WSU's 2019 Dreissenid Mussel Early Detection Monitoring in the Columbia River

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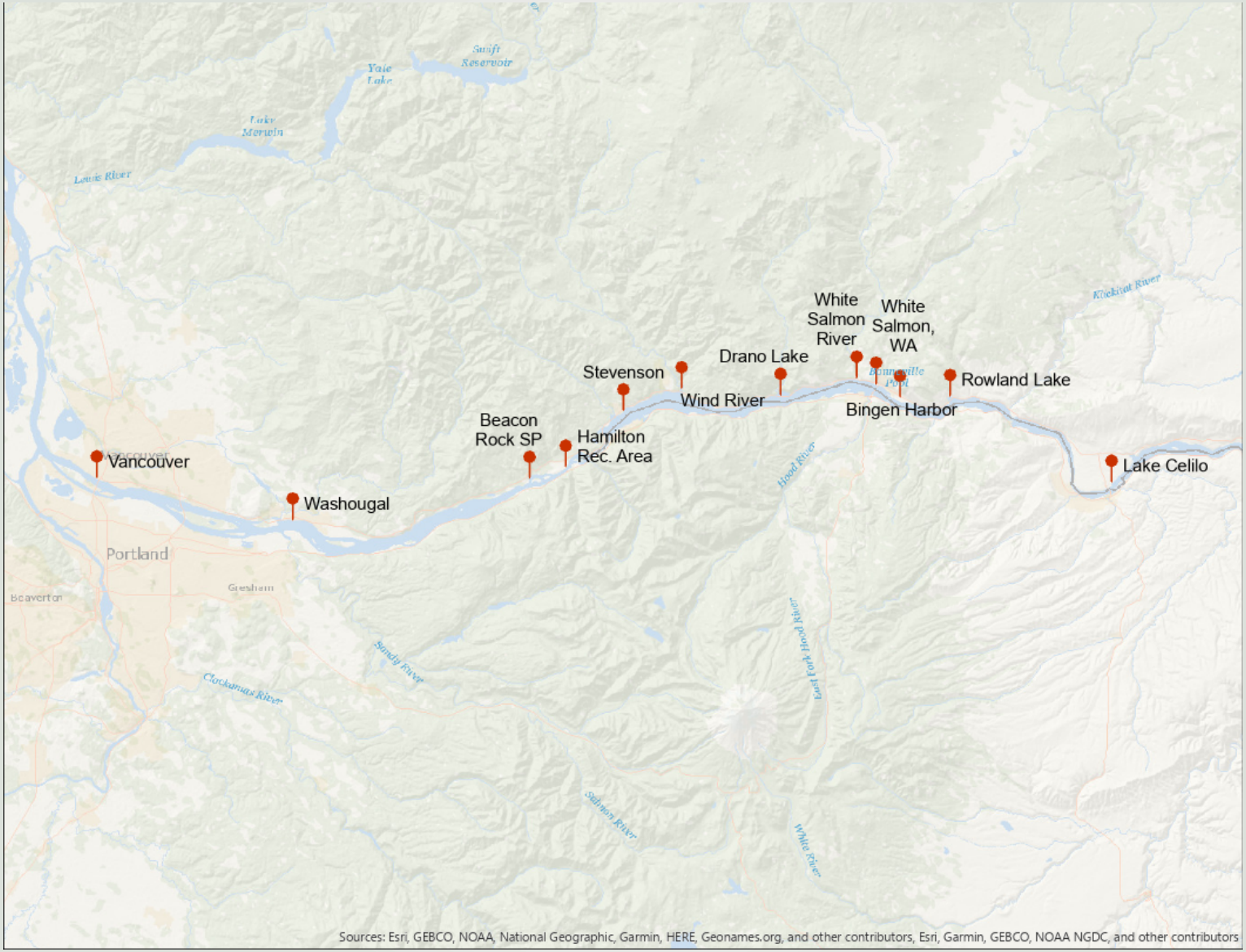
Location and number of samples collected in 2019

Sampling Location	Number of Net Samples	Number of eDNA Samples
Lake Celilo, WA	41	12
Rowland Lake	41	12
Bingen Harbor	41	12
White Salmon	41	12
White Salmon River at Underwood CUR	41	12
Drano Lake	41	12
Wind River	40	12
Stevenson	40	12
Near Bonneville Lock, Hamilton Recreation area	40	12
Beacon Rock SP	40	12
Washougal Marina	40	12
Vancouver, near I-5 bridge	40	12
Total	**486**	**144**

Location and number of samples collected in 2019



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Risk assessment data used to direct sampling

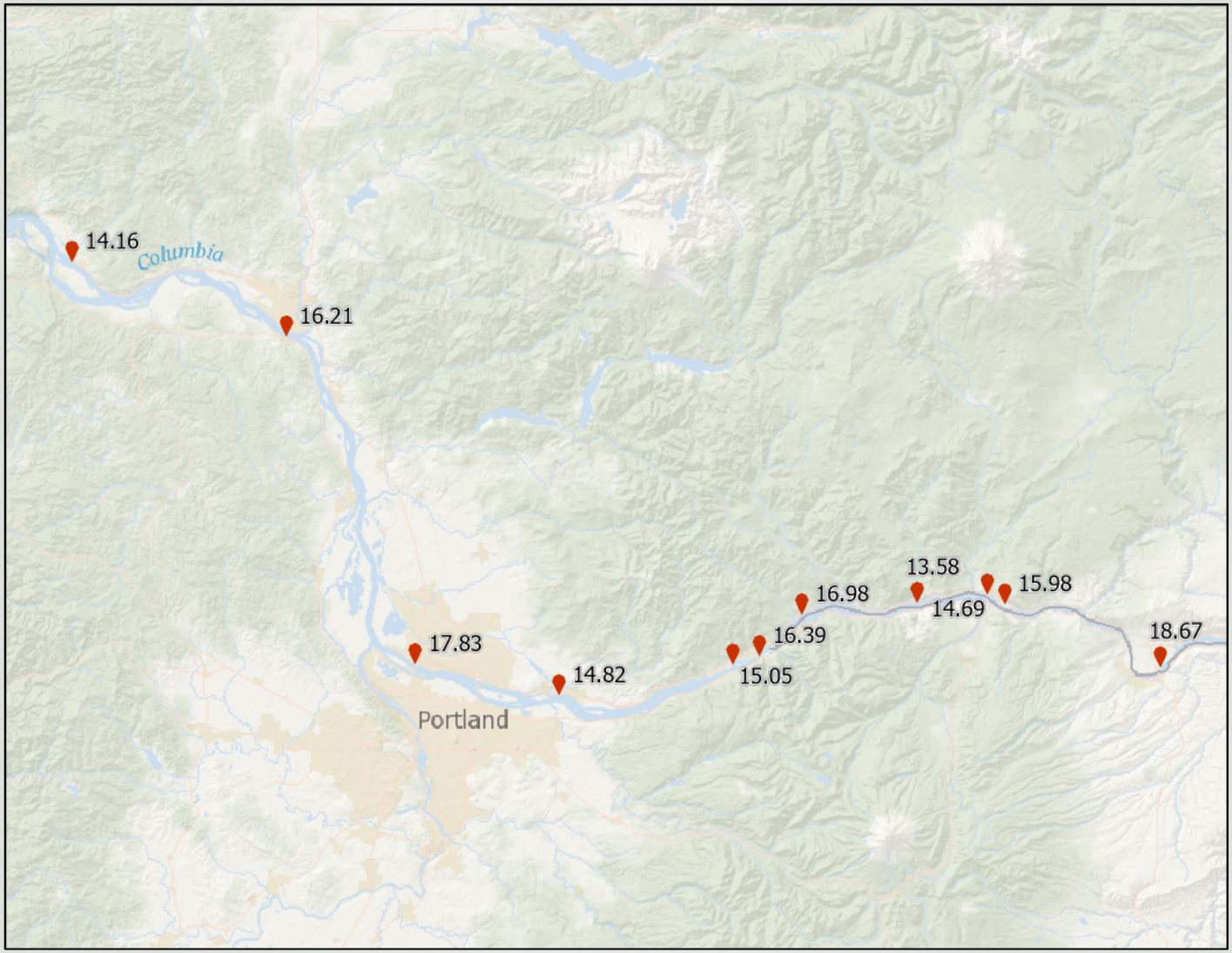
Table 21. Water bodies in Washington that have a high to medium relative risk of dreissenid mussel establishment and/or introduction. Risk categories were formulated using best professional judgment. The amount of data used to assign risk categories varied for each water body. Data is summarized in Appendix 1 and II, and risk categories based on one or two data points are flagged with an asterisk. Dreissenids can also establish in areas identified with low to very low risk of establishment.

Water Body Name	$[Ca^{2+}]$ mg/L	pH	Relative Risk Establishment	Relative Risk Introduction[#]
Moses Lake	30.5	8.18	High	High
Potholes Reservoir outflow	28.3	8.14	High	High
Pend Oreille River	20.1		Medium	High
Lake Washington, inflow	18.8	7.77	Medium	High
Banks Lake	17.8	7.90	Medium	High
Columbia River, Lake Celilo	16.8		Medium	High
Columbia River, Lake Bonneville	16.5	8.11	Medium	High
Clear Lake	16.4	8.47	Medium	High
Williams Lake	20.5	7.39	Medium	Medium
Columbia River, Lake Wanapum	18.1	8.02	Medium	Medium
Lake Cresent	15.9	6.94	Medium	Medium
Nooksack River	12.0	7.57	Low	Medium
Silver Lake	10.4	7.49	Very Low	High
Deer Lake	9.3	7.50	Very Low	High
Cowlitz River	8.1	7.47	Very Low	High
Lake Cushman	11.6	7.55	Very Low	Medium
Diamond Lake	7.5	7.90	Very Low	Medium
Mineral Lake, outflow	5.8	7.64	Very Low	Medium
Alder Lake	5.1	7.45	Very Low	Medium
Cle Elum Reservoir	4.7	7.08	Very Low	Medium
Bumping Reservoir	3.8	7.55	Very Low	Medium

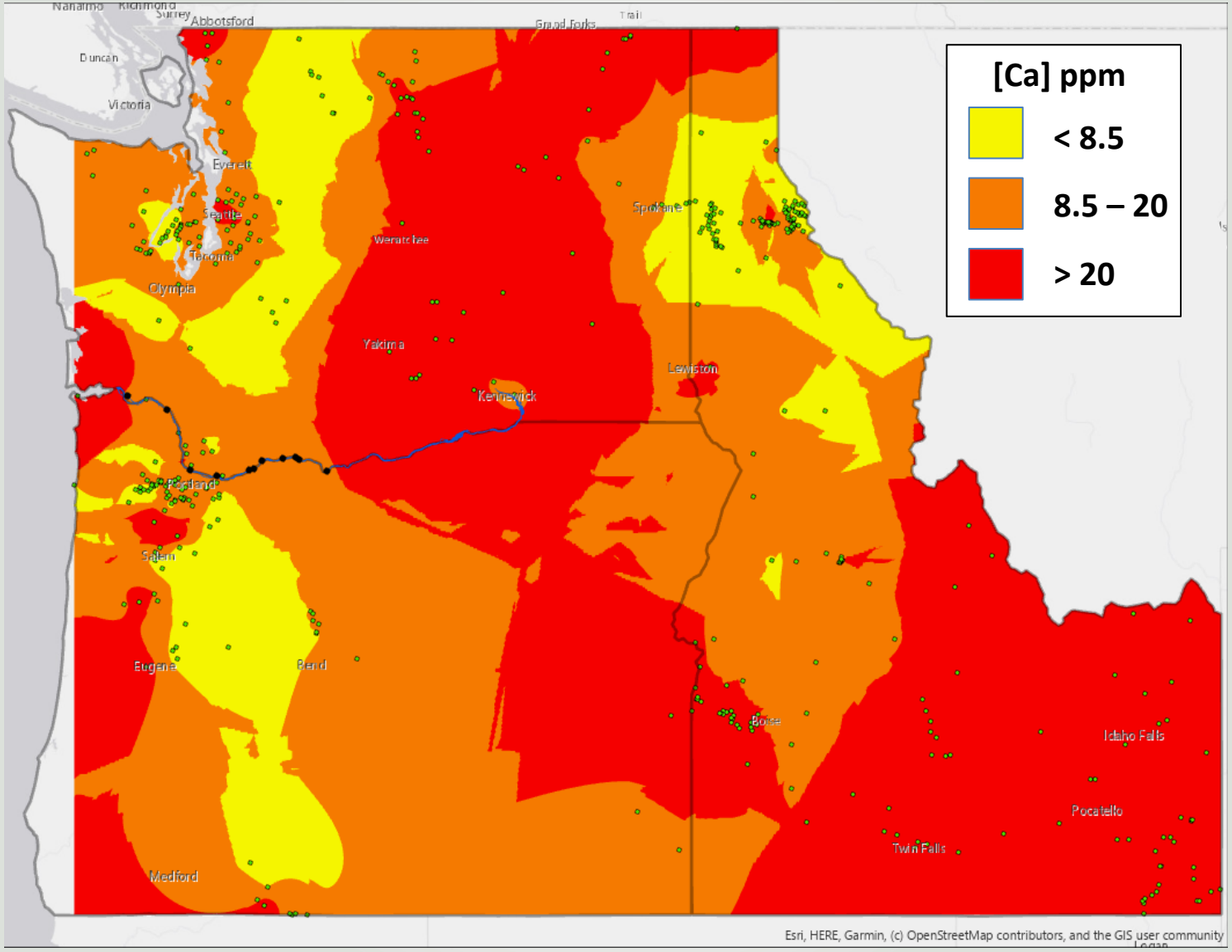
[#] When there were multiple measures of boater use, the measure with the highest risk category was used.

Wells et al. (2011)

WSU Calcium Data from 2018



Kriged Calcium Data from USGS NWIS & WSU



Water Chemistry Facility

AT WASHINGTON STATE UNIVERSITY VANCOUVER

In 2017, with generous support from the M.J. Murdock Charitable Trust, WSU Vancouver established the Water Chemistry Facility, a state-of-the-art water chemistry laboratory equipped with an Agilent 7900 ICP MS, a DIONEX Ion Chromatograph, and a Hach Dissolved Organic Carbon and Total Nitrogen Analyzer. Together, these instruments can be used to detect and quantify a broad range of elements and ions. In addition to its own research, the facility also offers its services to researchers, governmental users, and the private sector.

Analytical Capabilities

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List of analytes by instrument

ICPMS Major Elements	Na, Mg, Al, Si, P, K, Ca, Ti, Mn, Fe
ICPMS Trace Elements	Ag, As, Au, B, Ba, Be, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Gd, Ge, Hf, Ho, Ir, La, Lu, Mn, Mo, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Re, Rh, Ru, S, Sc, Sb, Se, Si, Sm, Sn, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
Ion Chromatograph Anions	Fluoride, Chloride, Nitrite, Bromide, Sulfate, Phosphate
Ion Chromatograph Cations	Na+, NH4+, K+, Mg2+, Ca2+
Dissolved Organic Carbon and Total Nitrogen Analyzer	Total organic carbon, dissolved organic carbon, dissolved inorganic carbon, total nitrogen, total dissolved nitrogen

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Risk of Introduction

High

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Risk of Introduction	Risk of Establishment
High	Medium

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Risk of Introduction	**Risk of Establishment**	**Potential Economic Impacts**
High	Medium	Extremely high

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Risk of Introduction	**Risk of Establishment**	**Potential Economic Impacts**	**Potential Ecological Impacts**
High	Medium	Extremely High	Extremely High

Allocation of samples by sampling method

FIELD COLLECTION METHOD	LABORATORY ANALYSIS METHOD	WATER BODY			TOTAL
		THE DALLES RESERVOIR	BONNEVILLE RESERVOIR	"LOWER" COLUMBIA	
Plankton tow	CPLM Microscopy	41	285	160	486
Water sample	eDNA	12	84	48	144
Plankton tow	FlowCam	12	36	0	48

Results of 2019 Surveys: Dreissenid Veligers

The Good News!

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		THE DALLES RESERVOIR	BONNEVILLE RESERVOIR	"LOWER" COLUMBIA	
Plankton tow	CPLM Microscopy	0	0	0	0
Water sample	eDNA	0	0	0	0
Plankton tow	FlowCam	In progress	In progress	In progress	In progress

What went well and what posed difficulties?

Everything went “smooth as silk” – we’ve been doing this for many years now, so we are a “well-oiled machine.”

Plans and outlook for 2020

Little will be changed, except:

- slightly more frequent sampling (every 2 weeks rather than twice monthly)
- slight expansion upstream and downstream
- thus, we propose an approximate 10-20% greater effort in 2020 vs. recent years.

One last thought … Where is this sampled water coming from?

E.g., If flow rate = 50 cm/s

= 30 m/minute

= 1.8 km/hour or ~ 1 nautical mile/hour

= 24 nautical miles/day

= 168 nautical miles/week

= 336 nautical miles/2 weeks

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