	2.1



Results – tissue concentrations (bluegills)

Fall tissue concentrations greater than spring concentrations

Oxbow concentrations higher than main channel concentrations



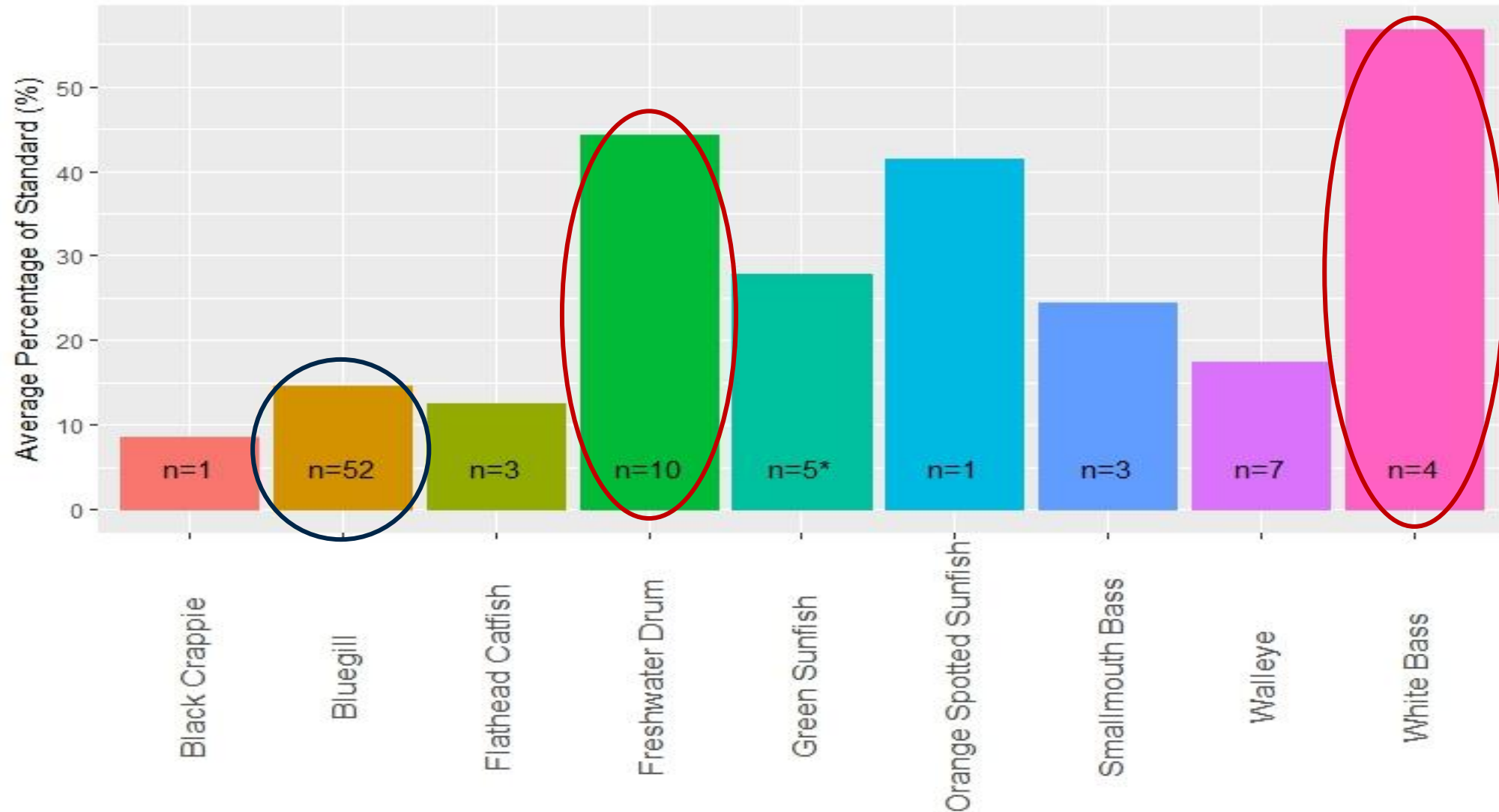
Calculated standard values

<i>Habitat</i>	<i>Fall 2017 average bluegill whole-body tissue concentration</i>	<i>2017 average water concentration</i>	<i>BAF</i>	<i>Site-specific water column standard</i>
Main Channel	1.82 mg/kg dw	2.4 µg/L	0.76	11 µg/L
Oxbow	3.16 mg/kg dw	2.1 µg/L	1.50	5.6 µg/L

Proposed site-specific standard

Media Type	Fish Tissue		Water Column
Criterion Element	Fish tissue values taken directly from EPA 2016 criterion to protect fish from reproductive effects		Water column values calculated using site-specific info to prevent exceedance of fish tissue standards
Magnitude			
Duration	Instantaneous measurement	Instantaneous measurement	30 days
Frequency	Not to be exceeded	Not to be exceeded	Not more than once in three years on average

Concentrations in other species



Implementation and proposed permit conditions

- Target species for determining compliance with fish tissue standards will be species that bioaccumulate
 - Bluegill Sunfish
 - Freshwater drum
 - White bass
- Sample fish in late fall, when concentrations are highest
- Intervention concentration
- Antidegradation rules will apply, with a numeric quantification of existing loading that would trigger an antidegradation review
- Maintain downstream protections

Fish	Minimum Sample Mass (grams)	Maximum length (inches)	Target Sample Count		
			MN River (Lotic)	Gun Club Lake (Lentic)	Oxbow Lake (Lentic) ^a
Bluegill Sunfish	5	6	5	5	5
White Bass	5	17	3	3b	3b
Freshwater Drum	5	18	3	3b	3b

***a** Target sample count is dependent on accessibility and safety.*

***b** Target sample count is dependent on species presence.*

Questions

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