

Occupancy, Detection, and Habitat Use of Larval Pacific Lamprey *Entosphenus* *tridentatus* and *Lampetra* spp. in Large River Habitats of the Columbia River Basin

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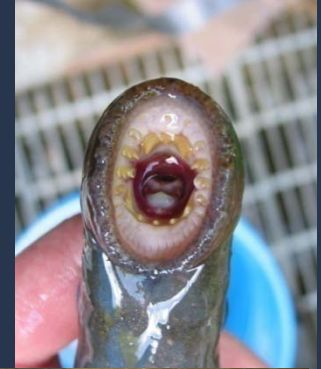


Thanks to

- **Columbia River Fisheries Program Office staff**
- **M. Satter, B. Davis, K. Allbritton, K. Steinke, H. Schaller, A. Baptista**
- **M. Fodale and D. Kochanski – Marquette Biological Station**
- **J. Buck – USFWS - OR**
- **City of Portland**

Lamprey

- One of least-derived fish (Agnathans)
- Sucker-like mouth, eel-like body
- No scales, bones
- About 50 species
 - Parasitic and Non-parasitic
 - Anadromous and Resident
- Native to Pacific Northwest
 - Pacific Lamprey
 - Western Brook Lamprey
 - River Lamprey
 - paired species with WBL

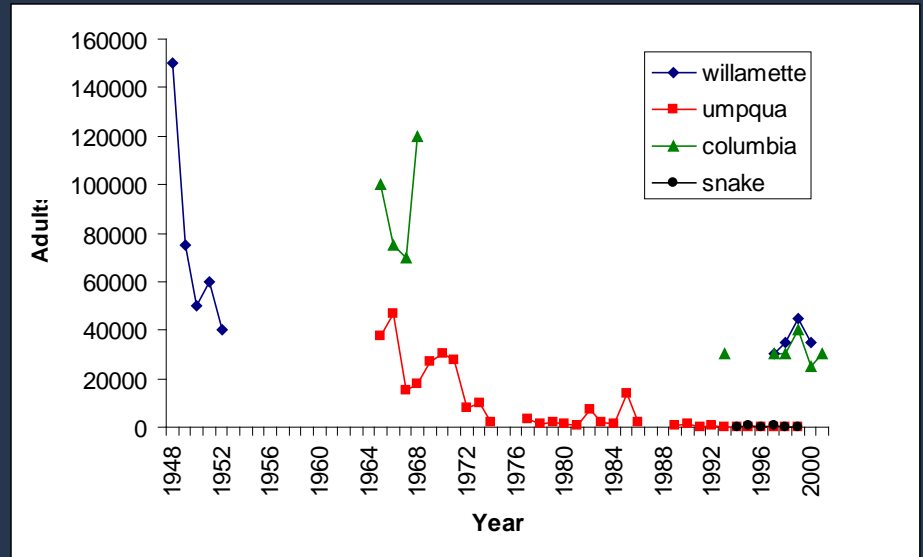


Conservation Concern

Pacific lamprey

Declining trends

Petitioned for listing



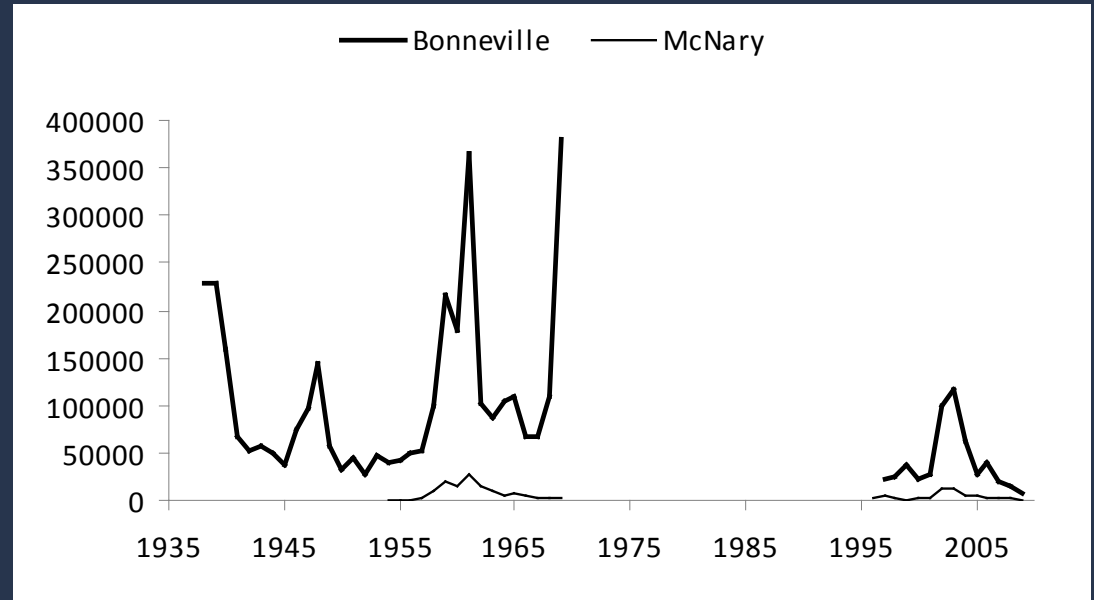
Western Brook Lamprey

Largely unknown

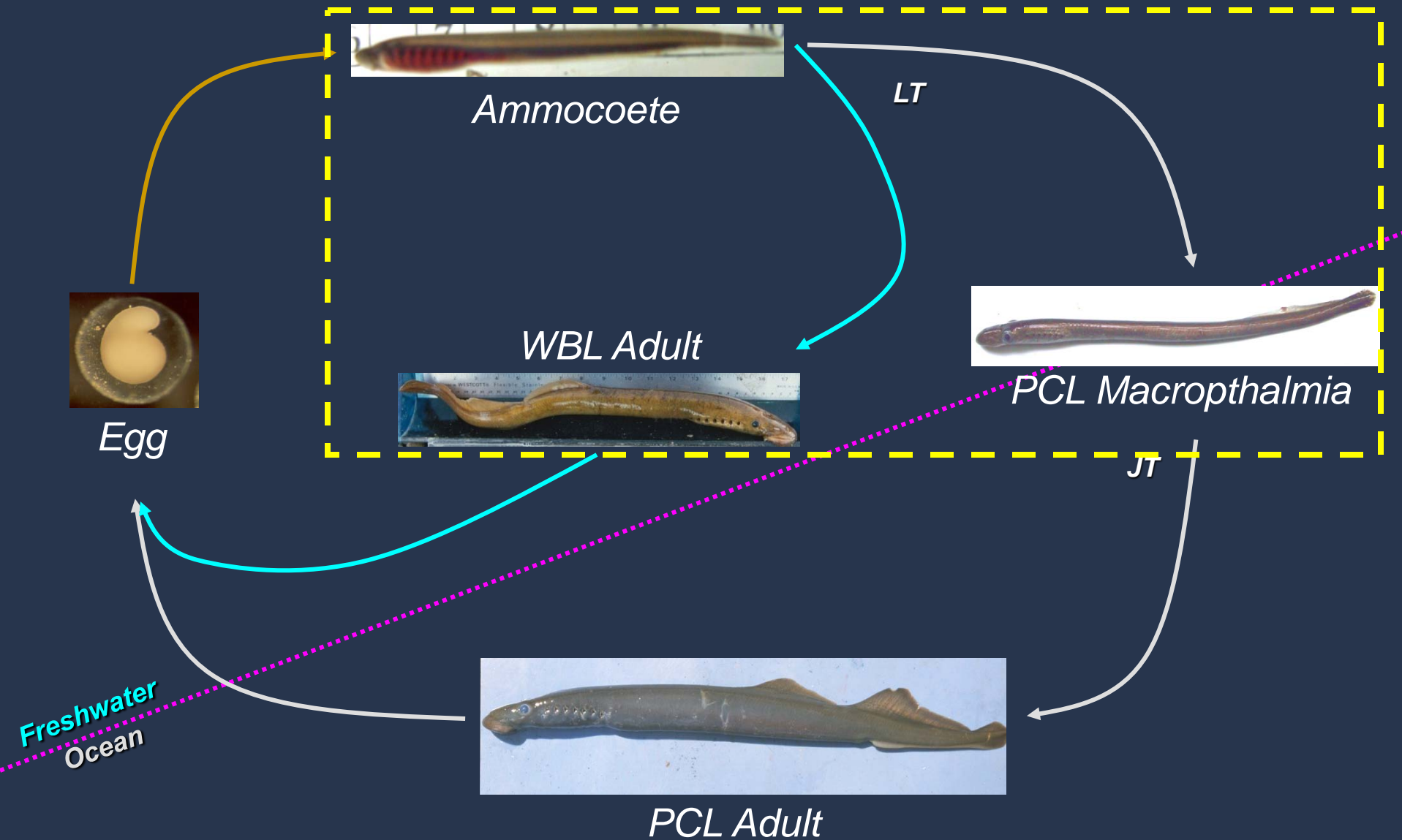
Conservation Status

Petitioned for ESA listing in 2003

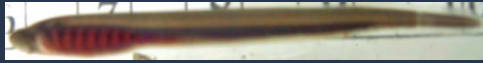
Denied for ESA listing in 2004



General Life History



Specific Life History: Larval Phase



Ammocoete

- Spawn in spring
- Small, 1st-3rd order tributaries
- Incubate approximately 3 weeks
- Emerge, drift to nearest 'mud/silt' substrate
- Burrow
- Blind, filter feeders
- Rear in FW 3-7 years

LT



PCL Macrophthalmia



WBL Adult

Mainstem Use

- Passive movement downstream
- Active movement downstream (“browns” vs “silvers”)
- Anecdotal observations
 - Parasitizing migratory fish
 - At hydropower projects
 - As prey of avian predators
- Generally believed to be
 - migrating through as macropthalmia or
 - lost to the population



Unknowns

- Little known downstream of Bonneville Dam
- Unclear if larval lamprey rear in mainstem areas
- Very challenging to sample large rivers in a quantitative manner

Project Goal

- Document presence or absence of larval lamprey throughout the mainstem of the Lower Willamette River and Columbia River



Objectives - 2009

- 1) Qualitatively explore whether larval lamprey occupy the Lower Willamette River
- 2) Determine the probability of detecting larval lampreys in the Lower Willamette River with a deepwater electrofisher
- 3) Determine the probability of detecting larval lamprey in an occupied 30x30 m quadrat with a deepwater electrofisher
- 4) Evaluate the size distribution of larval lampreys in the Lower Willamette River
- 5) Evaluate the species composition of larval lampreys in the Lower Willamette River

Methods 2009: Deepwater electrofishing

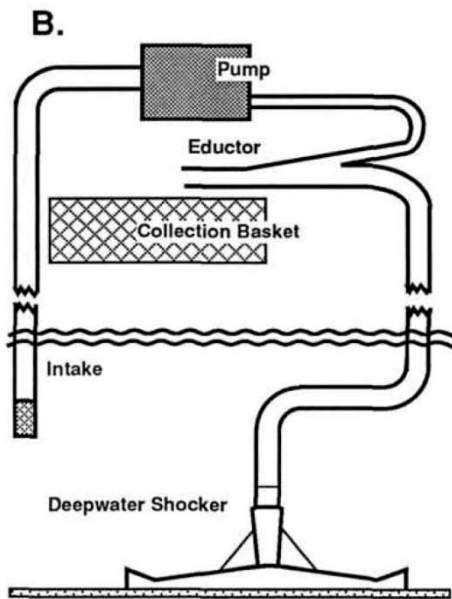
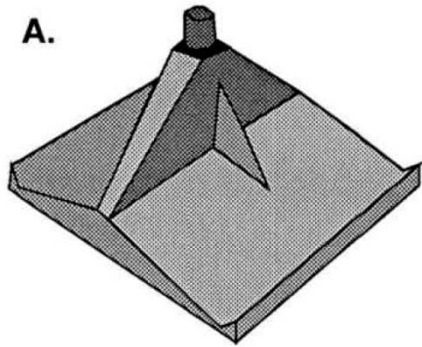


FIGURE 1.—(A) Deepwater electrofishing device for driving sea lamprey larvae from the bottom and (B) the pumping system used to move them to the surface for collection.



- sample area = 0.61 m²
- 3 pps DC, 10% duty cycle
- 2:2 pulse train
- Peak output 0.6 - 0.8 V/cm
- Continuous suction



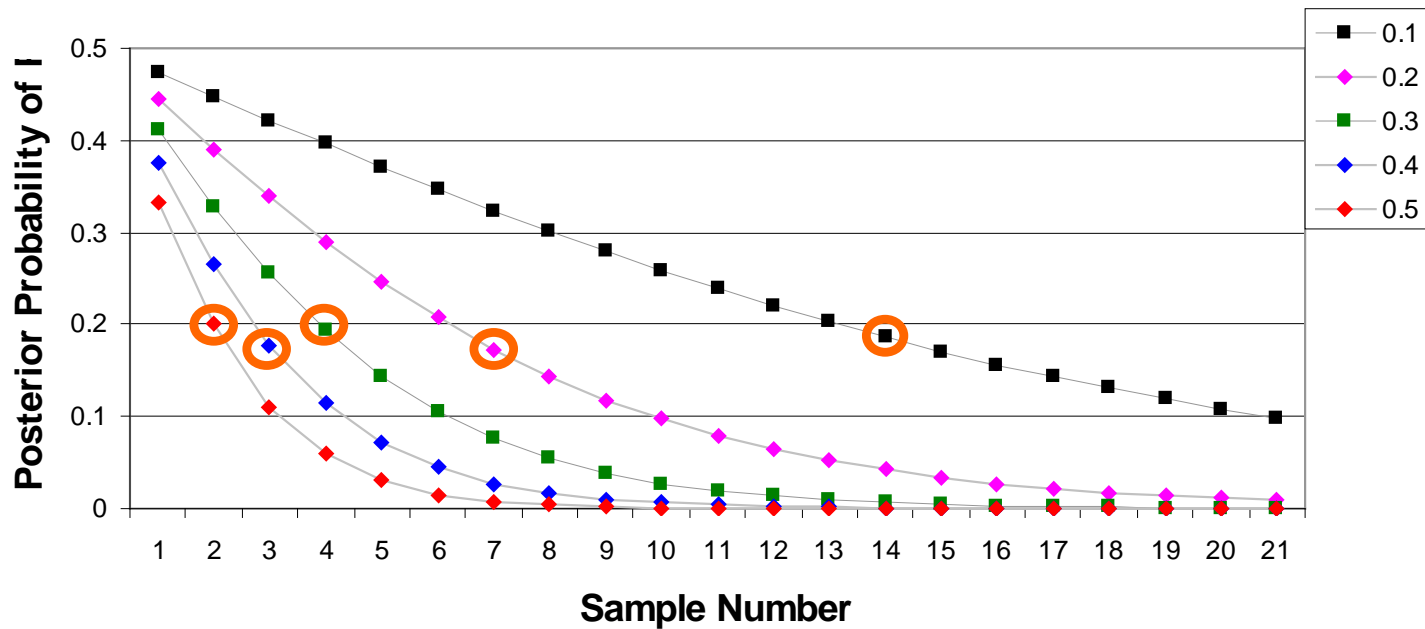
Probability of Detection – The Problem

		Actual	
		Present	Absent
Sample	Present	Correct	Non-Sensical
	Absent	Error 'False Absence'	Correct

Probability of Detection - Model

EFISH

Estimating the probability of presence
if no fish are detected during sampling
prior P of presence = 0.50



Methods: 2009

- Sample framework
 - define sample area

Downstream

Multnomah Channel



Mainstem Willamette river

City of Portland (OR)

Ross Island

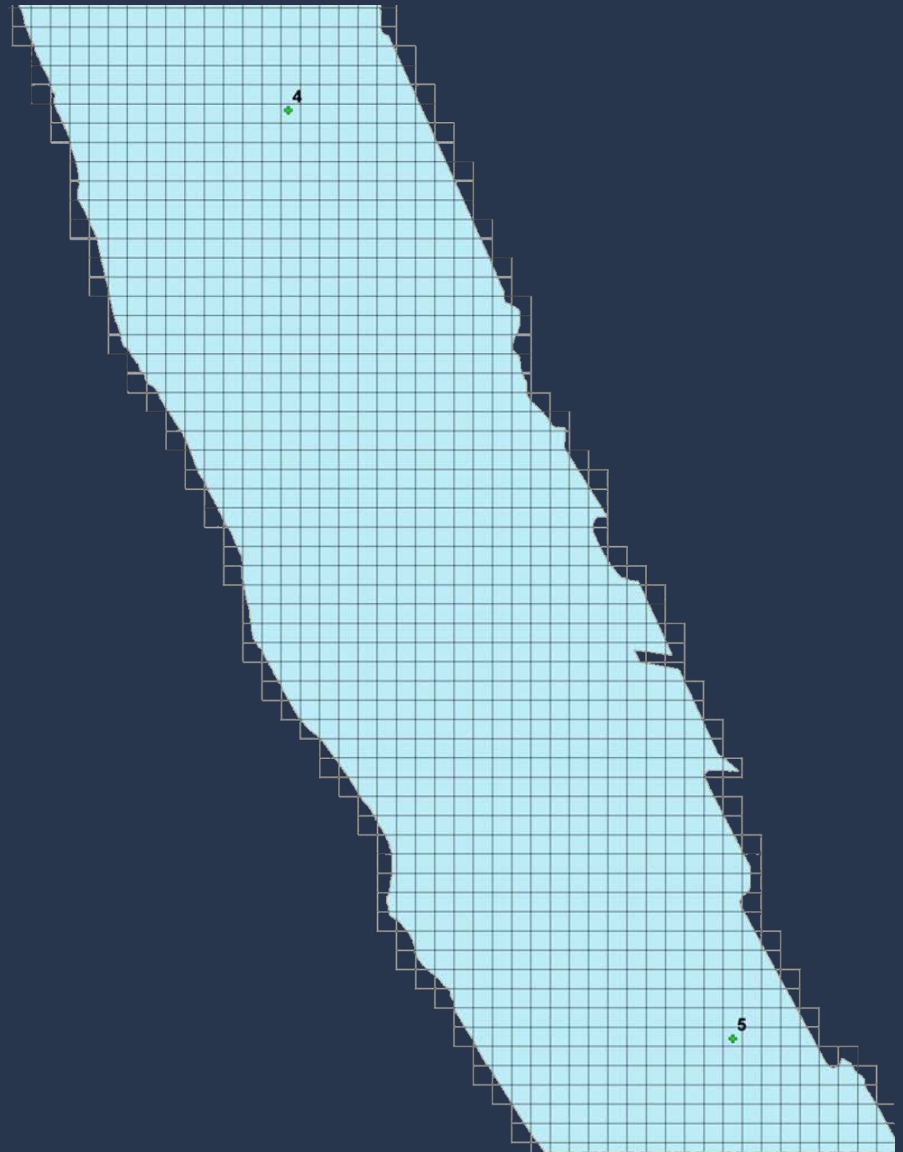


Willamette Falls

Upstream

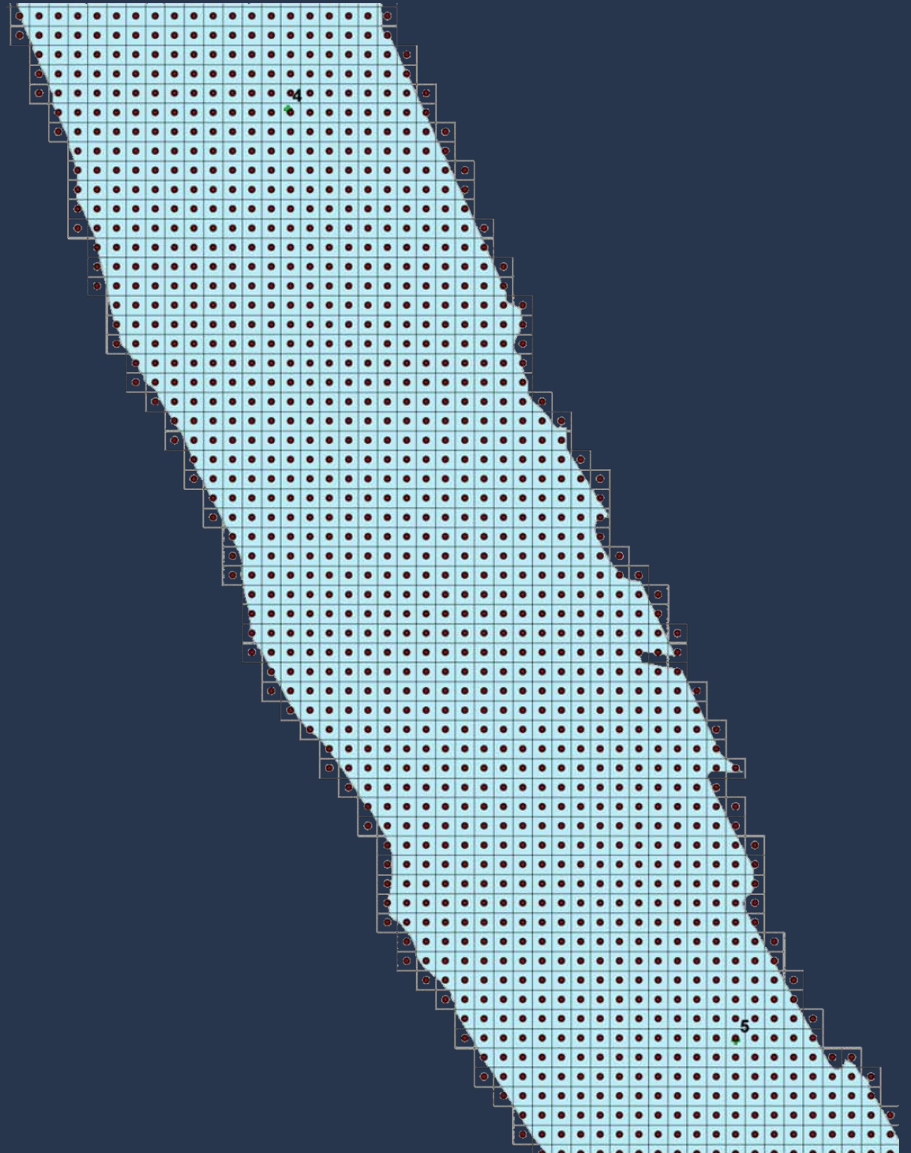
Methods: 2009

- Sample framework
 - define sample area
 - 30 x 30 m quadrats



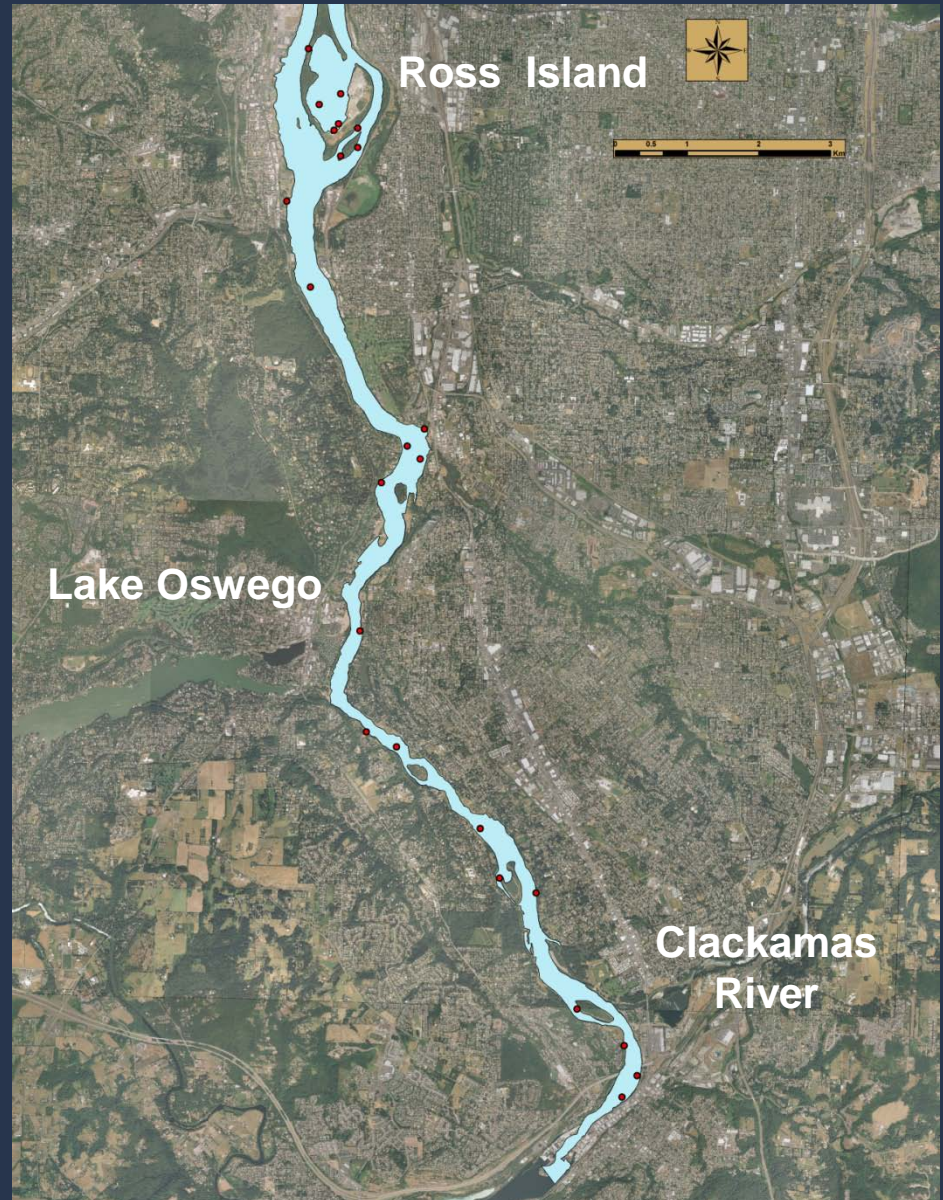
Methods: 2009

- Sample framework
 - define sample area
 - 30 x 30 m quadrats
 - UTM center points



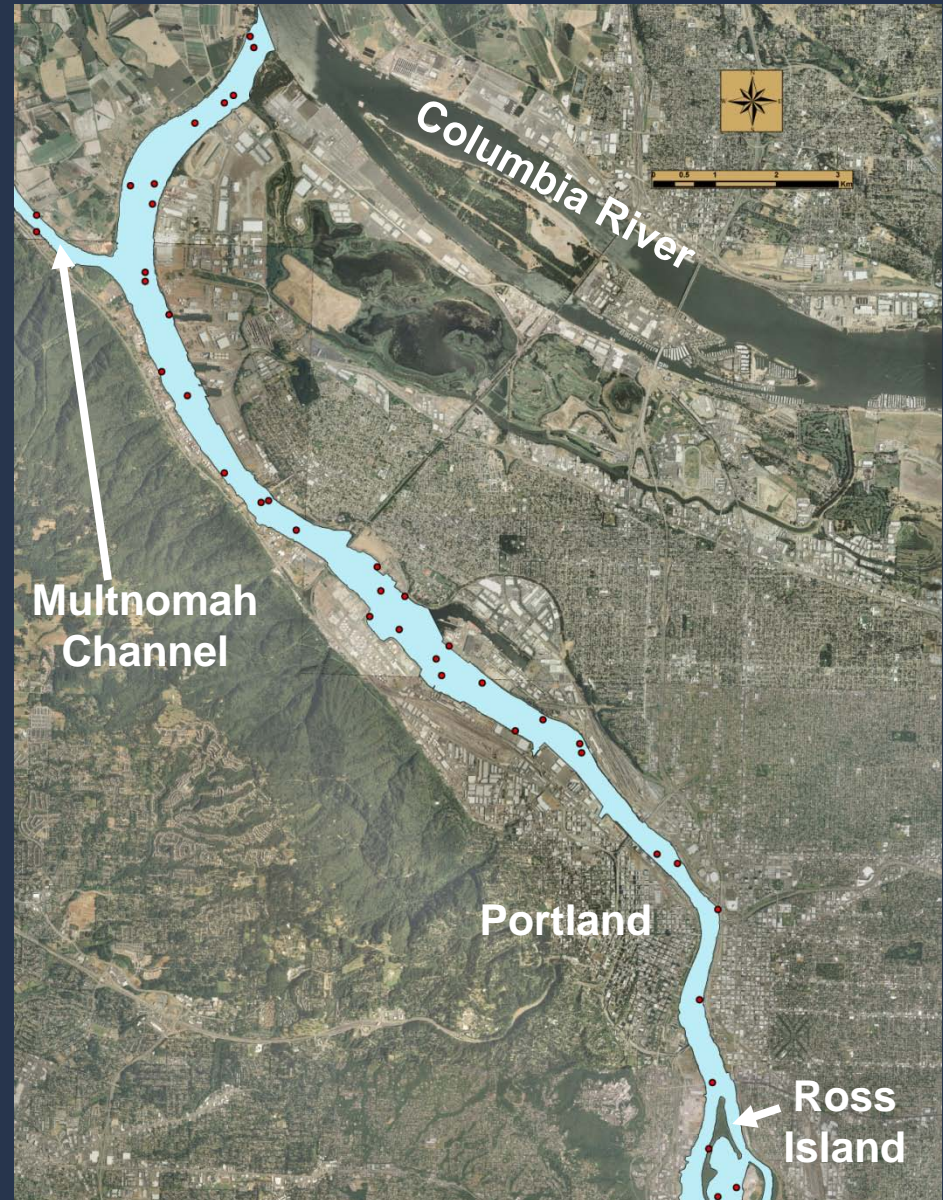
Methods: 2009

- Sample framework
 - define sample area
 - 30 x 30 m quadrats
 - UTM center points
 - GRTS approach
 - random
 - spatial balance
 - ordered



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Methods: 2009

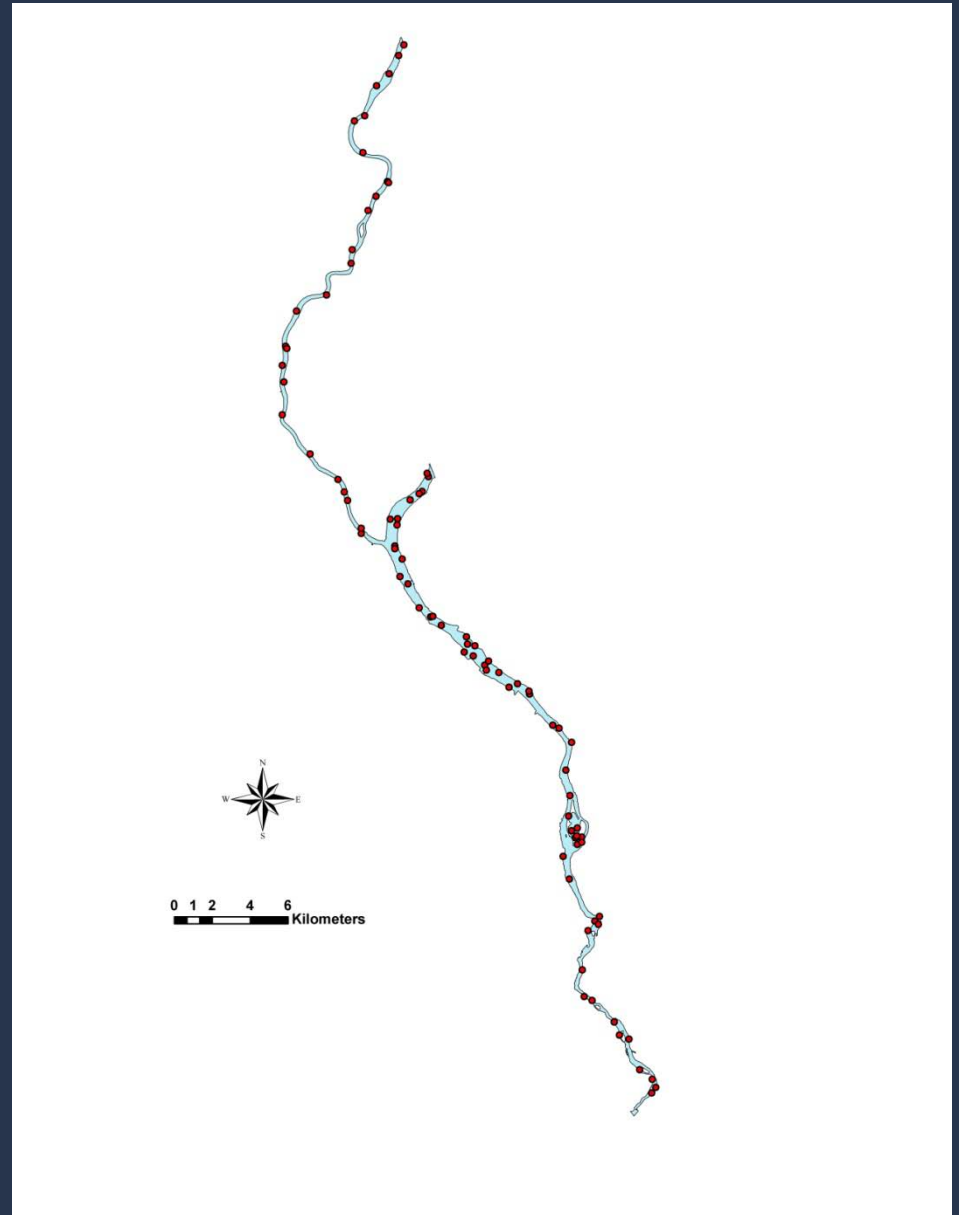
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Methods: 2009 Quadrats

Quadrats

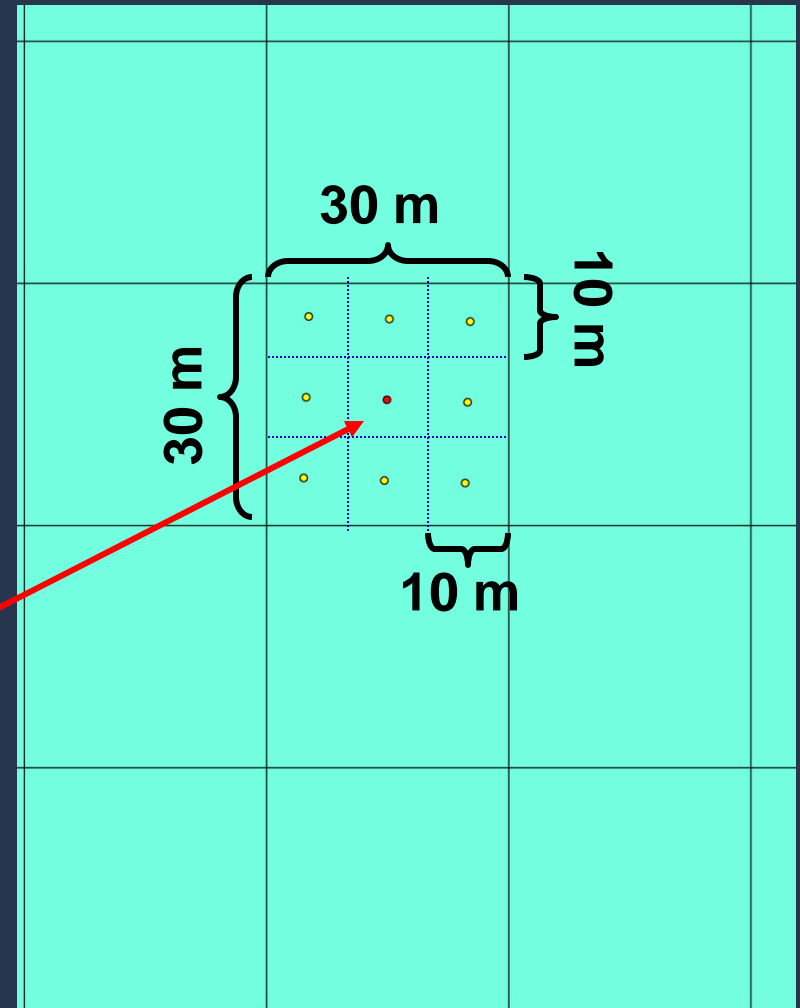
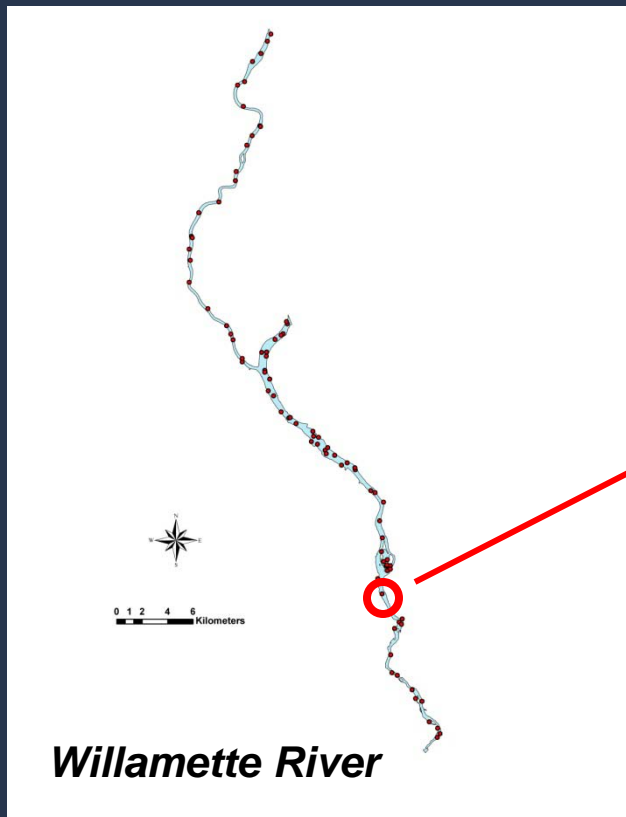
- 262 total quadrats
- 208 'viable' quadrats (79%)
- ordered by priority

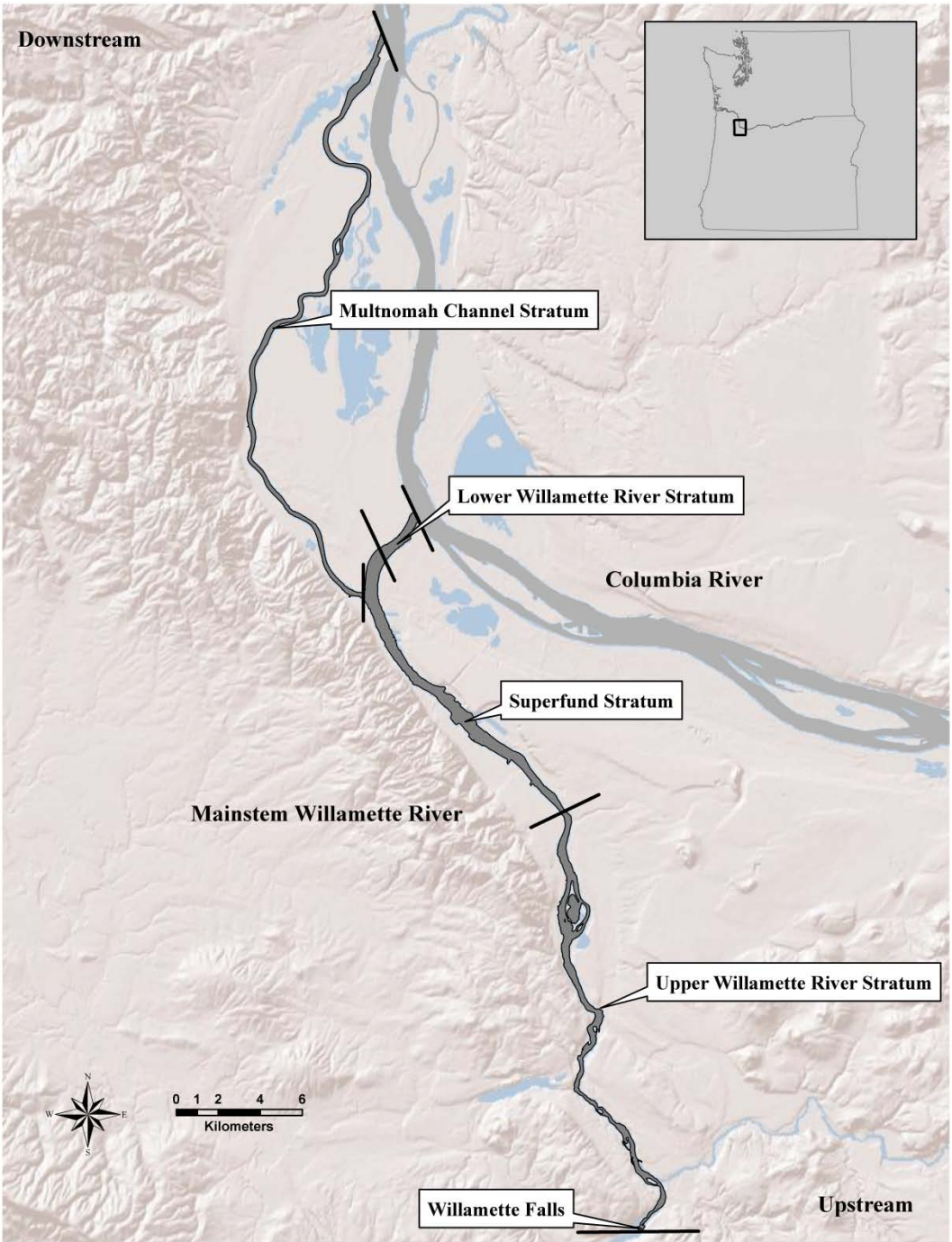


Methods: 2009 Subquadrats

Subquadrats

- associated with an occupied quadrat
- 10m x 10m
- 1 (original) + 8 (additional)





Findings – 2009 Quadrats

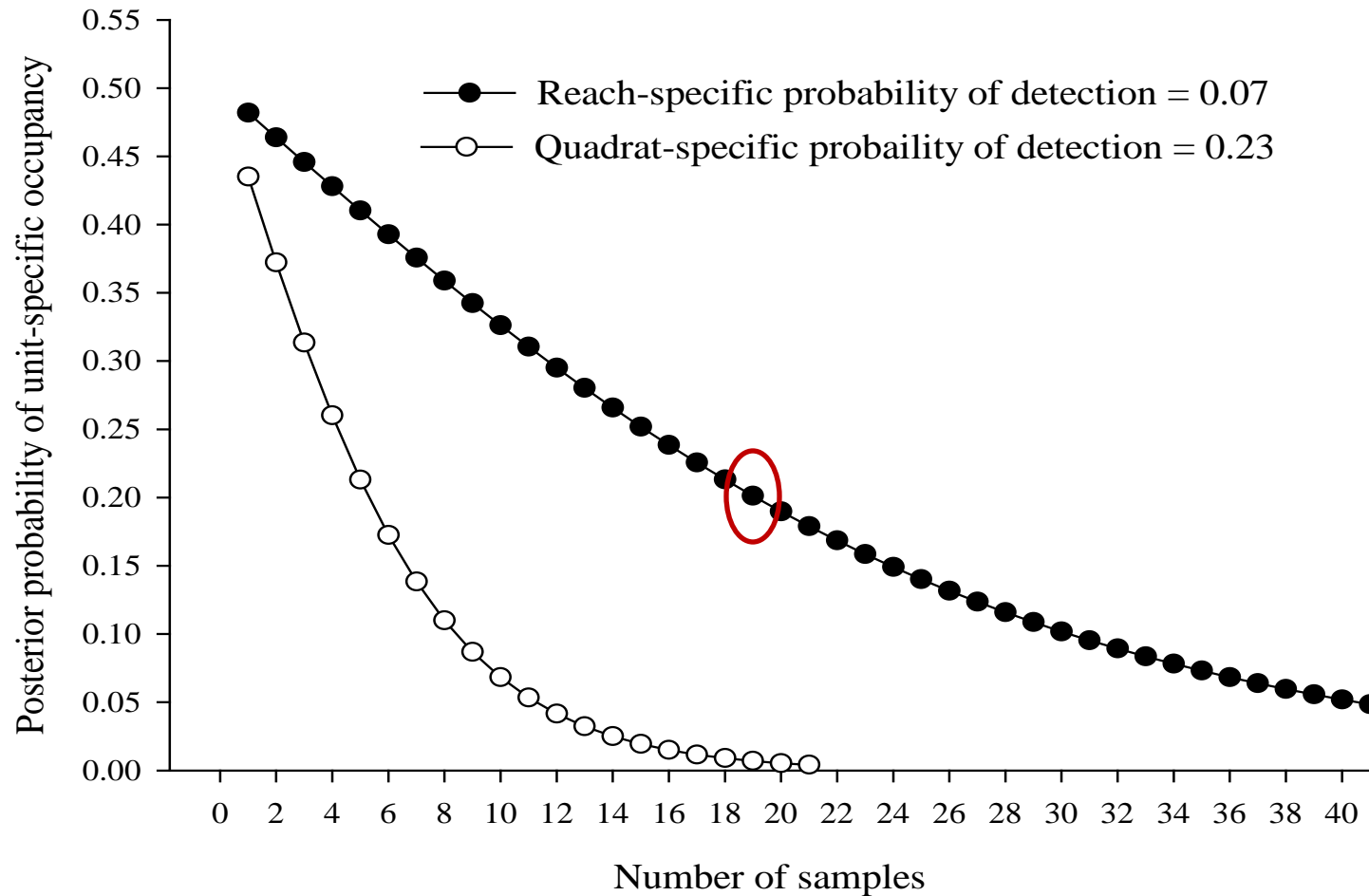
- 31,306 quadrats
- 208 quadrats were sampled from the mouth of the Willamette (including the entire length of the Multnomah Channel) to upstream of the Clackamas River and from the edge of the river to mid-channel
- Larval lamprey were detected in 11 of 208 quadrats
- Overall site-specific probability of detection was 0.075 (**SE ± 0.07**)



Findings – 2009 Quadrats

Month	Area	Quads sampled	Quads where detected	Detection probability	Lamprey detected		
					PCL	<i>Lam</i>	UID
Mar	Willamette R.	37	3	0.08	3	0	1
	Multnomah Ch.	19**	0	0.00	0	0	0
Jun	Upstream	24	3	0.13	2	2	0
	Superfund	21	1	0.05	0	1	0
	Downstream	21	0	0.00	0	0	0
	Multnomah Ch.	22**	0	0.00	0	0	0
Oct	Upstream	0	-	-	-	-	-
	Superfund	0	-	-	-	-	-
	Downstream	21	1	0.05	0	1	0
	DS (>13.7 m)	21	2	0.10	0	2	0
	Multnomah Ch.	21**	0	0.00	0	0	0
Totals		207**	10	0.07	5	7	1

Probability of Detection - Reach



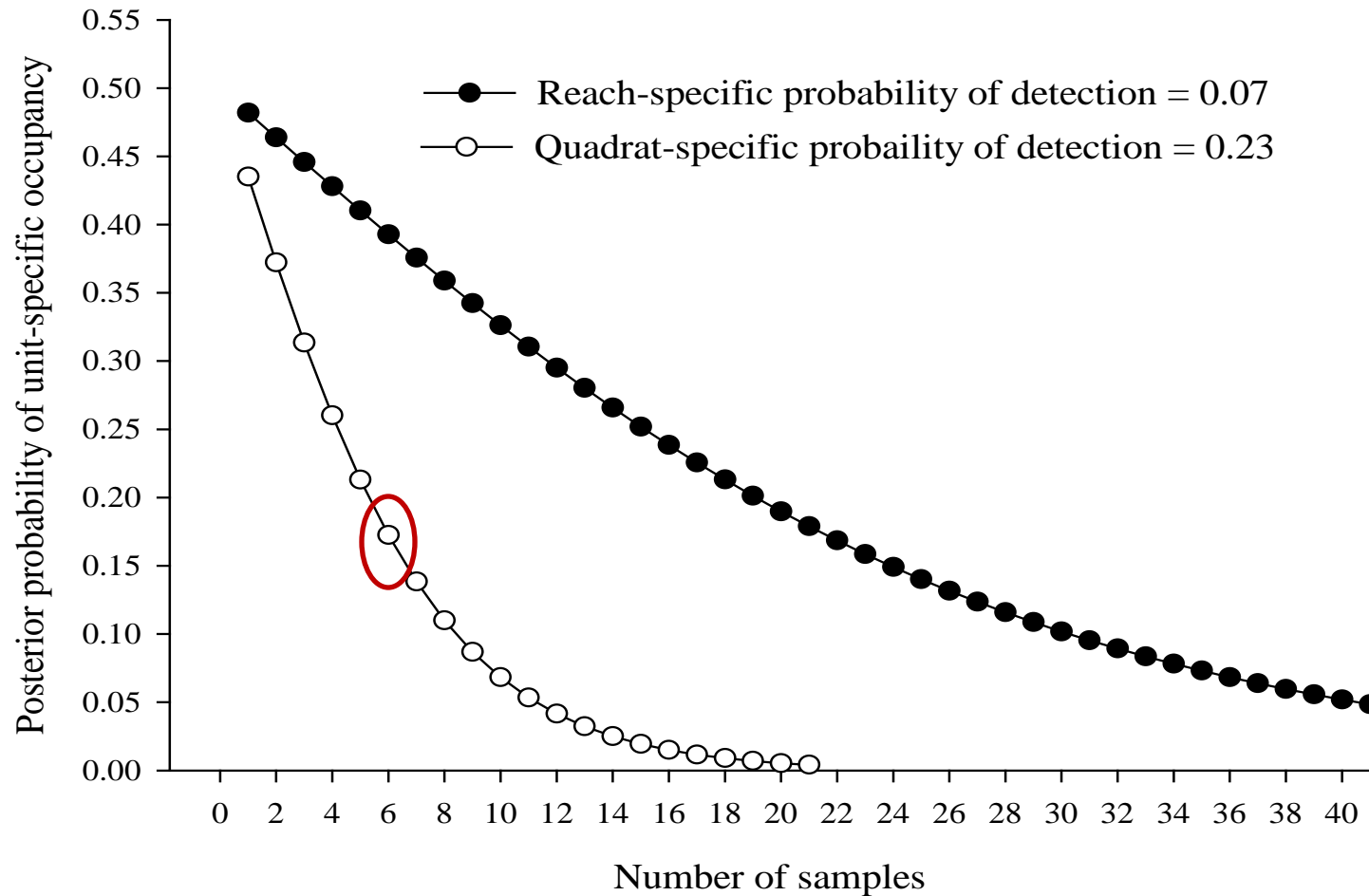
Findings – 2009 Subquadrats

Month	Subquads sampled	Subquads detected	<u>Lamprey detected</u>		
			Pacific	<i>Lampetra</i> spp.	Unid
March	33	8	5	13	0
July	27	5	3	3	5
Oct/Nov	27	6	0	6	2
Totals	87	19	8	22	7

- Detected in 19 of 87 subquads
- Always found lamprey at previously detected locations
- Average site-specific probability of detection was 0.23 (SE \pm 0.07)



Probability of Detection - Quadrat





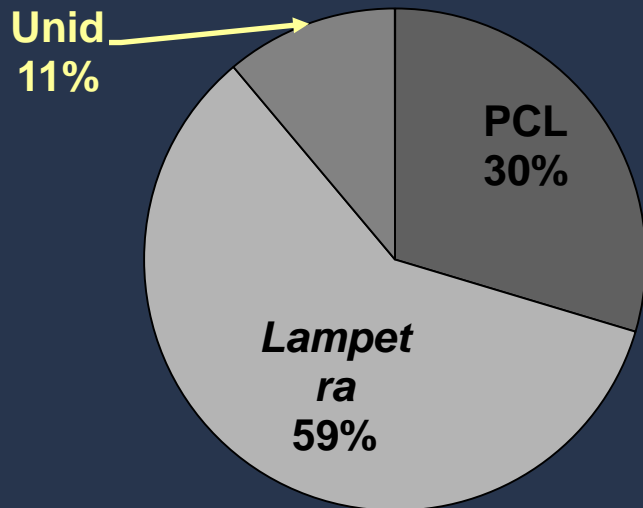
M. Koski FWS

Depth

Depth	Quadrats sampled	Quadrats occupied	Proportion occupied
< 5 m	80	6	0.08
5-10 m	64	1	0.02
> 5 m	64	5	0.08

Species

Species composition



- 54 identified and measured
- 16 PCL
- 32 *Lampetra*
- 1 adult WBL
- 6 unidentified

Total length

- Overall mean TL = 69 mm (SE \pm 4)

- PCL mean TL = 80 mm (SE \pm 4)

- WBL TL = 70 mm (SE \pm 5)

- Lengths similar

Age

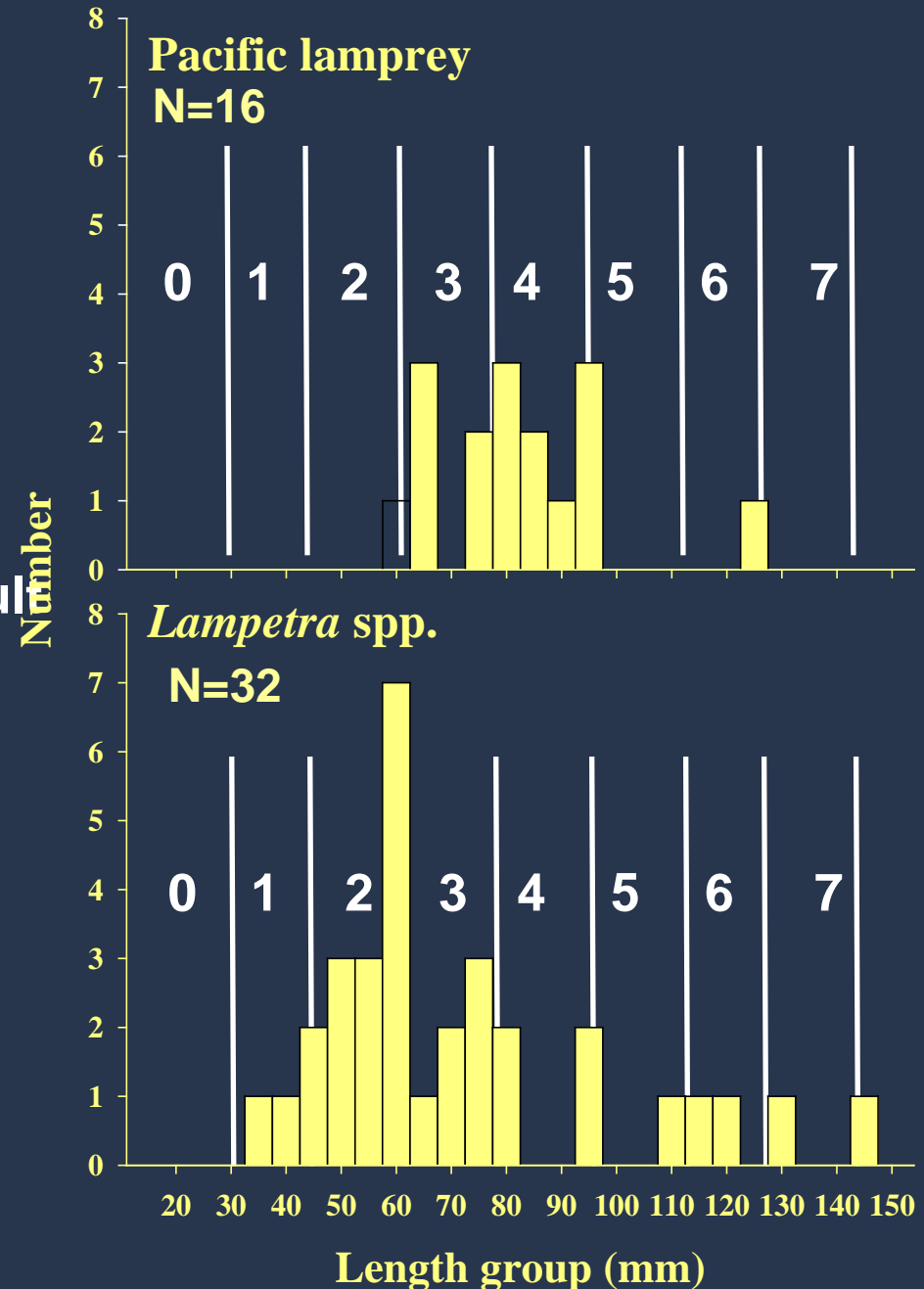
- Length to age interpretations difficult

- PCL likely 2 through at least 6

- WBL likely 1 through 7

- Presence of unidentifiable lamprey (TL < 20 mm) likely age 0

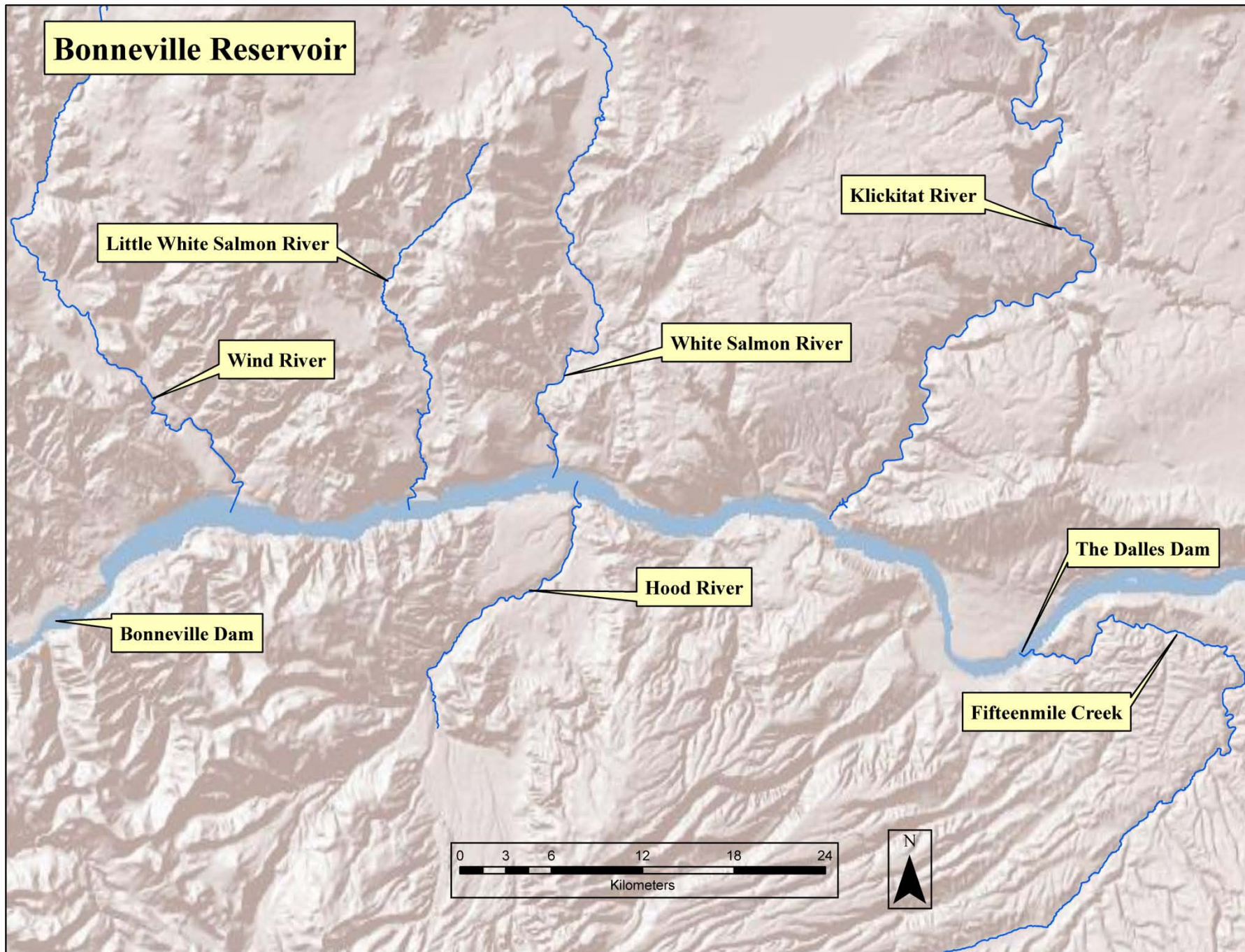
(Meeuwig and Bayer 2005)

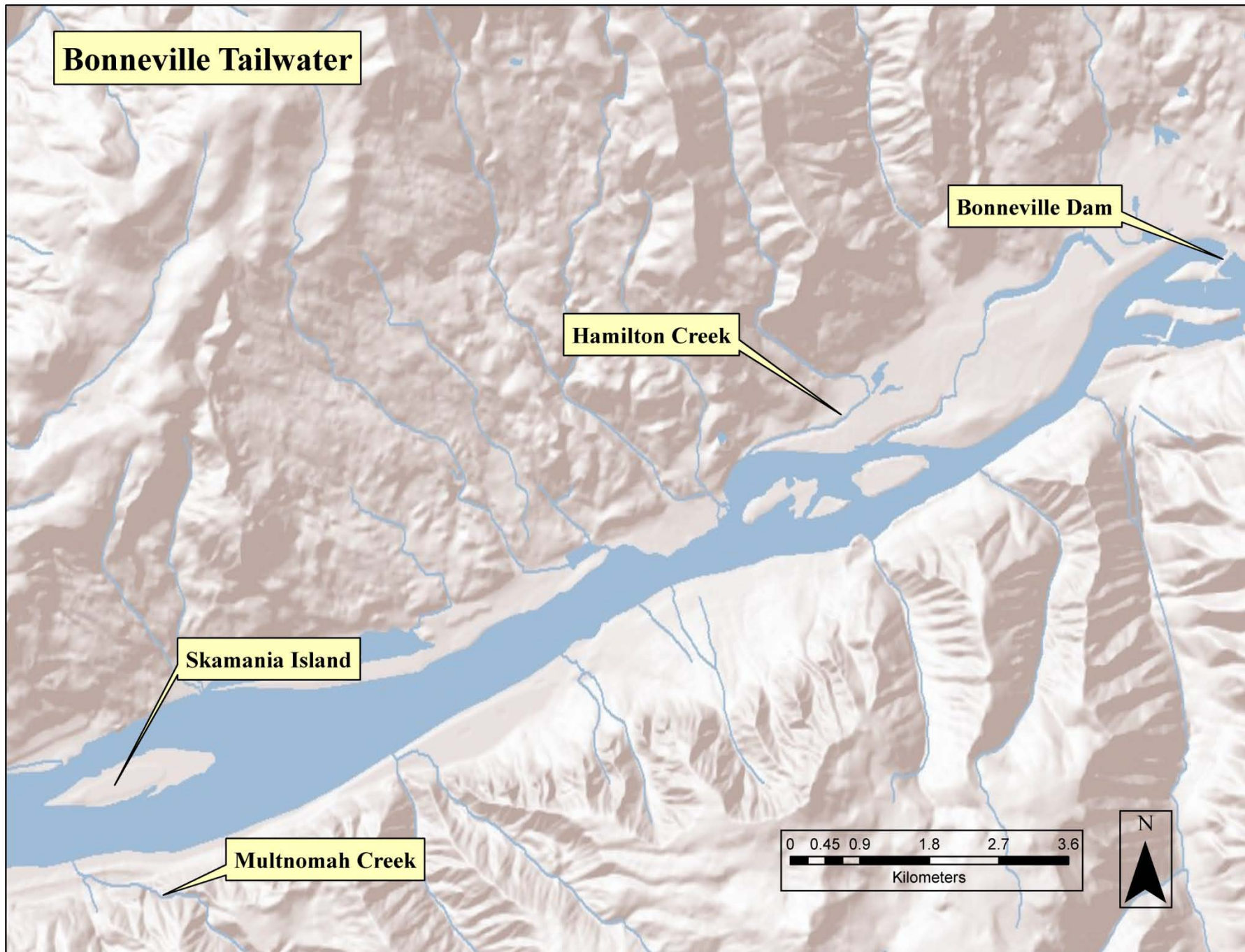


Objectives – 2010+ (ongoing)

- 1) Qualitatively explore whether larval lamprey occupy the Bonneville Reservoir and Bonneville Dam tailwater
 - Reach specific DPs
 - River mouth “aggregations”
 - Compare DP
- 2) Qualitatively explore larval lamprey occupy different “salinity zones” in the Lower Columbia River







Bonneville Tailwater

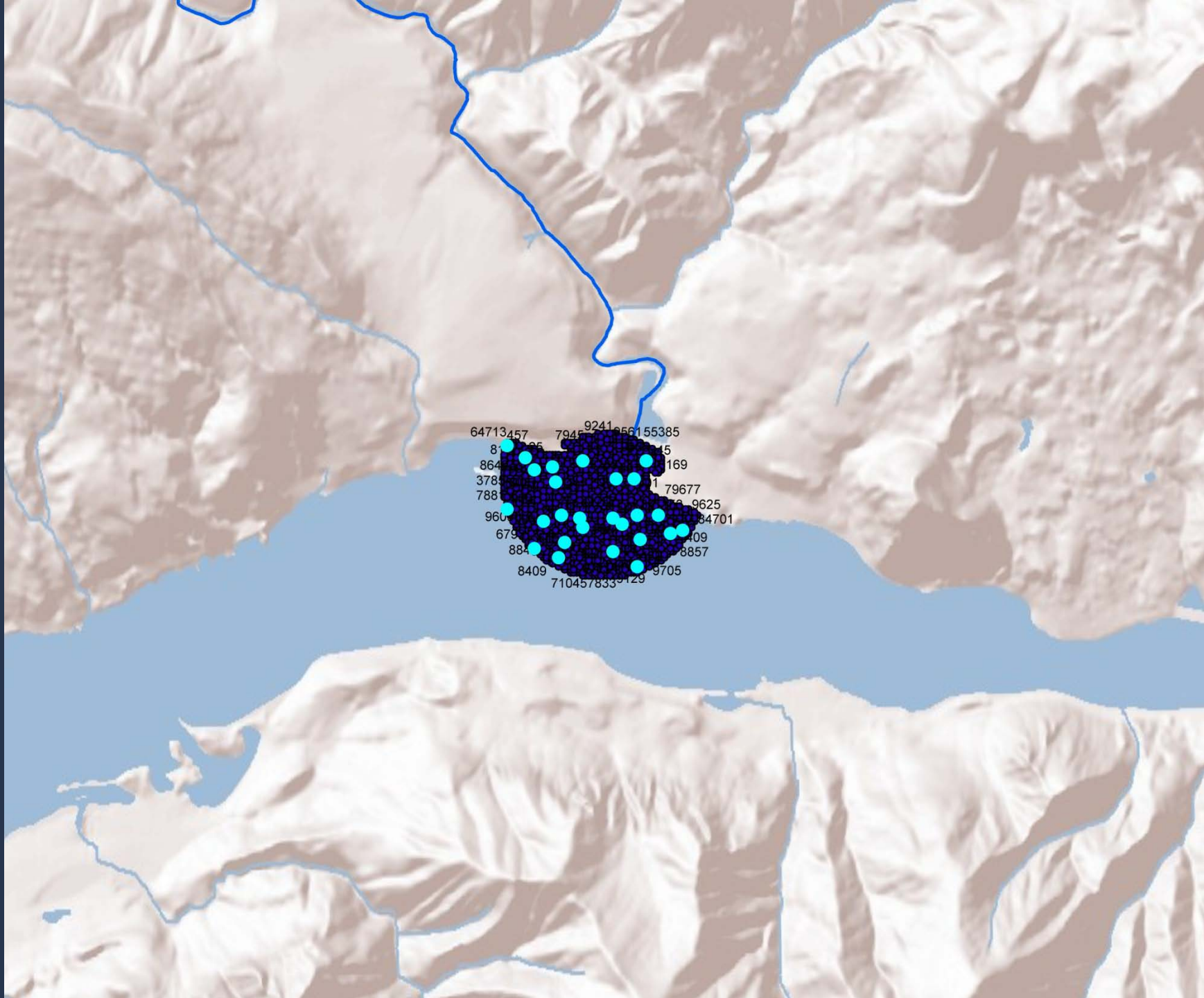
Bonneville Dam

Hamilton Creek

Skamania Island

Multnomah Creek





Lower Columbia River and Estuary

Grays River

Skamokawa, WA

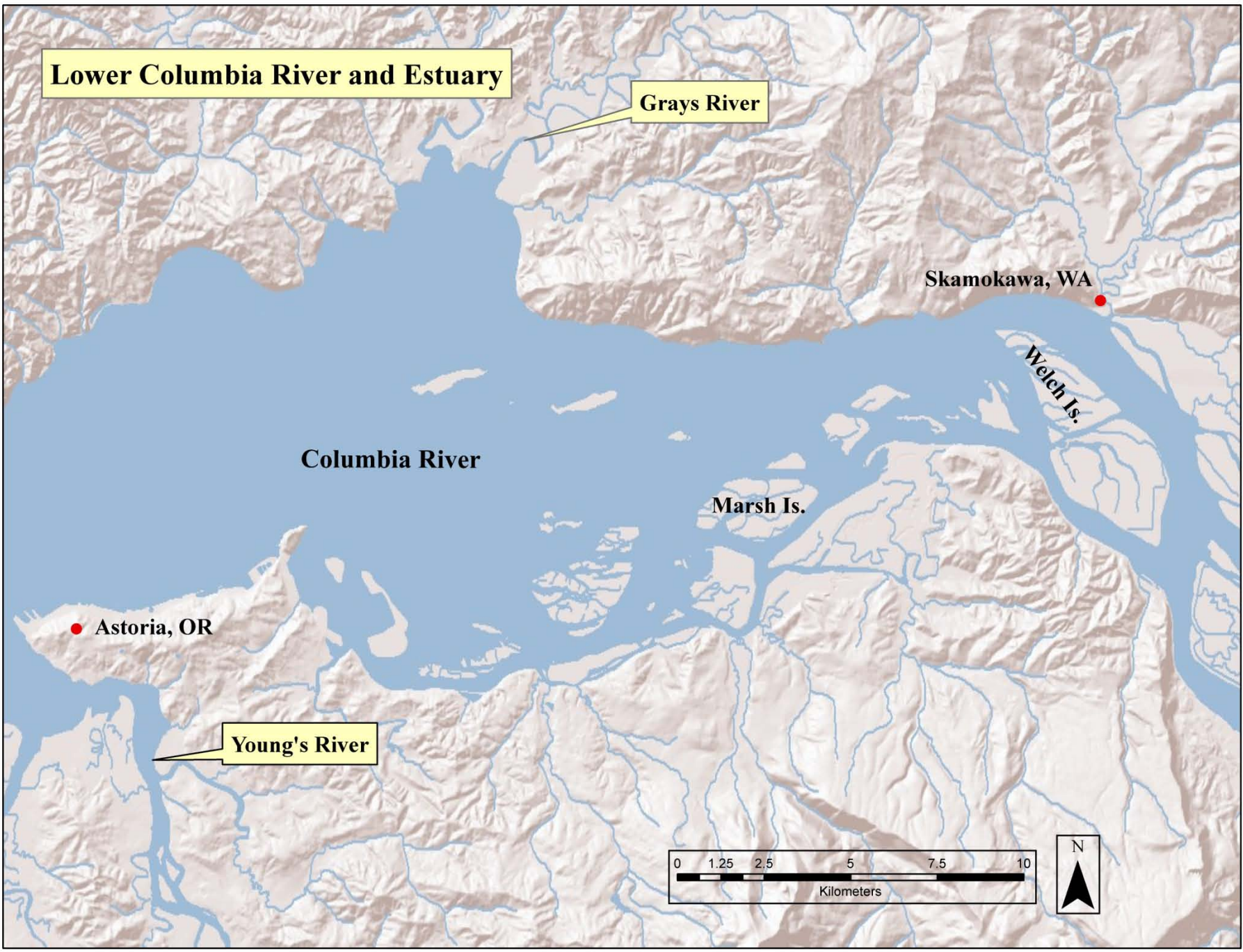
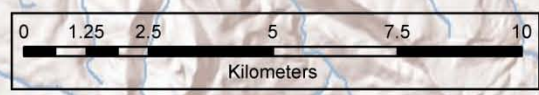
Welch Is.

Columbia River

Marsh Is.

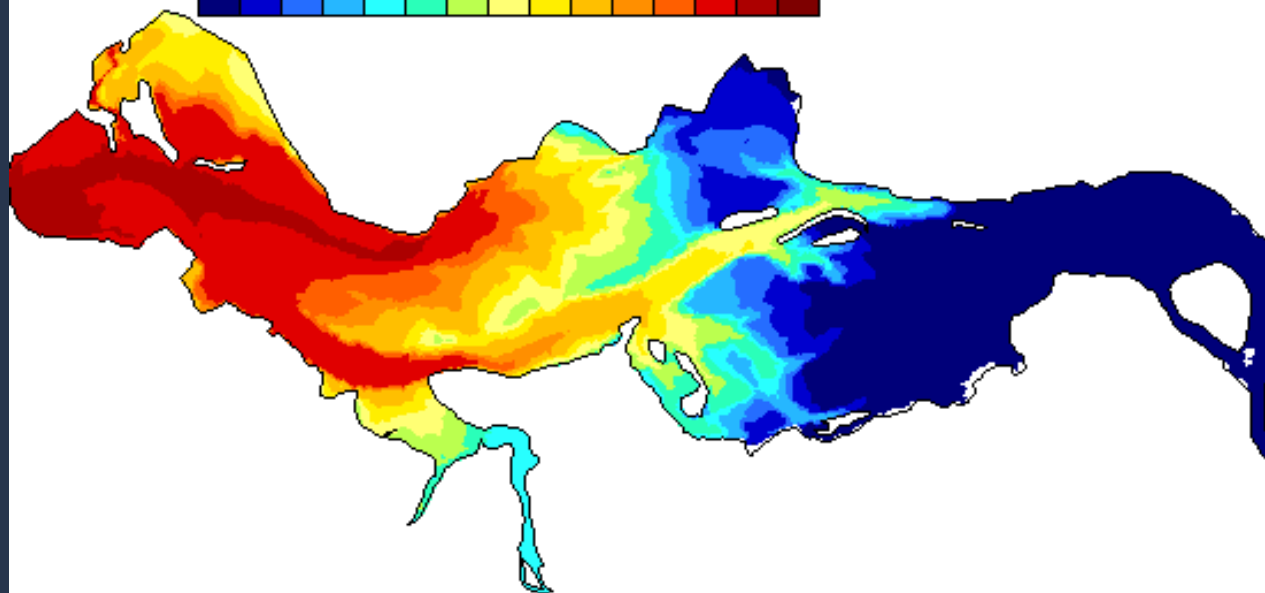
Astoria, OR

Young's River



Climatology: Bottom salinity, MAX, for 1999–2006, db=16

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25



Summary

- A deepwater electrofisher can be used to effectively sample large rivers
- Lower Willamette & Columbia Rivers are occupied with larval lamprey
- Using a GRTS approach in the Willamette River, need to sample approximately **20 quadrats** to be at least 80% certain that if larval lamprey were not detected they were actually not present
- In the Willamette River, need to sample approximately **6 subquadrats** to be at least 80% certain that if larval lamprey were not detected in a quadrat they were actually not present
- Larval lamprey may be widely distributed throughout the lower Willamette & Columbia Rivers
- Numerous age (length) classes and multiple species were present
- It is conceivable that mainstem areas of large rivers are significant rearing areas for larval lamprey and that these lamprey may rear in these areas for numerous years

Implications

- **Contaminants**
- **Channel alteration – dredging**
- **Sediment management**
- **Flow management**

