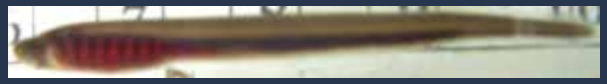
Evaluation of larval Pacific lamprey rearing in mainstem areas of the Columbia and Snake rivers impacted by dams

Timothy A. Whitesel
Jeffrey C. Jolley
Gregory S. Silver
Joseph J. Skalicky
U.S. Fish and Wildlife Service
Columbia River Fisheries Program Office

General Life History



Larvae/Ammocoete

Embryo

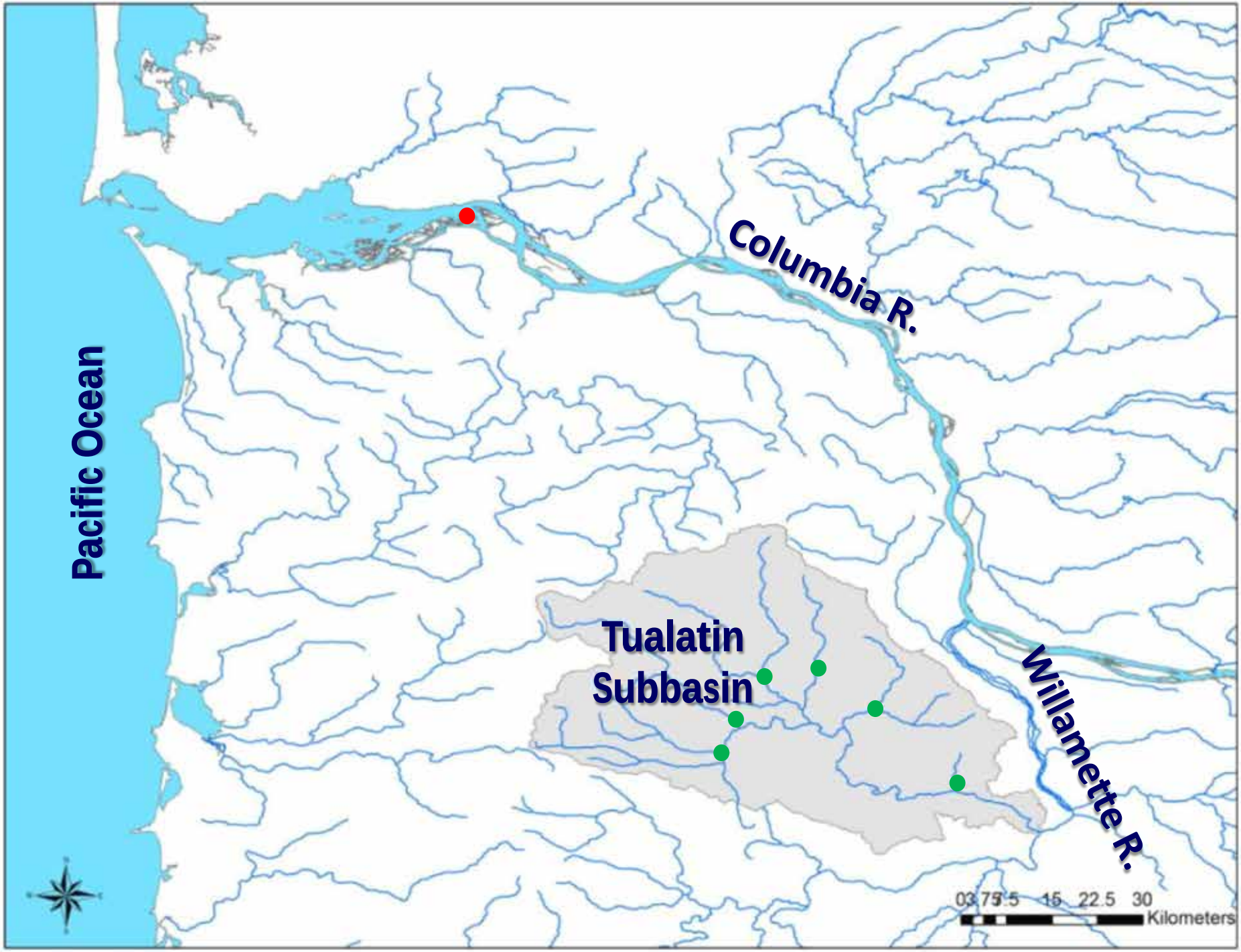
Juvenile/Macropthalmia

ANADROMOUS

Freshwater

Ocean

Adult


Pacific Ocean
Columbia R.
Tualatin
Subbasin
Willamette R.
0 3.75 7.5 15 22.5 30
Kilometers

Knowns

- Anecdotal observations
  - Parasitizing migratory fish
  - At hydropower projects
  - As prey of avian predators

- Generally believed to be
  - migrating through as macropthalmia (not rearing) or
  - lost to the population (not surviving)

Unknowns

- Active vs. passive downstream movement
- Extent (number & distribution) of mainstem habitat use
- Effects of hydrosystem operation
  - Dewatering/stranding
  - Passage
  - Rearing conditions
- Recruitment

G. Kovalchuk, PSMFC

Recent Information

- Lamprey collected in BON reservoir
- Higher detection rates in river mouth areas of BON
- Methods for quantitative sampling of patchy distribution in large rivers

Evaluation of larval Pacific lamprey rearing in mainstem areas of the Columbia and Snake rivers impacted by dams

(year 2 of proposed 4)

Objectives

- Evaluate whether mainstem pools are occupied by larval lamprey
- Evaluate strata-specific larval lamprey occupancy of mainstem pools
- Evaluate the genera and size of larval lamprey rearing in pools

Tools and techniques

From: Jolley et al. 2012 - Occupancy and Detection of Larval Pacific Lampreys and Lampetra spp. in a Large River: the Lower Willamette River

1) **The How:** Sampling – Deepwater electrofishing methodology
2) **The Where:** Random, spatially balanced site selection = quantitative unbiased sample framework
   - GRTS approach: generalized random tessellation stratified
3) **The Effort:** Reach specific detection probability – guidance for sampling effort, given level of certainty
   - 34 sample quads yields > 80% certainty when 0 detected

1. Tools and techniques (How)

Deepwater electrofisher methodology

- Boat-mounted bottom sampler (bell), coupled to ABP-2 electrofisher & pump
- Deployed in depths up to 60’
- Larvae brought to surface, strained into collection basket

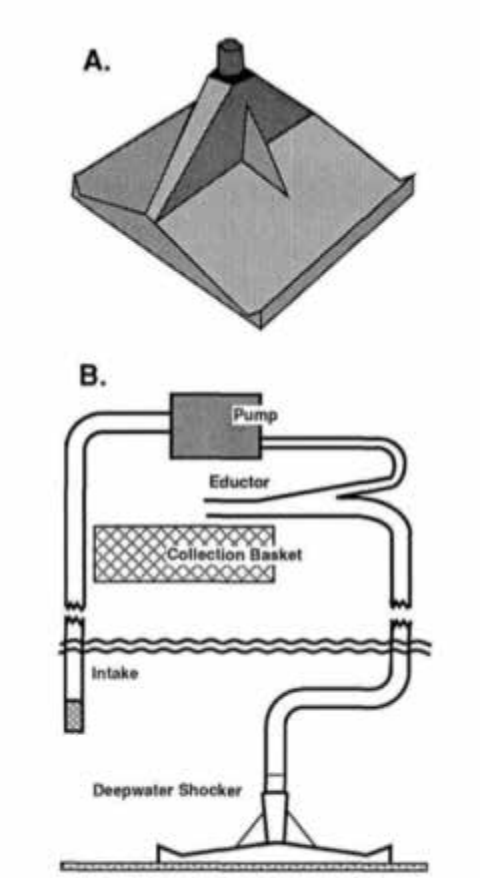


FIGURE 1.—(A) Deepwater electrofishing device for driving sea lamprey larvae from the bottom and (B) the pumping system used to move them to the surface for collection.

Bergstedt and Genovese 1994

1. Tools and techniques (How)

At each sample site

- Voltage maintained @ 0.6 - 0.8 V/cm at substrate
- 1 min pulse w/concurrent suction,
- Additional 1 min suction w/no pulse
- Samples 0.61m^2 area per site

1. Tools and techniques (How)

Captured larvae are

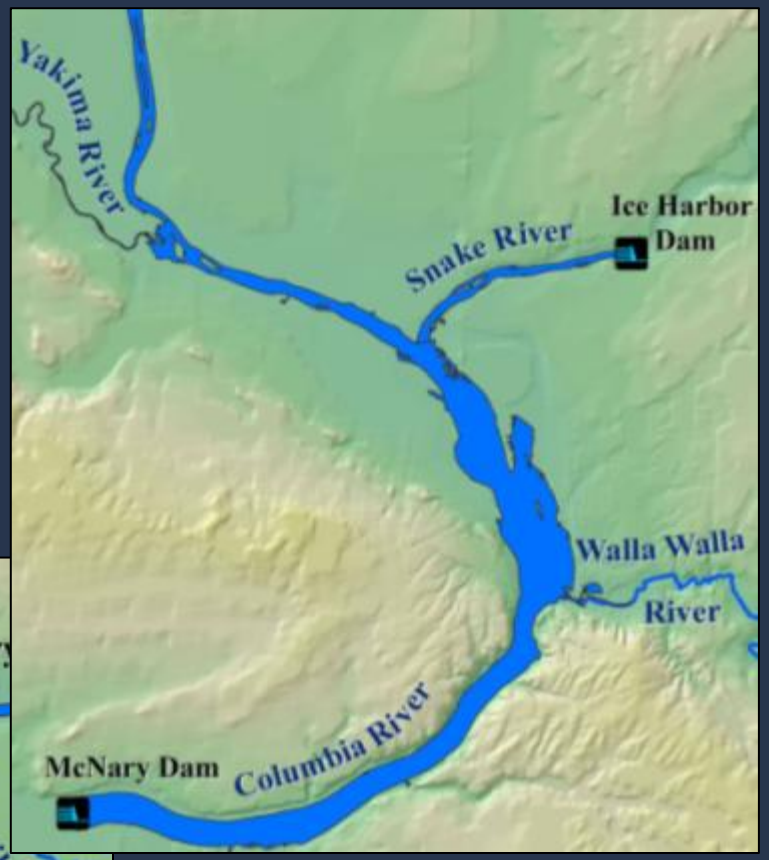
- Anesthetized
- Measured for TL
- Identified to genus using caudal pigmentation
- Caudal fin clip
- Released

2. Tools and techniques (Where)

Question – Do larval lamprey occupy *XX* area?

Define sample area

1. John Day Pool (a single strata)
2. McNary Pool (a single strata)



2. Tools and techniques (Where)

Question – Do larval lamprey occupy *XX* area?

3. Tributary mouths/deltas (within the pools)
   - John Day, Umatilla, Walla Walla, Yakima Rivers

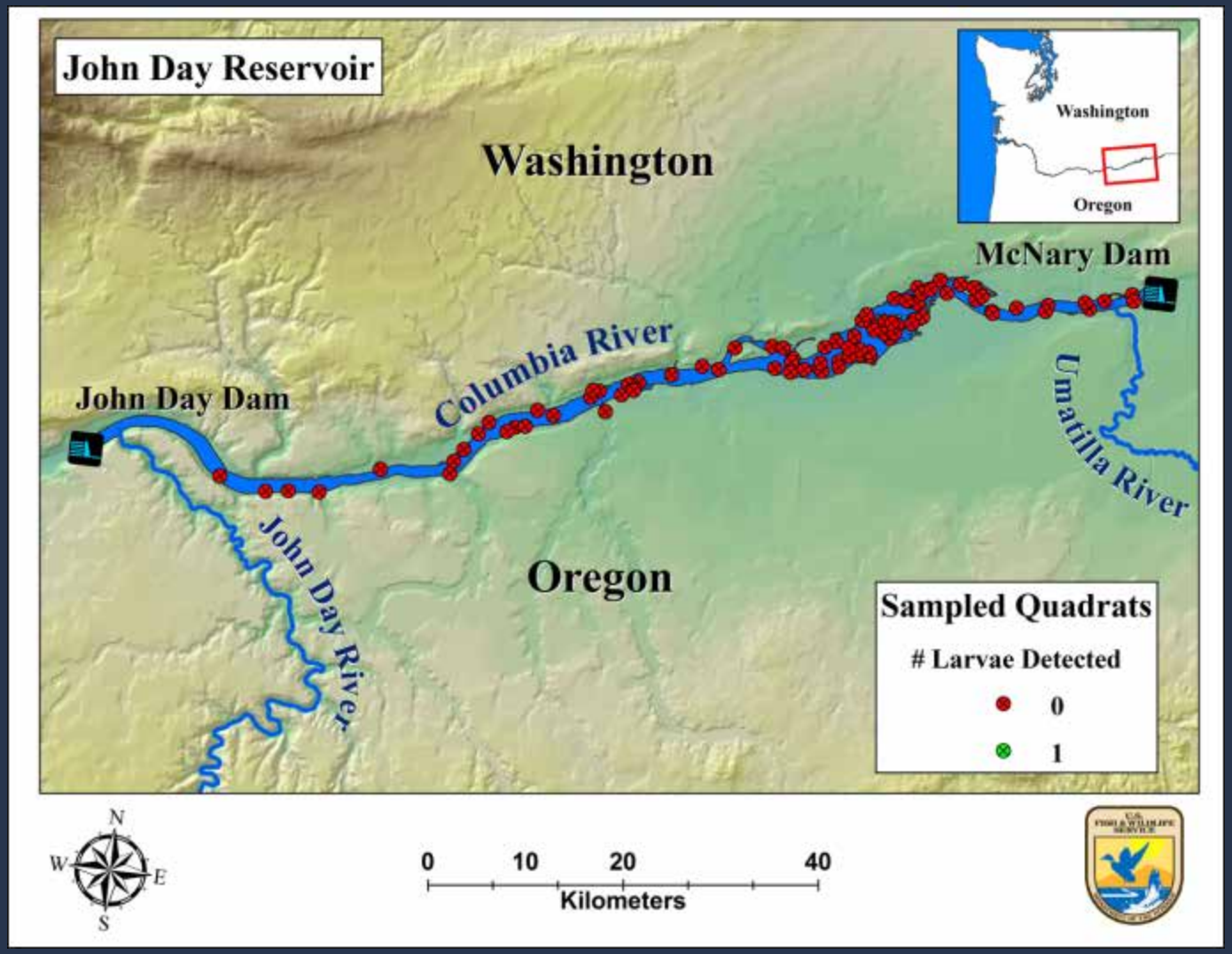
3. Tools and techniques (Effort)

GRTS Framework

1. 30x30 m quads
2. Center point coordinates - 225,998 total quads
3. GRTS script in Program R
   - Numerically ordered
   - Random, spatially-balanced
4. N = 85 quadrats

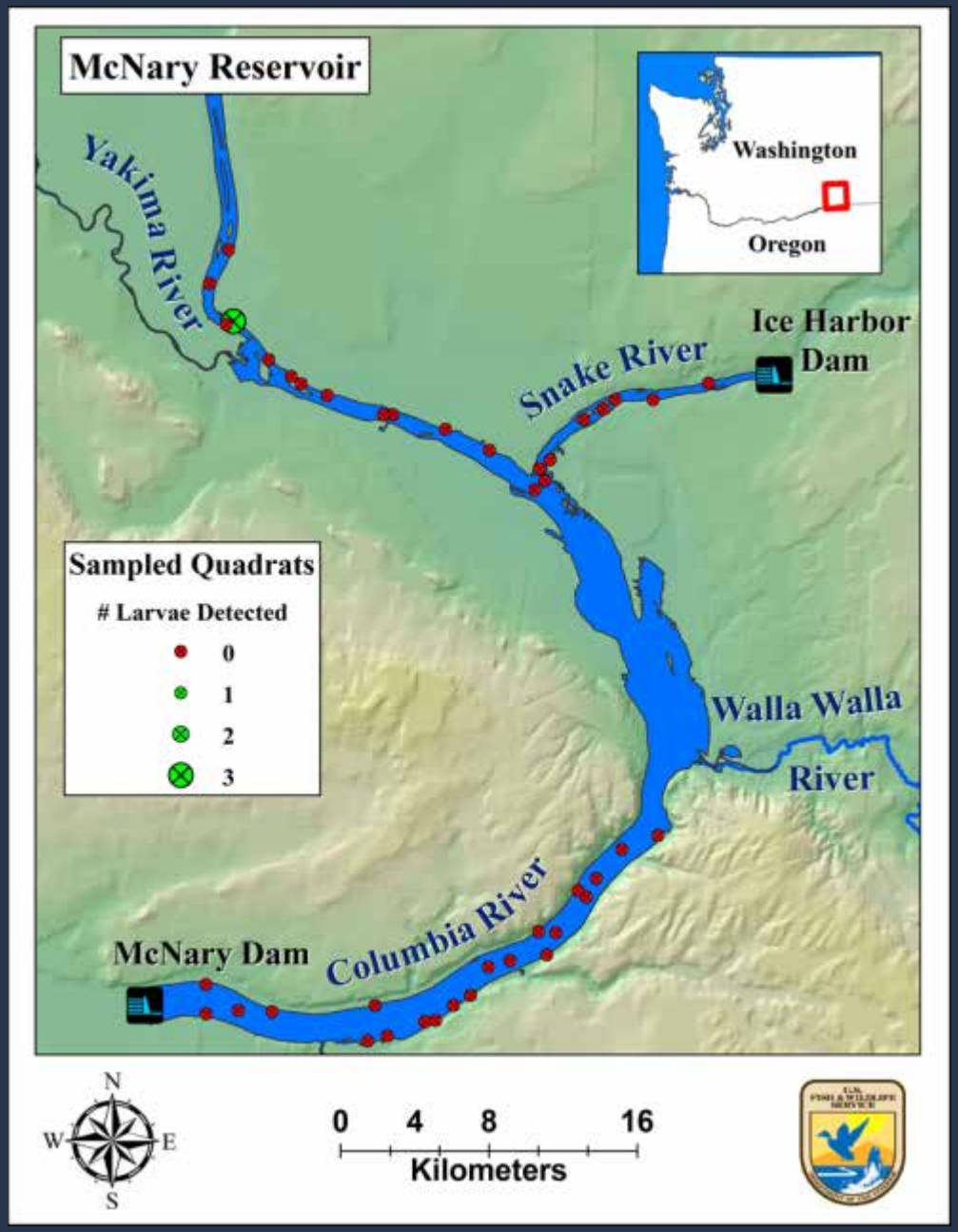
John Day Pool Results

- 225,998 total quads
- N = 85 sampled
- 0 occupied



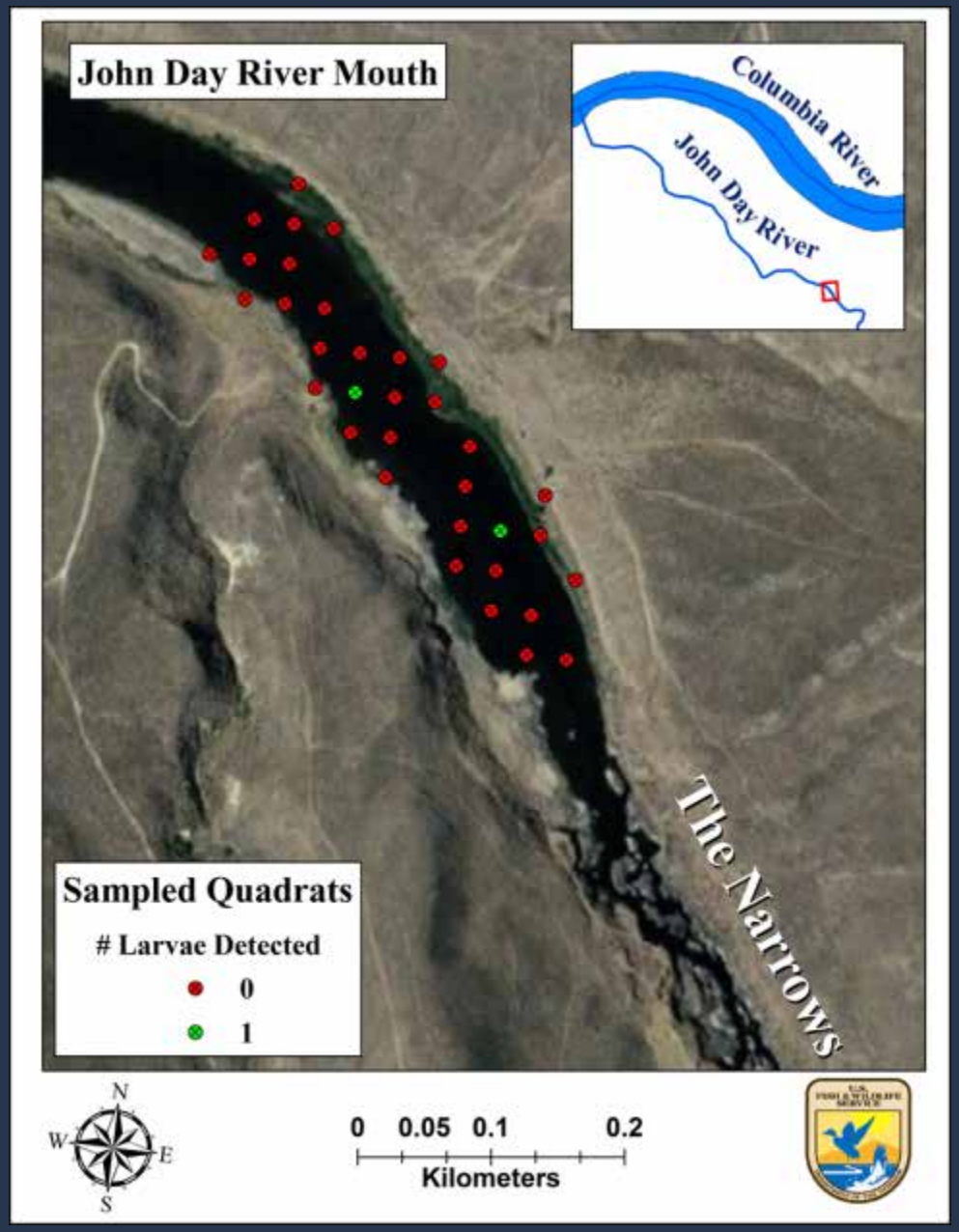
McNary Pool Results

- 165,215 total quads
- N = 43 of 85 sampled to date
- 1 occupied (3 larvae)



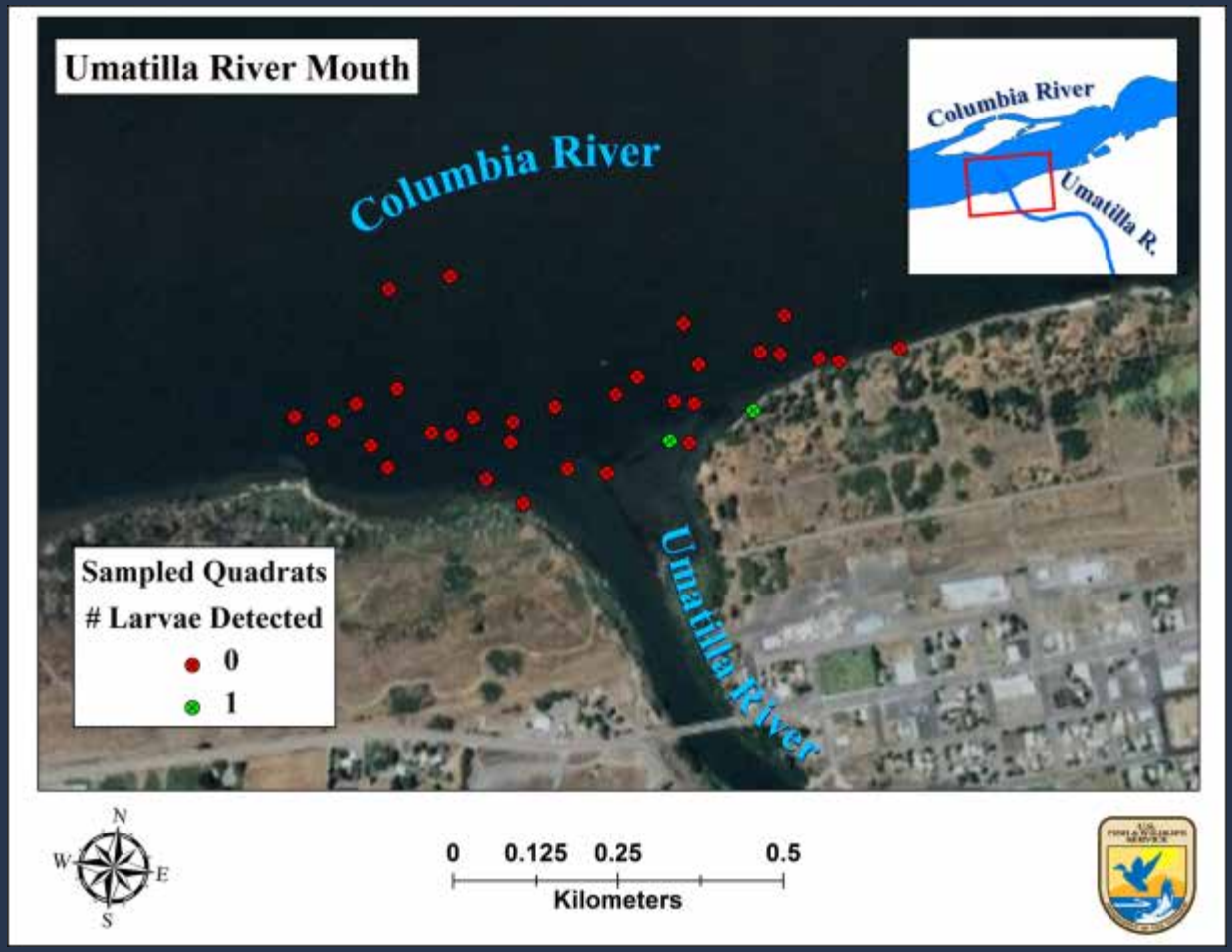
John Day River Mouth Results

- 500m reach from confluence
- 61 total quads
- N = 34 sampled
- 2 occupied



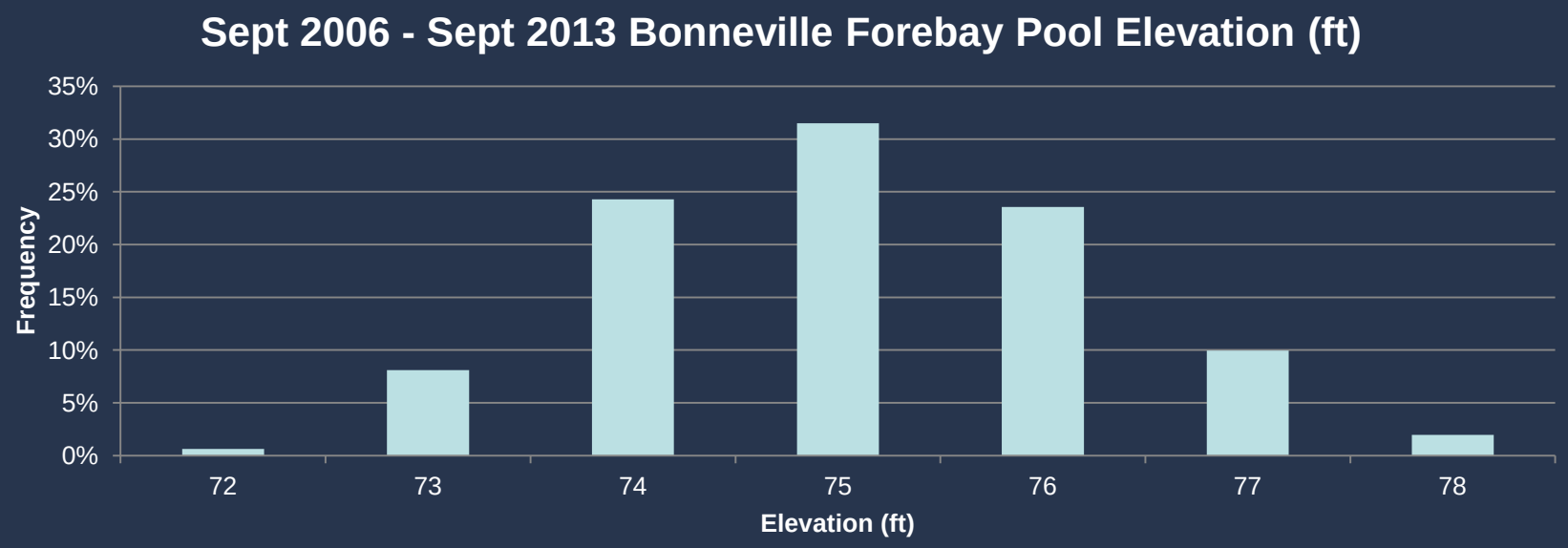
Umatilla River Mouth Results

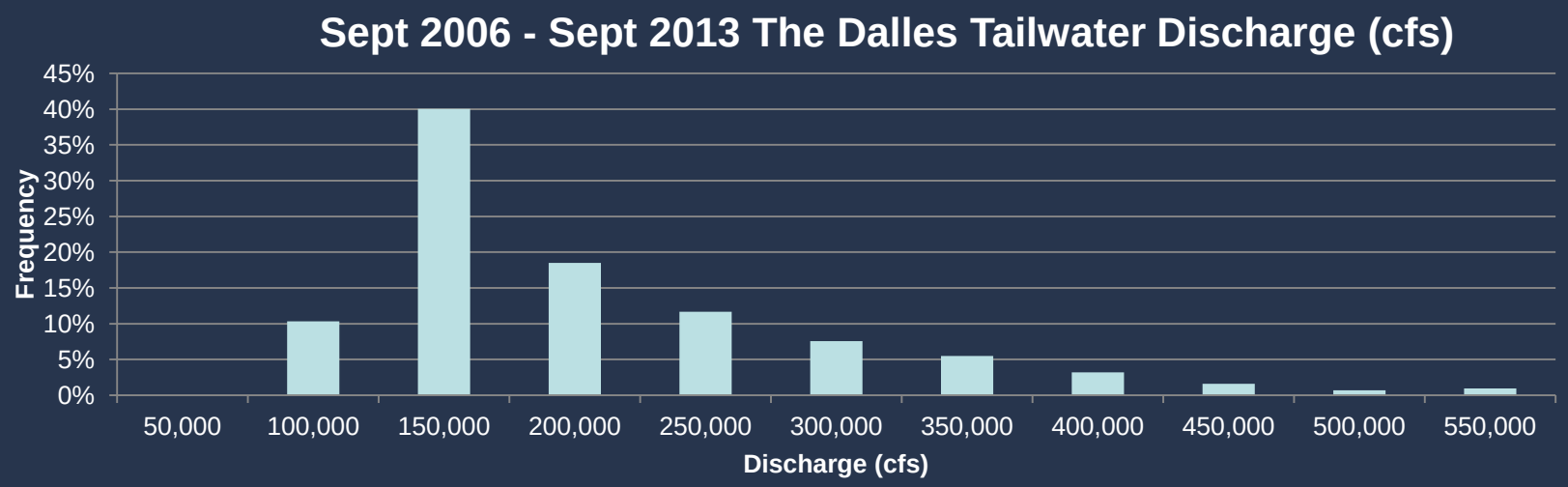
- 500m radius from confluence
- 442 total quads
- N = 34 sampled
- 2 occupied



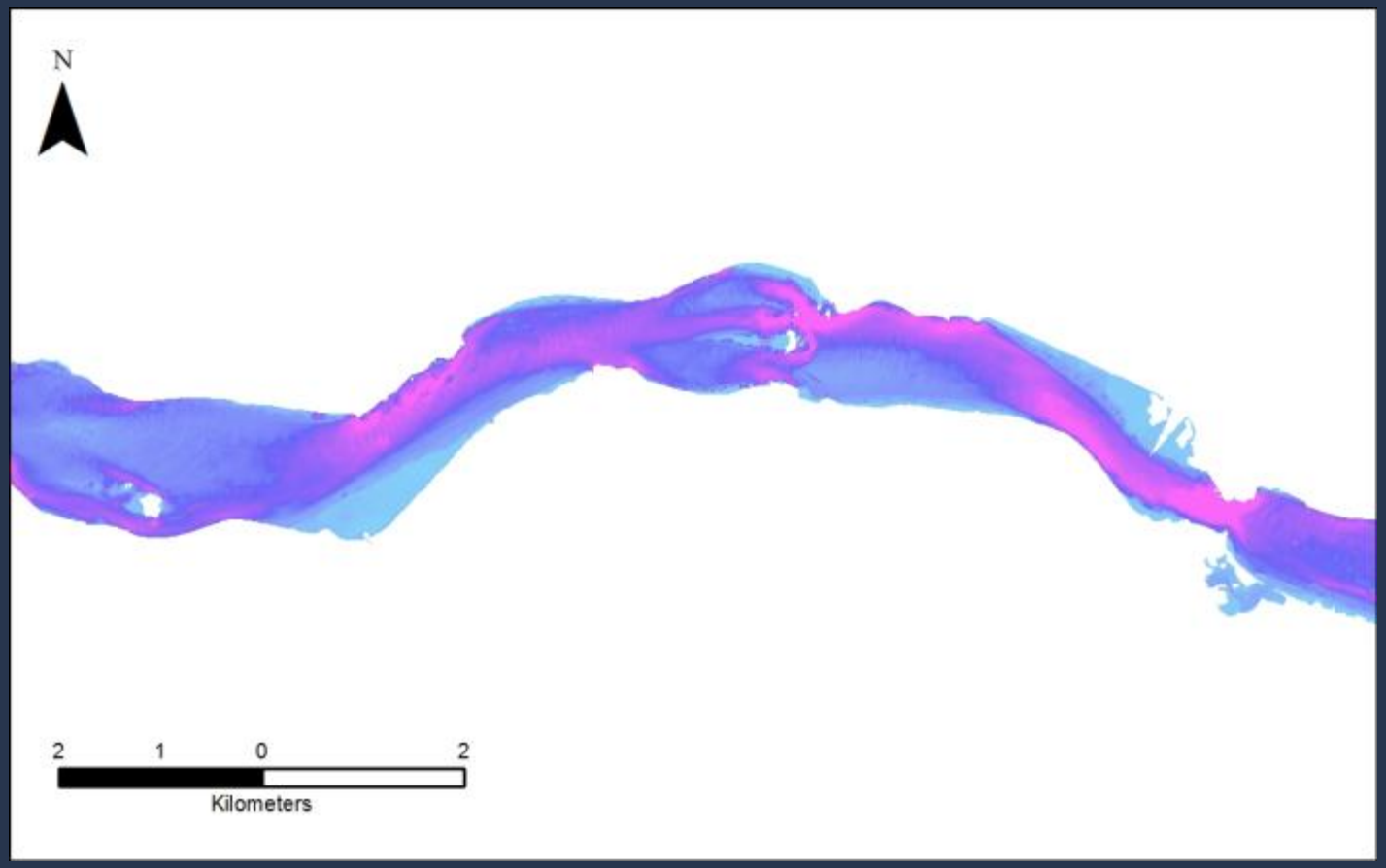
Areas of dewatering - Shallow strata (Where)

BON Shallow Water Strata





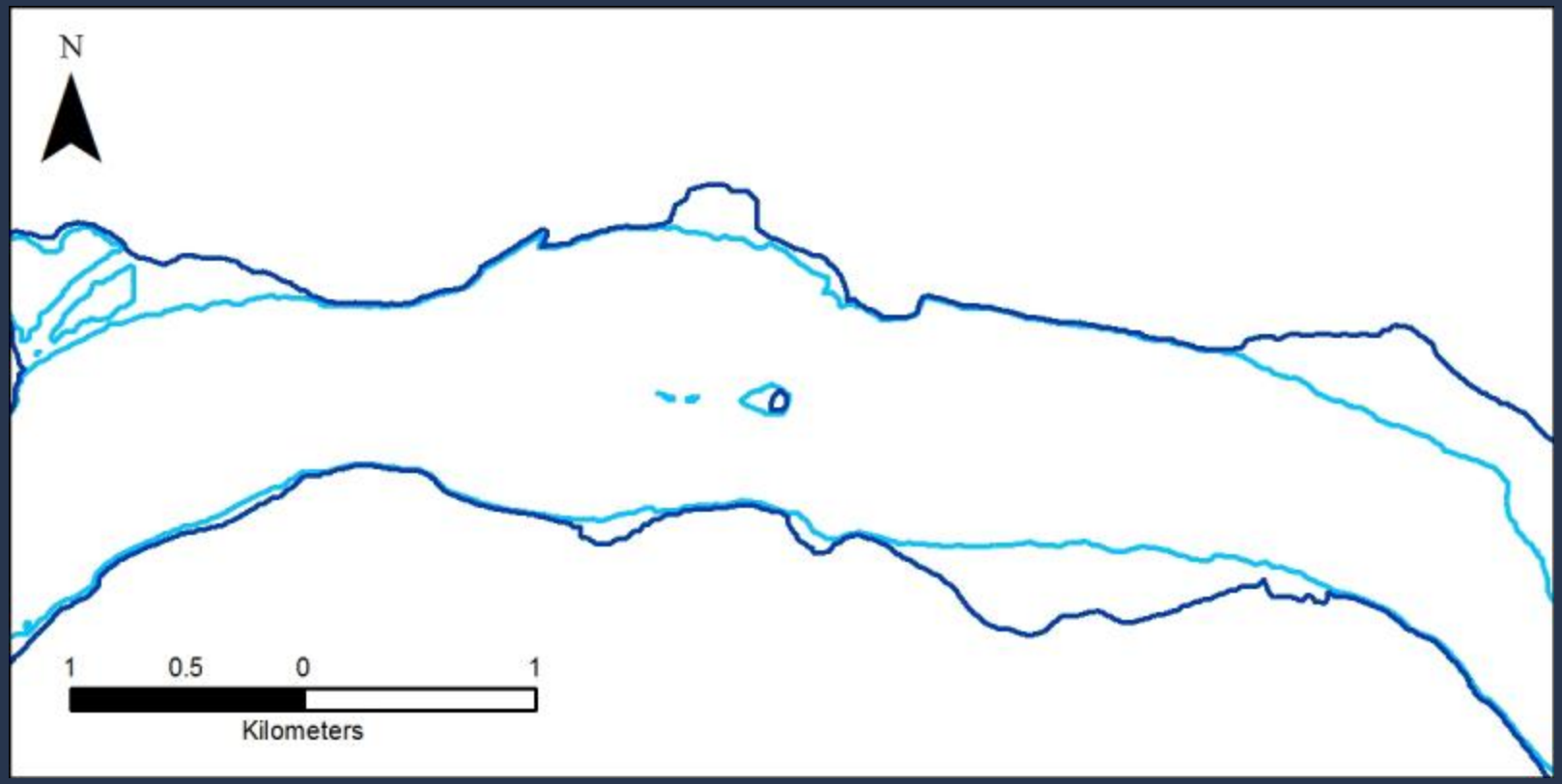
BON Shallow Water Strata



2D Hydrodynamic Model

- BON forebay elevation and TDA tailwater
- Bounding conditions modeled

BON Shallow Water Strata



Shoreline Model

- Low and high water conditions
- Area between potentially dewatered

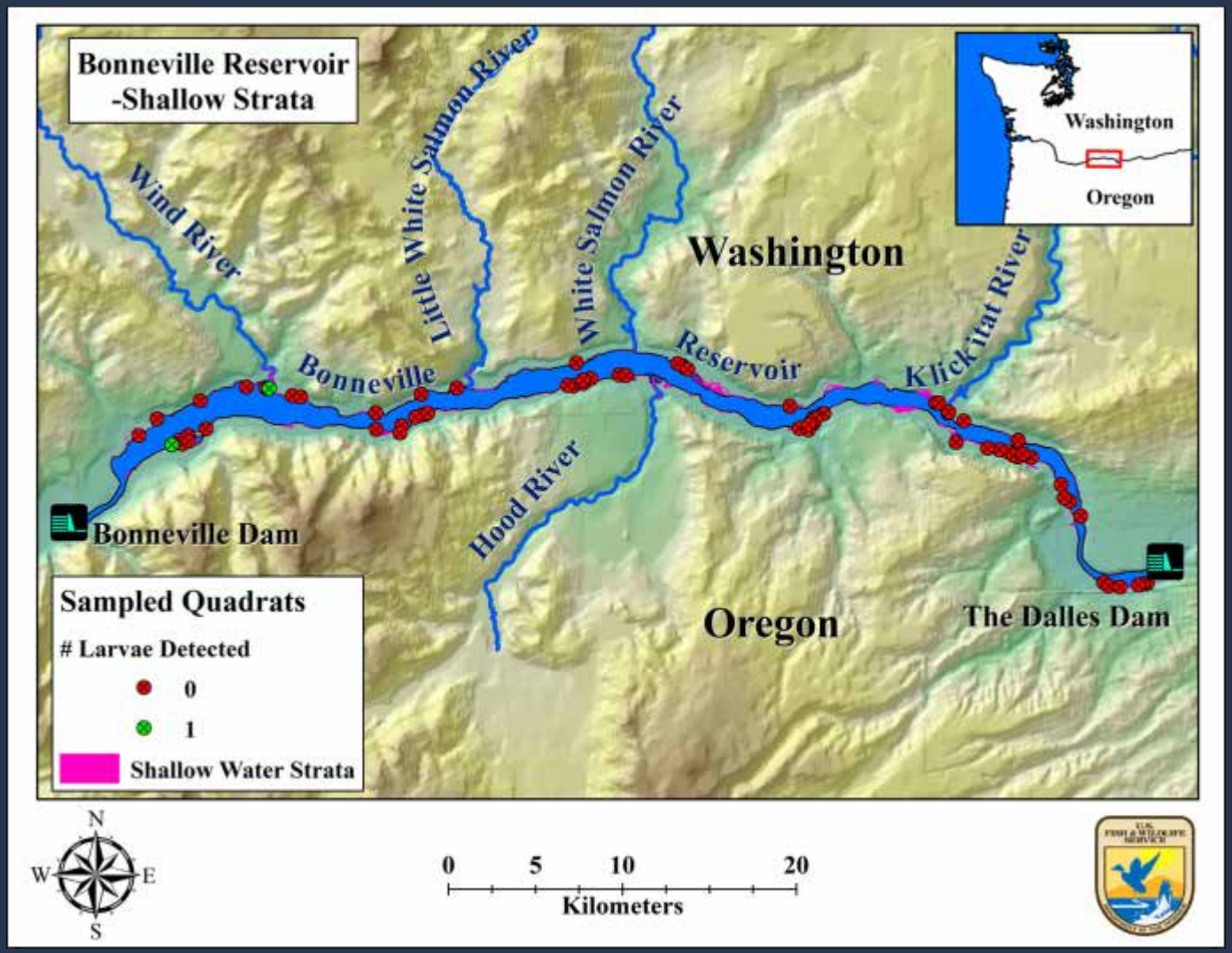
2. Tools and techniques (Where)

Question – Do larval lamprey occupy *XX* area?

4. Shallow water strata within BON pool

BON Shallow Water Strata Results

- 6,172 total quads in shallow zone (~7% of pool)
- N = 72 sampled
- 2 occupied

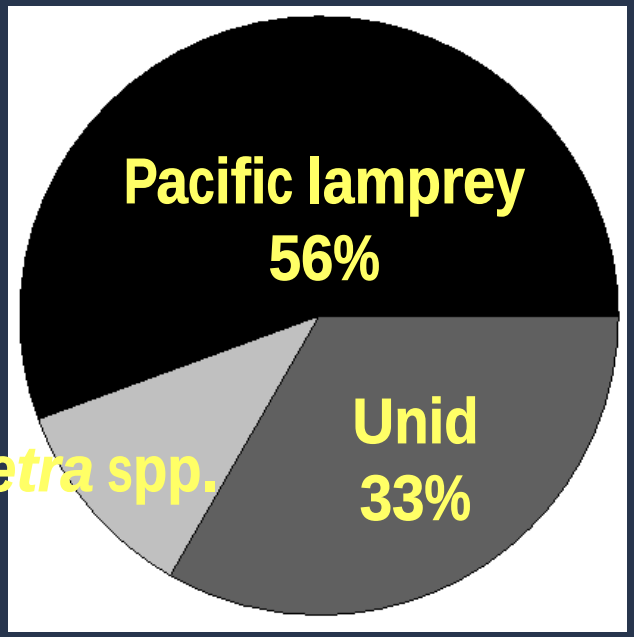


Preliminary Summary - Occupancy

- Occupied:
  - 1) John Day Pool (Umatilla and John Day mouths),
  - 2) McNary Pool (50% complete),
  - 3) Umatilla Mouth, John Day Mouth,
  - 4) BON shallow
- Detection (*d*) of larvae range was 0.00 – 0.06
- Sampling in progress

Reach	Total	Visited	Sampled	Occupied	*P(d)*	PCL	*Lampetra*	Unid	Total
JDA Pool	225,998	126	85	0	0.00	0	0	0	0
MCN Pool	165,215	55	42*	1	0.02	2	0	1	3
JDA mouth	61	41	34	2	0.06	1	0	1	2
Uma mouth	442	39	34	2	0.06	1	0	1	2
Yak mouth	481	34	23*	0	0.00	0	0	0	0
Bon shallow	6,172	80	72	2	0.03	1	1	0	2
WW mouth	654	0	0	-	-	-	-	-	-
JDA shallow	21,595	0	0	-	-	-	-	-	-
MCN shallow	ongoing	0	0	-	-	-	-	-	-

Preliminary Summary - Species



- 9 larvae total
  - 5 Pacific lamprey
  - 1 *Lampetra* spp.
  - 3 unid. larvae

Preliminary Summary - Size

- TL range 23 – 138 mm

Pacific lamprey
49, 50, 86, 98, 138 mm TL

***Lampetra* spp.**
107 mm TL

Unidentified
23, 26, 54 mm TL

Pending work (funded)

- Complete MCN pool
- Complete Yakima R. mouth
- Walla Walla R. mouth
- JDA shallow strata
- MCN shallow strata

Proposed work (unfunded)

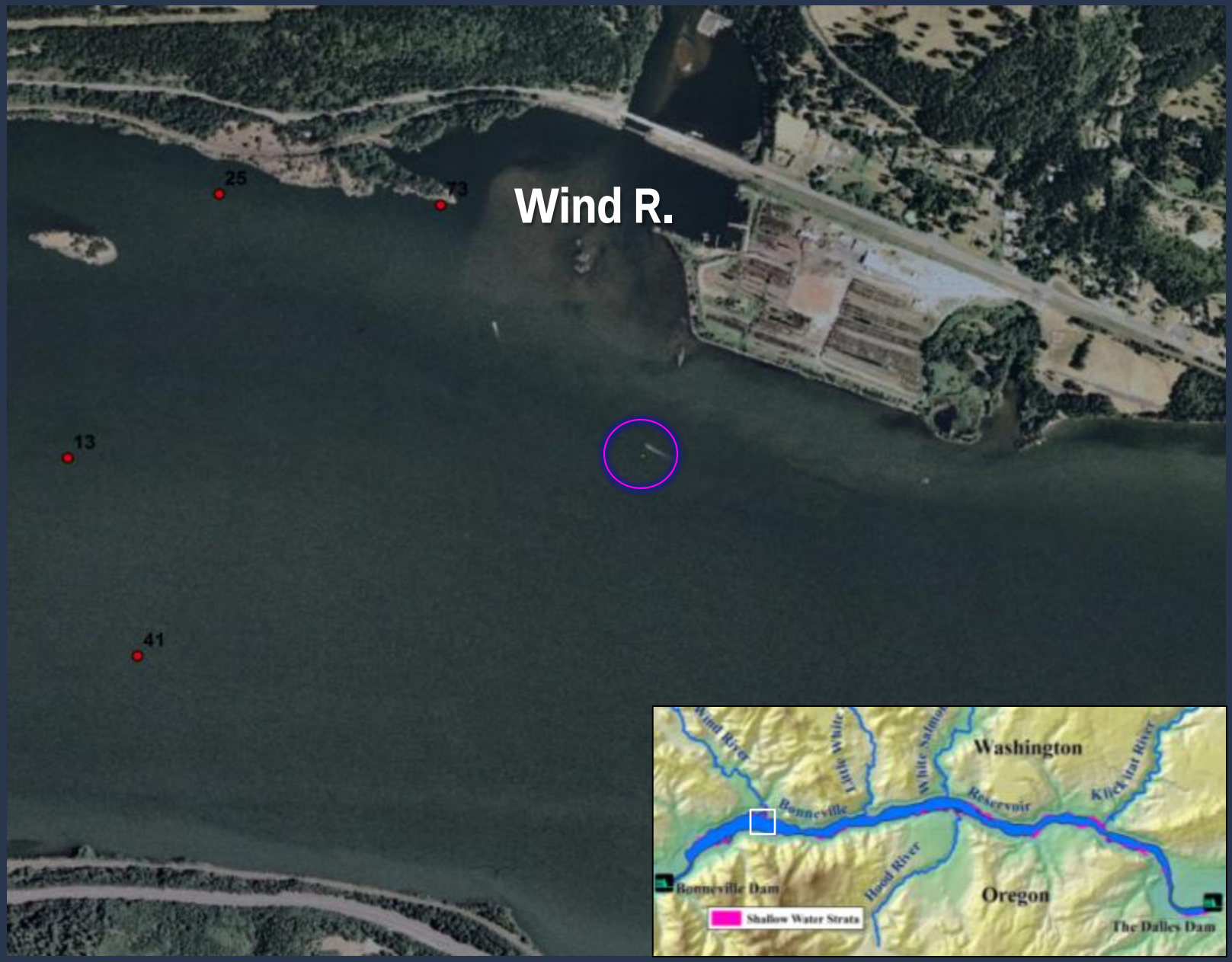
- Lower Granite pool
- Little Goose pool
- Lower Monumental pool
- Ice Harbor pool

Summary

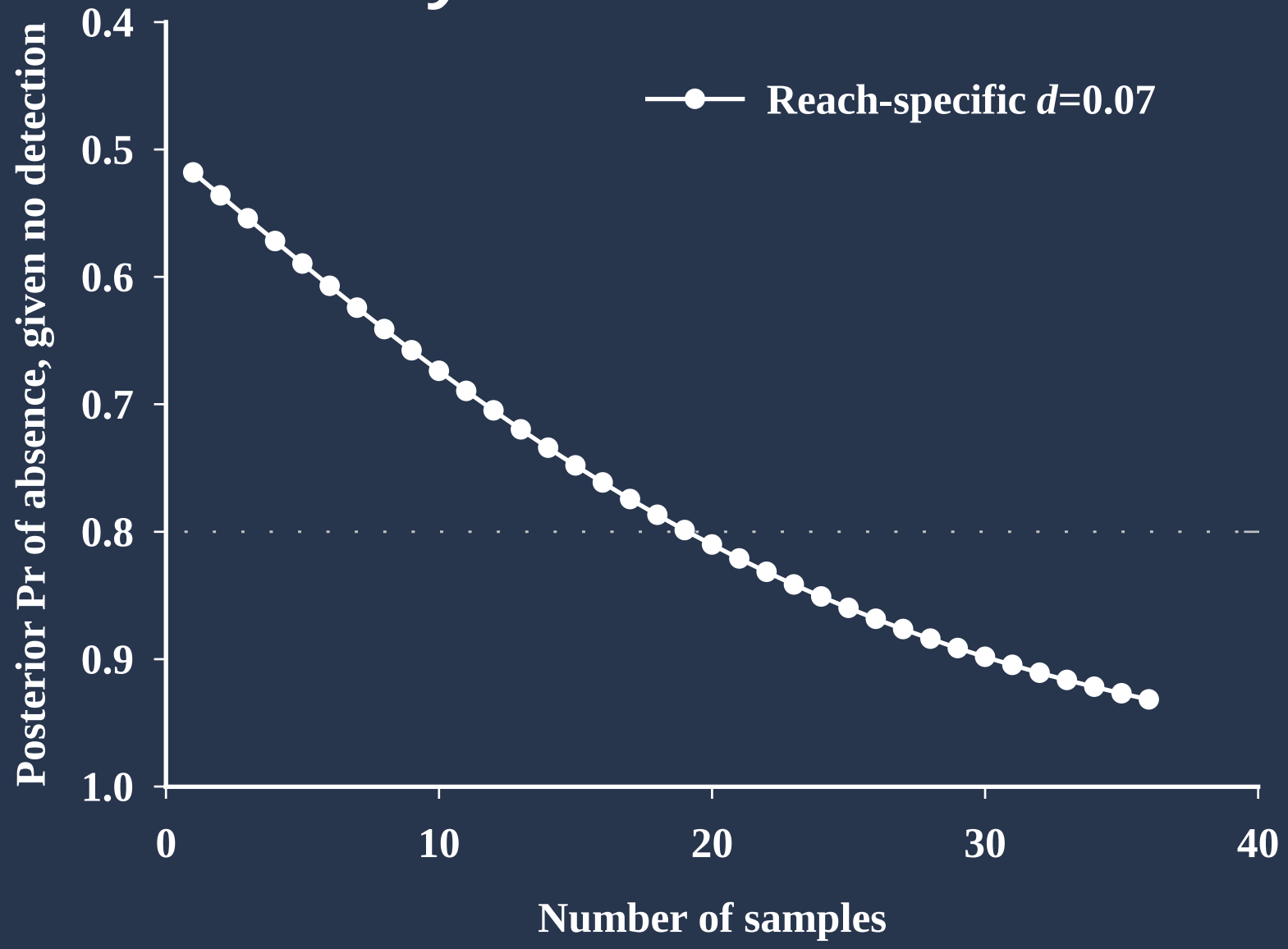
- BON, JDA, and MCN pools are occupied with larval lamprey
- Detection rates may have been higher proximate to tributary inputs
- Detection rates were lower relative to many areas in BON
- Multiple species over wide size range were present
- Larval lamprey may be widely distributed throughout the Columbia River mainstem
- It is possible that mainstem areas of large rivers are important rearing areas for larval lamprey and that larvae may rear in these habitats for numerous years

Questions...

How much sampling is 34 quadrats?



The problem: detecting rare/patchily distributed animals

	Present	Absent
Present	Correct	Non-sensical
Absent	Incorrect (false absence)	Correct

Probability of Detection - Reach