

Aquatic Life Criterion for Selenium

Negotiated Rulemaking

Docket No. 58-0102-1701

Stephanie Jenkins
Water Quality Standards
Idaho Department of Environmental Quality
June 13 2017



Agenda

<http://www.deq.idaho.gov/media/60180102/58-0102-1701-meeting-agenda-061317.pdf>

Outline

Response to
Comments



Sturgeon Surrogacy



Sturgeon Waters

Comments

- ◉ Bureau of Land Management (BLM)
- ◉ J.R. Simplot Company (SIM)
- ◉ Nu-West Industries, Inc. (NWI)
- ◉ Idaho Conservation League (ICL)
- ◉ EPA Region 10 (EPA)

Response to Comments

1. EPA Consultation with FWS and NOAA

- ICL

2. Non-Fish Aquatic Life and Aquatic Dependent Life

- ICL

3. New Inputs, Steady State, Hierarchy of Criterion Elements

- BLM, SIM, ICL

Response to Comments

4. Average or Composite Samples

- NWI, SIM, BLM

5. Exceedance Frequency

- SIM, NWI

6. Performance-Based Approach (Appendix K)

- NWI

7. Non-Sturgeon Waters

- ICL, SIM, NWI

Response to Comments

1. **EPA Consultation with FWS and NOAA**
2. Non-Fish Aquatic Life and Aquatic Dependent Life
3. New Inputs, Steady-State, Hierarchy of Criterion Elements
4. Average or Composite Samples
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2. Non-Fish Aquatic Life and Aquatic Dependent Life

○ Human Health

- This rulemaking only addresses aquatic life
- Human health criteria was revised (04/11/06) at 29 ug/L (water and fish) and 250 ug/L (fish) and is awaiting review by EPA.

○ Non-Fish Aquatic Life and Aquatic Dependent Life

- Fish-tissue criterion is based on data from invertebrates and crustaceans in addition to fish.
 - Invertebrates have been shown to be less sensitive than fish species.
 - The EPA recommended criterion specifies that this does not evaluate aquatic dependent life such as waterfowl and other riparian obligate bird species.

Response to Comments

1. EPA Consultation with FWS and NOAA
2. Non-Fish Aquatic Life and Aquatic Dependent Life
3. **New Inputs, Steady-State, Hierarchy of Criterion Elements**
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3. New Inputs, Steady State, Hierarchy of Criterion Elements

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<i>Chronic</i>			<i>Short-term</i>		
<i>Egg-Ovary (mg/kg dw)</i>	<i>Fish Tissue (mg/kg dw)</i>		<i>Water Column (µg/L)</i>		<i>Water Column (µg/L)</i>
<i>Egg-Ovary</i>	<i>Whole Body</i>	<i>Muscle</i>	<i>Water Lentic</i>	<i>Water Lotic</i>	<i>Water</i>
<i>15.1¹</i>	<i>8.5²</i>	<i>11.3²</i>	<i>1.5 (30 day average)³</i>	<i>3.1 (30 day average)³</i>	<i>Intermittent exposure Equation^{3,4}</i>

mg/kg dw – milligrams per kilogram dry weight, µg/L – micrograms per liter

1. Egg/Ovary supersedes any whole-body, muscle, or water column element when fish egg/ovary concentrations are measured. Single measurement of an average or composite sample of at least five individuals of the same species.

3. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Water column values are the applicable criterion element in the absence of **steady-state condition fish tissue data.**

-4. Intermittent Exposure Equation =

$$\frac{WQC_{30\text{-day}} - C_{bkgnd} (1 - f_{int})}{f_{int}}$$

where $WQC_{30\text{-day}}$ is the water column monthly element, for either lentic or lotic waters; C_{bkgnd} is the average background selenium concentration, and f_{int} is the fraction of any 30-day period during which elevated selenium concentrations occur, with f_{int} assigned a value ≥ 0.033 (corresponding to one day)

Steady State – New Inputs

- New inputs: new activities resulting in selenium being released into a lentic or lotic waterbody (EPA 2016).
- Annual pulses induced by runoff?
 - Known annual pattern
 - Expect bioaccumulation in fish to remain relatively stable

Steady-State Definition

- ⦿ Does not include 'new inputs'
- ⦿ Variable by Site
 - Hydrodynamics
 - Aquatic community bioaccumulation
 - Migration

Hierarchy of Fish Tissue over Water Column Concentrations

- Water column concentration supersede fish tissue:
 - Only when systems are not steady-state
 - Fishless stream
- Computer modeling packages: reconstructed to support new parameters

Thus, EPA recommends that fish tissue concentration not supersede water column concentration until these periods of time have passed in lotic and lentic systems, respectively, or until steady state concentrations can be determined.

Sampling in Fishless Waters

For purposes of this document, EPA defines “fishless waters” as waters with insufficient instream habitat and/or flow to support a population of any fish species on a continuing basis, or waters that once supported populations of one or more fish species but no longer support fish (e.g., extirpation) due to temporary or permanent changes in water quality (e.g., selenium pollution), flow or instream habitat. Because of the inability to collect sufficient fish tissue to measure selenium concentrations in fish in such waters, water column concentrations will best represent selenium levels required to protect aquatic communities and downstream waters in such areas. Appendix K of this criterion document discusses approaches to develop a site-specific water column criterion element in such situations.

EPA, 2016. Aquatic life ambient water quality criterion for selenium – freshwater. EPA 822-R-15-006

Sampling in Fishless Waters

When fish are absent from a waterbody, consideration of **sampling the most sensitive fish species inhabiting nearby, most proximate downstream waters may be useful** in order to understand selenium bioaccumulation potential in such systems. Although the upper reaches of some aquatic systems may not support fish communities, the invertebrate organisms that reside there may tolerate high concentrations of selenium and pose a selenium risk to predator fish if transported downstream. **Users may choose to evaluate upstream waters without fish by measuring the selenium concentration in water,** biotic and/or abiotic particulate material, and/or the tissues of invertebrate aquatic organisms that reside there. Because selenium associated with particulate material and invertebrate organisms can be transported downstream during intermittent high flows, elevated concentrations of selenium in the tissues of downstream fish could indicate upstream sources of selenium that require a more detailed evaluation of upstream conditions.

EPA, 2016. Aquatic life ambient water quality criterion for selenium – freshwater. Appendix K. EPA 822-R-15-006

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4. **Average or Composite Samples**
5. Exceedance Frequency
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7. Non-Sturgeon Waters

4. Average or Composite Samples

<i>Chronic</i>			<i>Short-term</i>		
<i>Egg-Ovary (mg/kg dw)</i>	<i>Fish Tissue (mg/kg dw)</i>		<i>Water Column (µg/L)</i>		<i>Water Column (µg/L)</i>
<i>Egg-Ovary</i>	<i>Whole Body</i>	<i>Muscle</i>	<i>Water Lentic</i>	<i>Water Lotic</i>	<i>Water</i>
15.1 ²	8.5 ²	11.3 ²	1.5 (30 day average) ³⁺⁵	3.1 (30 day average) ³⁺⁵	Intermittent exposure Equation ³⁺⁵⁺⁶

mg/kg dw - milligrams per kilogram dry weight, µg/L - micrograms per liter

1. Egg/Ovary supersedes any whole-body, muscle, or water column element when fish egg/ovary concentrations are measured. Instantaneous Single measurement of an average or composite sample of at least five individuals of the same species.

23. Fish whole-body or muscle tissue supersedes water column element when both fish tissue and

23. Fish whole-body or muscle tissue supersedes water column element when both fish tissue and water concentrations are measured. Instantaneous measurement of an average or composite sample of at least five individuals of the same species and similar size (within the 75% rule).

5. Frequency: Not to be exceeded more than once in three years on average.

46. Intermittent Exposure Equation =

$$\frac{WQC_{30\text{-day}} - C_{background} (1 - f_{int})}{f_{int}}$$

where $WQC_{30\text{-day}}$ is the water column monthly element, for either lentic or lotic waters; $C_{background}$ is the average background selenium concentration, and f_{int} is the fraction of any 30-day period during which elevated selenium concentrations occur, with f_{int} assigned a value ≥ 0.033

Number of Samples

- Fish tissue: Average or composite of five individual fish
- Water column: No specified number of samples within 30 day window
- Protection of Fish Populations
 - Southeast Idaho: Protocol for Collecting Fish for Selenium Tissue Analysis (DEQ 2016)
 - Coordinates sampling efforts (multiple entities)

Response to Comments

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5. Exceedance Frequency

Definition of chronic criteria in IDAPA 58.01.02.010.15

“...Chronic criteria are expected to adequately protect the designated aquatic life use if not exceeded more than once every three (3) years...”

Chronic					
Egg-Ovary (mg/kg dw)					
Egg-Ovary					
	15.1 ²	8.5 ²	11.3 ²	1.5 (30 day average) ³⁺⁵	average) ³⁺⁵ Equation ³⁺⁵⁺⁶
	mg/kg dw - milligrams per kilogram dry weight, µg/L - micrograms per liter				
1. Egg/Ovary supersedes any whole-body, muscle, or water column element when fish egg/ovary concentrations are measured. <u>Instantaneous Single measurement of an average or composite</u>					
2. Frequency: Not to be exceeded.					
23. Fish whole-body or muscle tissue supersedes water column element when both fish tissue and water concentrations are measured. <u>Instantaneous measurement of an average or composite sample of at least five individuals of the same species and similar size (within the 75% rule).</u>					
5. Frequency: Not to be exceeded more than once in three years on average.					
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46. Intermittent Exposure Equation =					
$\frac{WQC_{30\text{-day}} - C_{bkgrnd} (1 - f_{int})}{f_{int}}$					
where WQC _{30-day} is the water column monthly element, for either lentic or lotic waters; C _{bkgrnd} is the average background selenium concentration, and f _{int} is the fraction of any 30-day period during which elevated selenium concentrations occur, with f _{int} assigned a value ≥ 0.033					

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6. Performance-based Approach

- Did not change statewide language, but added using Appendix K as an overarching approach to calculating SSCs
 - Statewide Rule Footnote

34. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data.

- Site-Specific Criteria

287. **SITE-SPECIFIC CRITERIA FOR SELENIUM.**

Site-specific water column values (30-day average) are based on dissolved total selenium in water and are derived using a performance-based approach from fish tissue values via mechanistic or bioaccumulation modeling methods in Appendix K: Translation of a Selenium Fish Tissue Criterion Element to a Site-Specific Water Column Value, Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater, EPA-822-R-16-006 (June 2016).

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7. **Non-Sturgeon Waters**

Outline

Response to
Comments

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Sturgeon Surrogacy

Sturgeon
Waters

Defining a Site based on Fish Presence

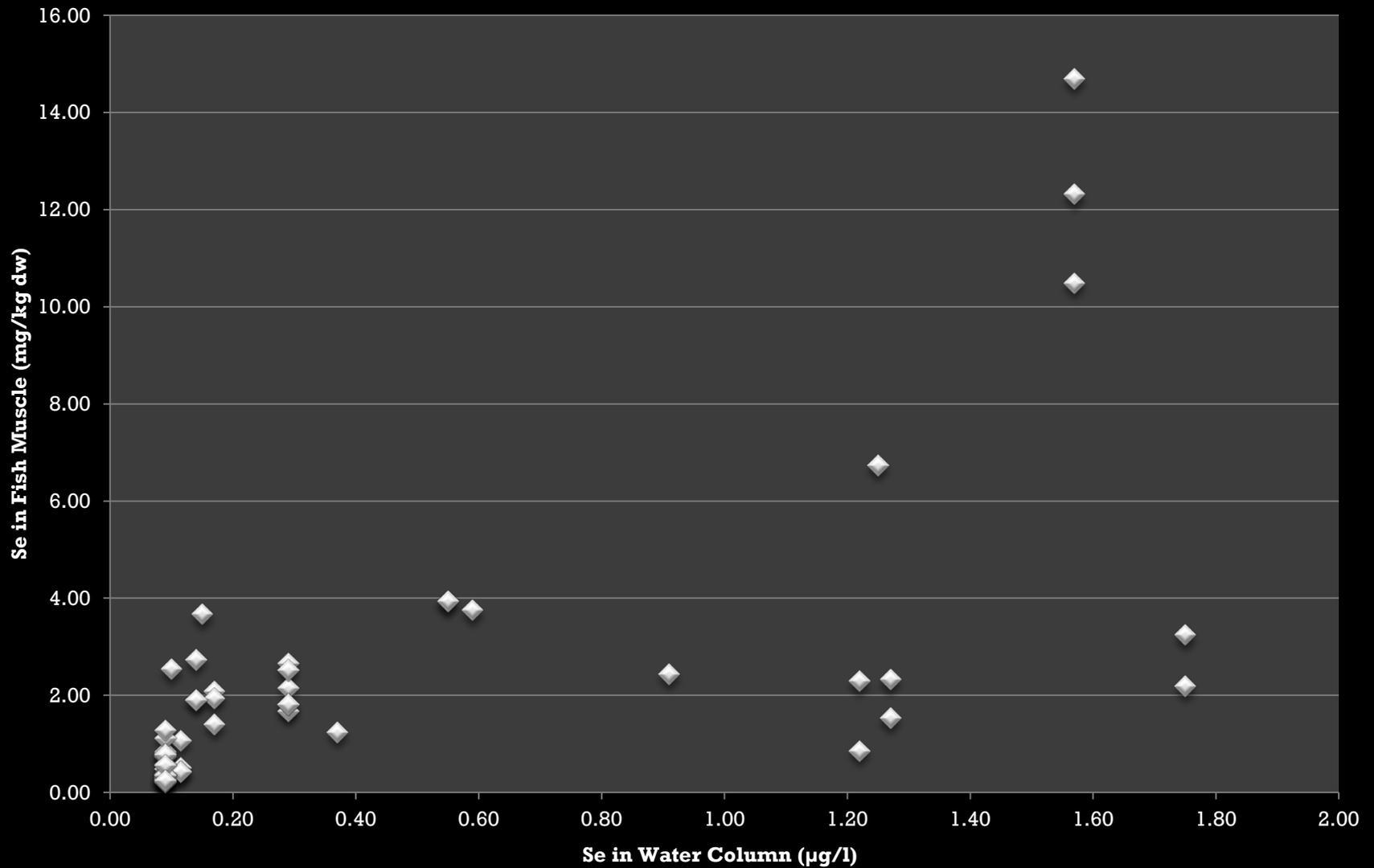
Complies with Idaho rules and EPA guidelines for establishing site-specific criteria

- ◉ IDAPA 58.01.02.275: Expanded geographical area, aquatic communities cannot vary substantially in sensitivity to pollutant
- ◉ EPA, Stephen et al 1985 pg3: ...with appropriate modifications these National Guidelines can be used to derive criteria for any specific geographical area, body of water (such as the Great Salt Lake), or group of similar bodies of water, if adequate information is available concerning the effects of the material of concern on appropriate species and their uses.

Non-Sturgeon Waters

Selenium Criterion	Chronic					Short-term
	Egg-Ovary (mg/kg dw)	Fish Tissue (mg/kg dw)		Water Column (µg/L)		Water Column (µg/L)
	Egg-Ovary	Whole Body	Muscle	Water (Lentic)	Water (Lotic)	Water
Statewide	15.1	8.5	11.3	1.5 (30 day)	3.1 (30 day)	Intermittent exposure equation
Non-Sturgeon Waters	19.0	9.5	13.1	1.7 (30 day)	3.4 (30 day)	Intermittent exposure equation

Comparison of Selenium in WC and Fish Tissue in Idaho, 2008



Phylogeny of Idaho Fishes

Class	Superorder	Order	Family	Genus	Species
Chondrostei	x	Acipenseriformes	Acipenseridae	Acipenser	White Sturgeon
Teleostei	Acanthopterygii	Cyprinodontiformes	Poeciliidae	Gambusia	Mosquitofish
Teleostei	Acanthopterygii	Perciformes	Centrarchidae	Lepomis	Sunfish
Teleostei	Acanthopterygii	Perciformes	Centrarchidae	Micropterus	Bass
Teleostei	Acanthopterygii	Scorpaeniformes	Cottidae	Cottus	Sculpin
Teleostei	Ostariophysi	Cypriniformes	Catostomidae	Catostomus	Sucker
Teleostei	Ostariophysi	Cypriniformes	Cyprinidae	Pimephales	Minnnow
Teleostei	Protacanthopterygii	Esociformes	Esocidae	Esox	Northern Pike
Teleostei	Protacanthopterygii	Salmoniformes	Salmonidae	Oncorhynchus	Cutthroat trout, rainbow trout, salmon
Teleostei	Protacanthopterygii	Salmoniformes	Salmonidae	Salmo	Brown trout
Teleostei	Protacanthopterygii	Salmoniformes	Salmonidae	Savelinus	Brook trout, bull trout, lake trout
Teleostei	Protacanthopterygii	Salmoniformes	Salmonidae	Coregonus	Lake whitefish
Teleostei	Protacanthopterygii	Salmoniformes	Salmonidae	Prosopium	Whitefish

<https://www.itis.gov/>

Species Deletion Process

1. Does a species in the genus occur at the site?
If “No”, go to step 2.
If “Yes”, are there one or more species in the genus that occur at the site but are not in the national toxicity dataset?
If “No”, delete the uncircled species.*
If “Yes”, retain the uncircled species.*
2. Does a species in the family occur at the site?
If “No”, go to step 3.
If “Yes”, are there one or more genera in the family that occur at the site but are not in the national toxicity dataset?
If “No”, delete the uncircled species.*
If “Yes”, retain the uncircled species.*
3. Does a species in the order occur at the site?
If “No”, go to step 4.
If “Yes”, are there one or more families in the order that occur at the site but are not in the national toxicity dataset?
If “No”, delete the uncircled species.*
If “Yes”, retain the uncircled species.*
4. Does a species in the class occur at the site?
If “No”, go to step 5.
If “Yes”, are there one or more orders in the class that occur at the site but are not in the national toxicity dataset?
If “No”, delete the uncircled species.*
If “Yes”, retain the uncircled species.*
5. Does a species in the phylum occur at the site?
If “No”, delete the uncircled species.*
If “Yes”, are there one or more classes in the phylum that occur at the site but are not in the national toxicity dataset?
If “No”, delete the uncircled species.*
If “Yes”, retain the uncircled species.*

* = Continue the deletion process by starting at step 1 for another uncircled species unless all uncircled species in the national toxicity dataset have been addressed.

1. Does a species in the genus occur at the site?

If **No** go to step 2.

If "Yes", are there one or more species in the genus that occur at the site but are not in the national toxicity dataset?

If "No", delete the uncircled species.*

If "Yes", retain the uncircled species.*

Order	Family	Genus	Species
Acipenseriformes	Acipenseridae	Acipenser	White sturgeon
Cyprinodontiformes	Poeciliidae	Gambusia	Mosquitofish
Perciformes	Centrarchidae	Lepomis	Sunfish
Perciformes	Centrarchidae	Micropterus	Bass
Scorpaeniformes	Cottidae	Cottus	Sculpin
Cypriniformes	Catostomidae	Catostomus	Sucker
Cypriniformes	Cyprinidae	Pimephales	Minnow
Esociformes	Esocidae	Esox	Northern Pike
Salmoniformes	Salmonidae	Oncorhynchus	Cutthroat trout, rainbow trout, salmon
Salmoniformes	Salmonidae	Salmo	Brown trout
Salmoniformes	Salmonidae	Savelinus	Brook trout, bull trout, lake trout
Salmoniformes	Salmonidae	Coregonus	Lake whitefish
Salmoniformes	Salmonidae	Prosopium	Whitefish

2. Does a species in the family occur at the site?

If "No", go to step 3.

If "Yes", are there one or more genera in the family that occur at the site but are not in the national toxicity dataset?

If "No", delete the uncircled species.*

If "Yes", retain the uncircled species.*

Order	Family	Genus	Species
Acipenseriformes	Acipenseridae	Acipenser	White sturgeon
Cyprinodontiformes	Poeciliidae	Gambusia	Mosquitofish
Perciformes	Centrarchidae	Lepomis	Sunfish
Perciformes	Centrarchidae	Micropterus	Bass
Scorpaeniformes	Cottidae	Cottus	Sculpin
Cypriniformes	Catostomidae	Catostomus	Sucker
Cypriniformes	Cyprinidae	Pimephales	Minnow
Esociformes	Esocidae	Esox	Northern Pike
Salmoniformes	Salmonidae	Oncorhynchus	Cutthroat trout, rainbow trout, salmon
Salmoniformes	Salmonidae	Salmo	Brown trout
Salmoniformes	Salmonidae	Savelinus	Brook trout, bull trout, lake trout
Salmoniformes	Salmonidae	Coregonus	Lake whitefish
Salmoniformes	Salmonidae	Prosopium	Whitefish

3. Does a species in the order occur at the site?

If "No" go to step 4.

If "Yes", are there one or more families in the order that occur at the site but are not in the national toxicity dataset?

If "No", delete the uncircled species.*

If "Yes", retain the uncircled species.*

Order	Family	Genus	Species
Acipenseriformes	Acipenseridae	Acipenser	White sturgeon
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Salmoniformes	Salmonidae	Savelinus	Brook trout, bull trout, lake trout
Salmoniformes	Salmonidae	Coregonus	Lake whitefish
Salmoniformes	Salmonidae	Prosopium	Whitefish

4. Does a species in the class occur at the site?

If **No**, go to step 5.

If "Yes", are there one or more orders in the class that occur at the site but are not in the national toxicity dataset?

If "No", delete the uncircled species.*

If "Yes", retain the uncircled species.*

Class	Order	Family	Genus	Species
Chondrostei	Acipenseriformes	Acipenseridae	Acipenser	White Sturgeon
Teleostei	Cyprinodontiformes	Poeciliidae	Gambusia	Mosquitofish
Teleostei	Perciformes	Centrarchidae	Lepomis	Sunfish
Teleostei	Perciformes	Centrarchidae	Micropterus	Bass
Teleostei	Scorpaeniformes	Cottidae	Cottus	Sculpin
Teleostei	Cypriniformes	Catostomidae	Catostomus	Sucker
Teleostei	Cypriniformes	Cyprinidae	Pimephales	Minnow
Teleostei	Esociformes	Esocidae	Esox	Northern Pike
Teleostei	Salmoniformes	Salmonidae	Oncorhynchus	Cutthroat trout, rainbow trout, salmon
Teleostei	Salmoniformes	Salmonidae	Salmo	Brown trout
Teleostei	Salmoniformes	Salmonidae	Savelinus	Brook trout, bull trout, lake trout
Teleostei	Salmoniformes	Salmonidae	Coregonus	Lake whitefish
Teleostei	Salmoniformes	Salmonidae	Prosopium	Whitefish

5. Does a species in the phylum occur at the site?

If “No”, delete the uncircled species.*

If “Yes”, are there one or more classes in the phylum that occur at the site but are not in the national toxicity dataset?

If “No”, delete the uncircled species.*

If “Yes”, retain the uncircled species.*

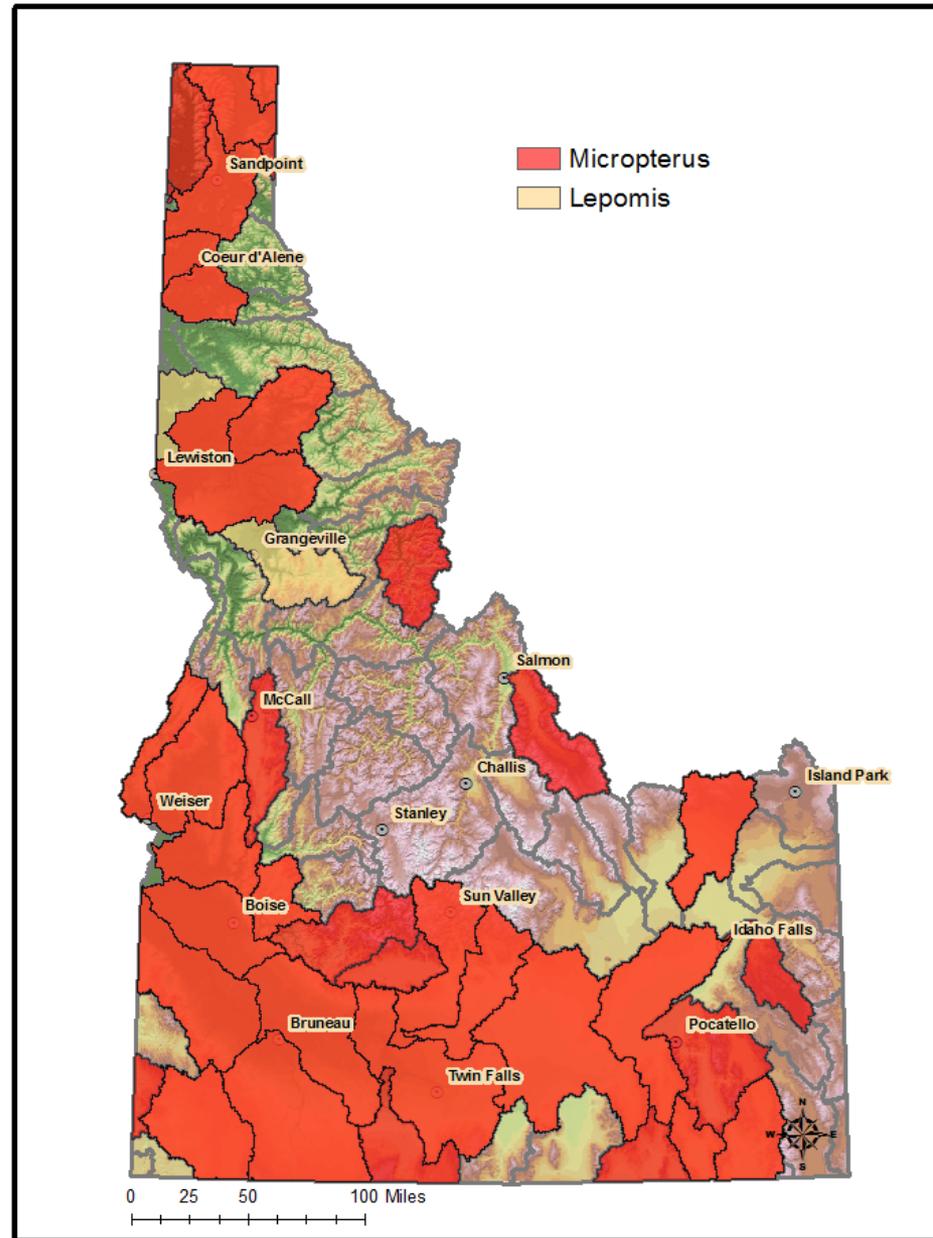
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Chondrostei	Acipenseriformes	Acipenseridae	Acipenser	White Sturgeon
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Teleostei	Perciformes	Centrarchidae	Micropterus	Bass
Teleostei	Scorpaeniformes	Cottidae	Cottus	Sculpin
Teleostei	Cypriniformes	Catostomidae	Catostomus	Sucker
Teleostei	Cypriniformes	Cyprinidae	Pimephales	Minnow
Teleostei	Esociformes	Esocidae	Esox	Northern Pike
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Teleostei	Salmoniformes	Salmonidae	Prosopium	Whitefish

Why Acipenser and not Lepomis or Micropterus? (EPA)

- Both genera are pervasive in Idaho

**Lepomis or Micropterus protection would additionally include upstream water and surrogacy considerations.*

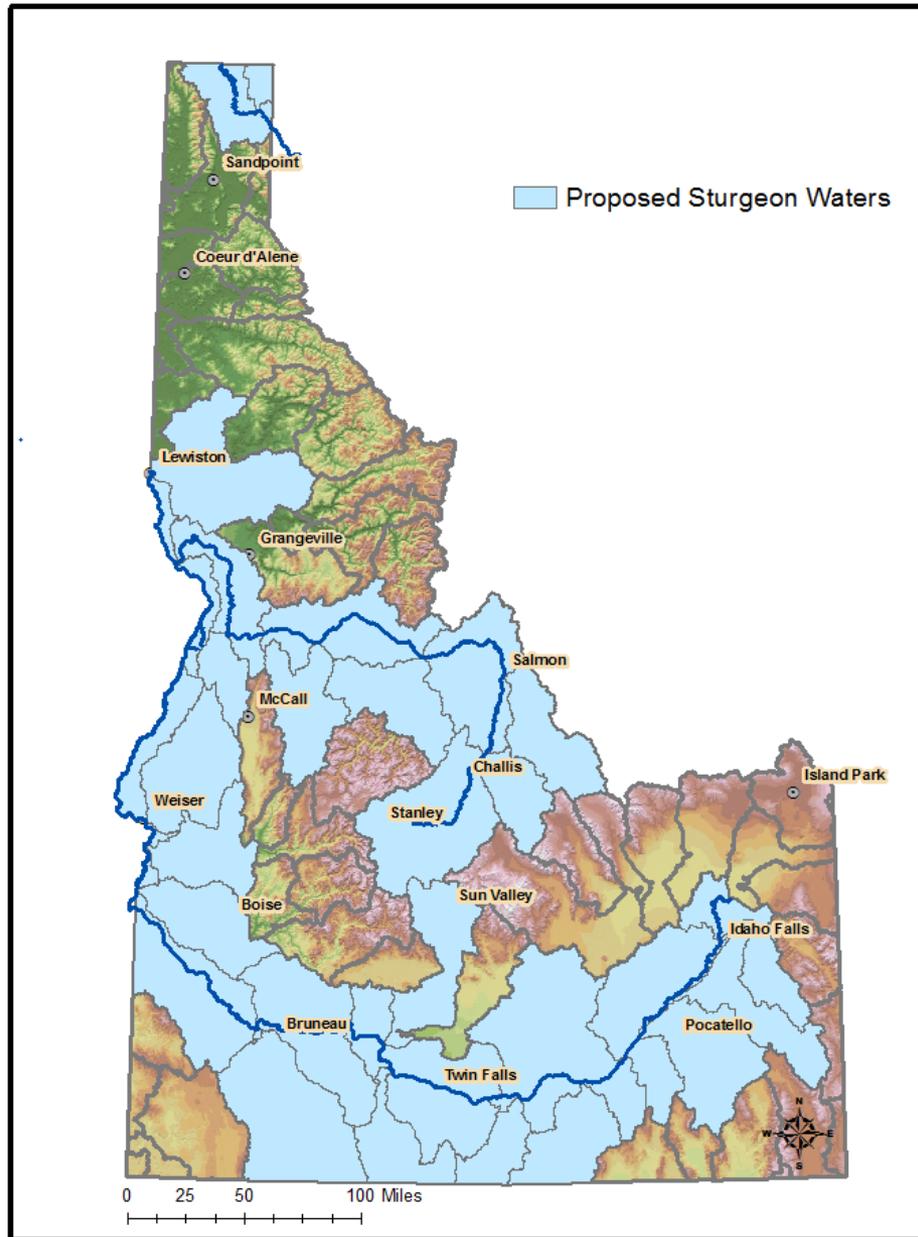
Occurrence of Select Fish Genera



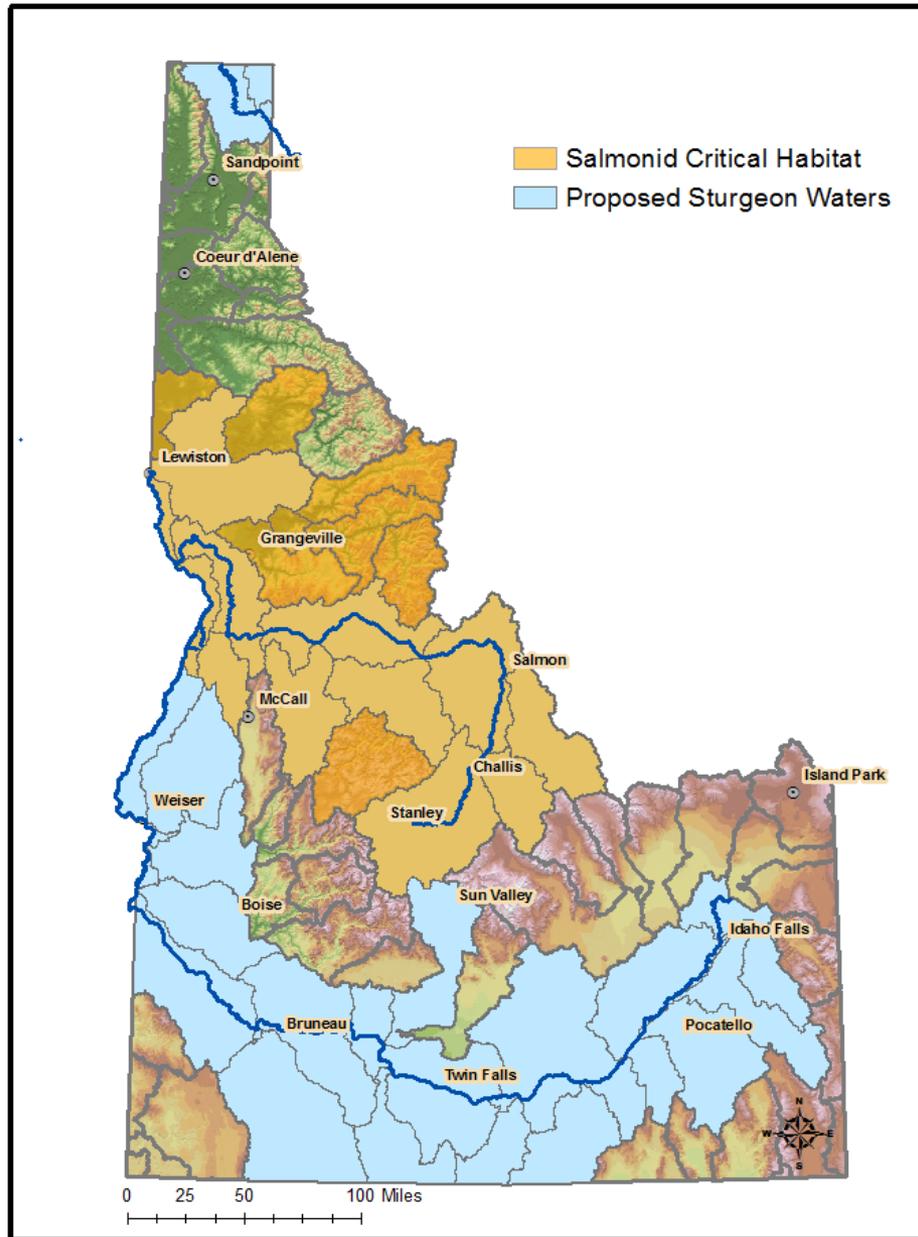
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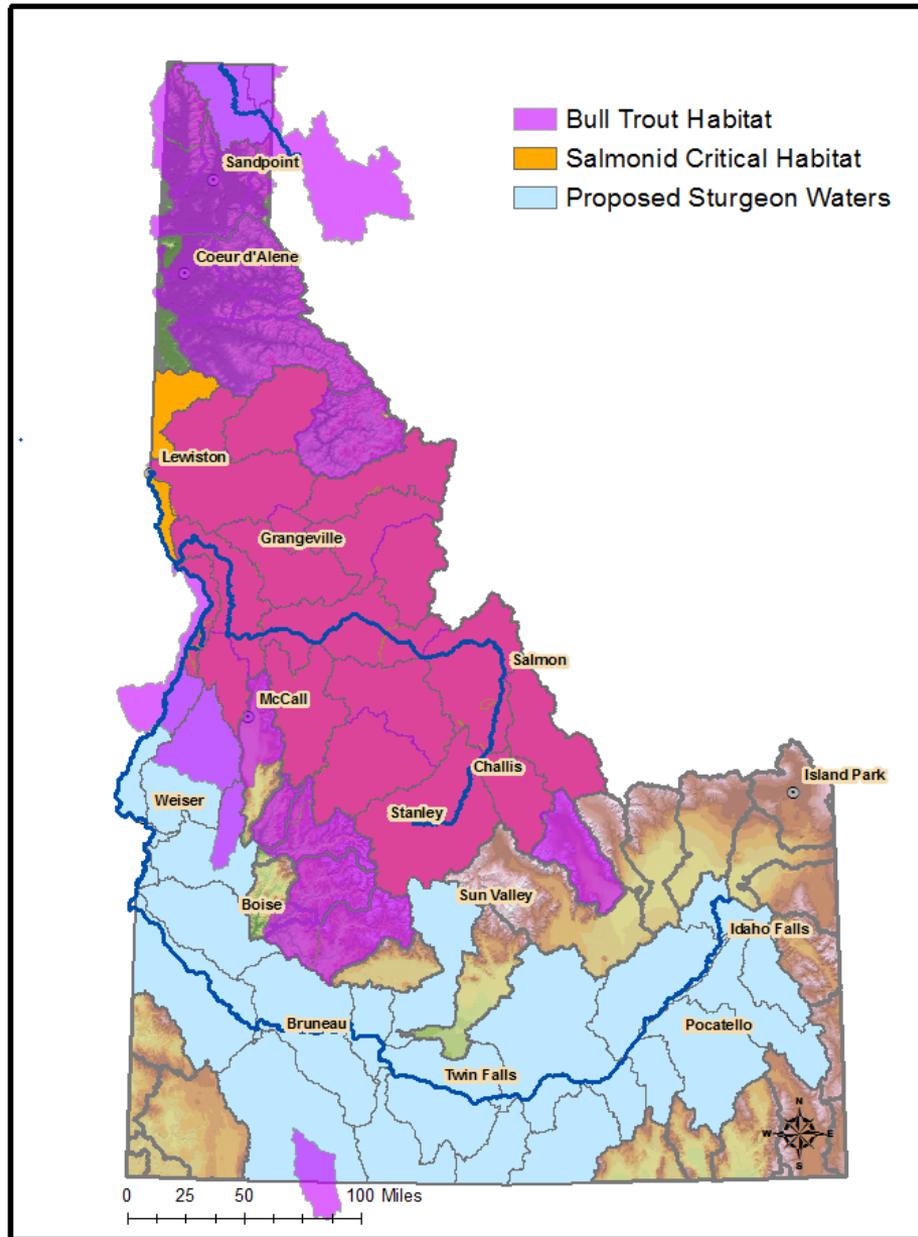
Proposed Sturgeon Waters - DRAFT



Proposed Sturgeon Waters - DRAFT



Proposed Sturgeon Waters - DRAFT



Bull trout sensitivity

Eight most sensitive genera used in EPA criterion

Genus	Rank	Egg-Ovary
Acipenser	1	15.6
Lepomis	2	20.6
Salmo	3	21
Oncorhynchus	4	25.3
Micropterus	5	26.3
Cyprinodon	6	27
Esox	7	34
Salvelinus	8	56.2

Genus	Rank	Whole Body
Acipenser	1	9.2
Lepomis	2	9.9
Oncorhynchus	3	11.6
Salmo	4	13.2
Esox	5	14.2
Micropterus	6	18.5
Cyprinodon	7	22.6
Salvelinus	8	34.9

Genus	Rank	Muscle
Acipenser	1	11.9
Oncorhynchus	2	14.3
Lepomis	3	15.9
Salmo	4	18.5
Esox	5	21.7
Micropterus	6	22.2
Cyprinodon	7	28.7
Salvelinus	8	44.5

*Fish tissue concentration units (mg/kg dw)

Next Steps

- Comments due: 6/23/2017
- 3rd meeting: 7/25/2017 (Final)
 - Comments due: 8/1/2017
- September Bulletin: 9/6/2017
 - Deadline for Rule Publication: 8/4/2017
- BiOP RPA: Criterion by 5/7/2018

Questions

