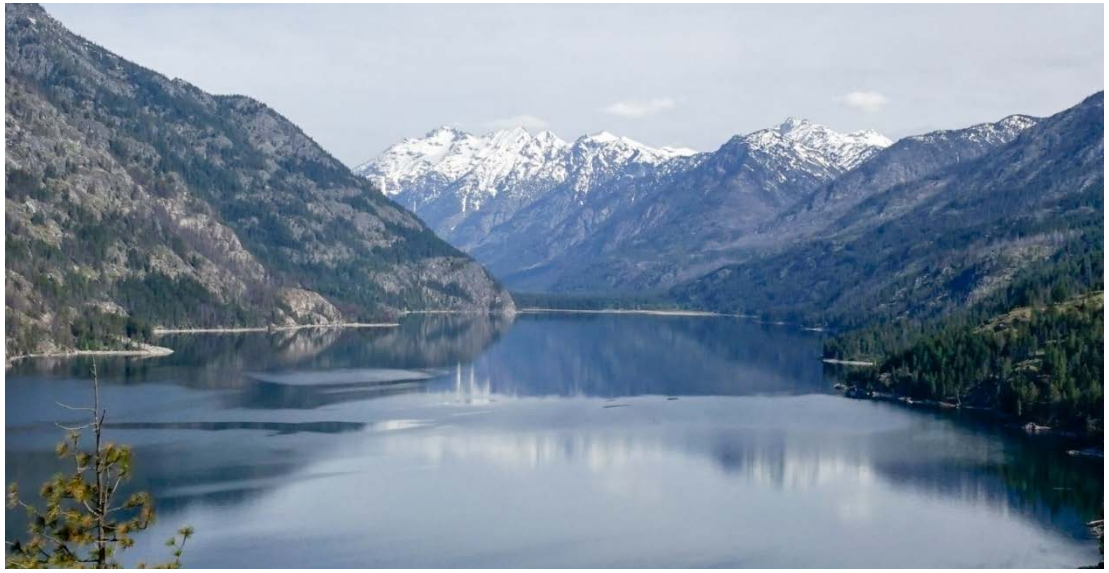
Lake Chelan Vulnerability and Habitat Suitability Analysis for Aquatic Invasive Species

Chelan County Natural Resources Department



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Environmental Science Associates

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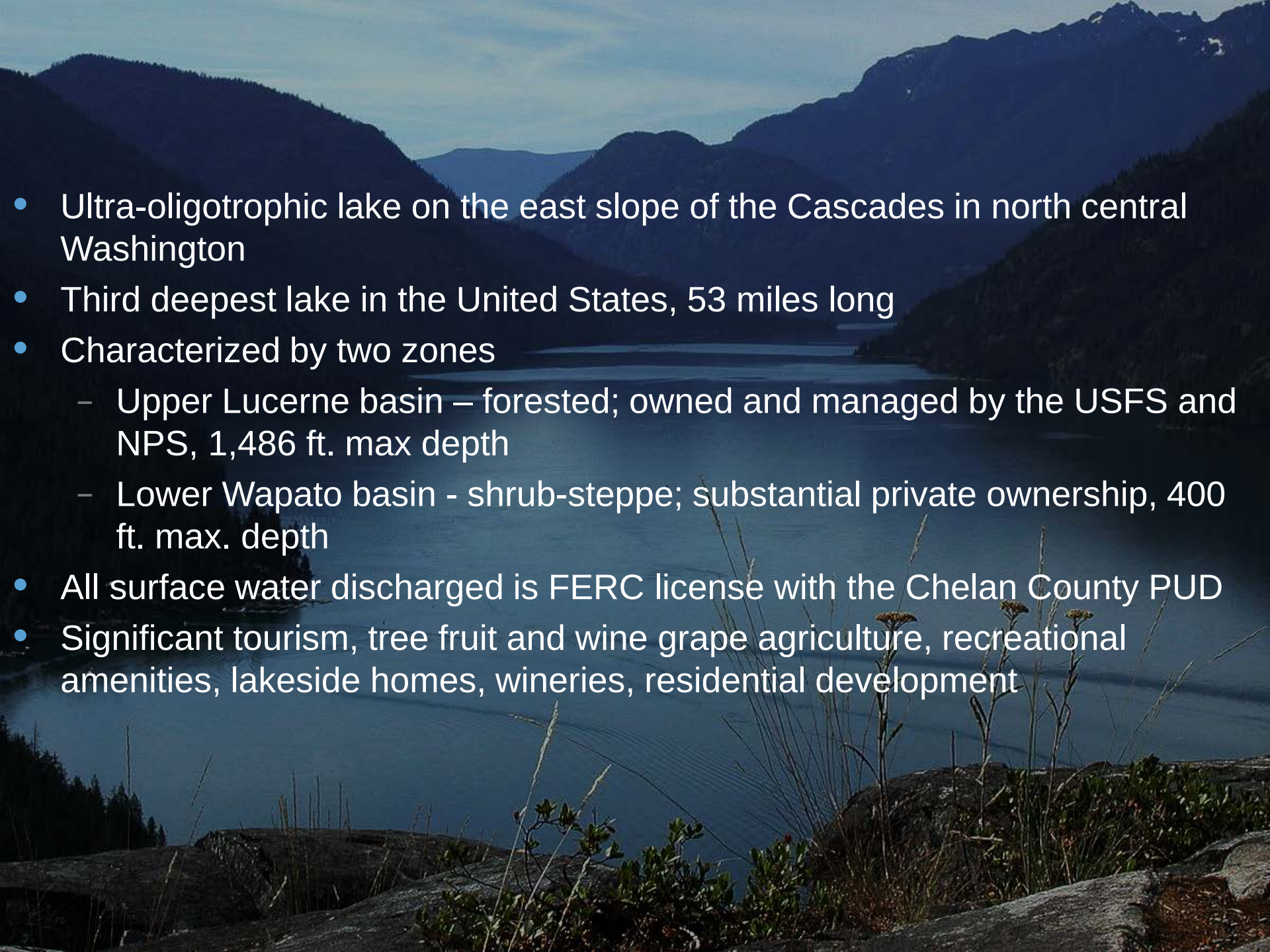
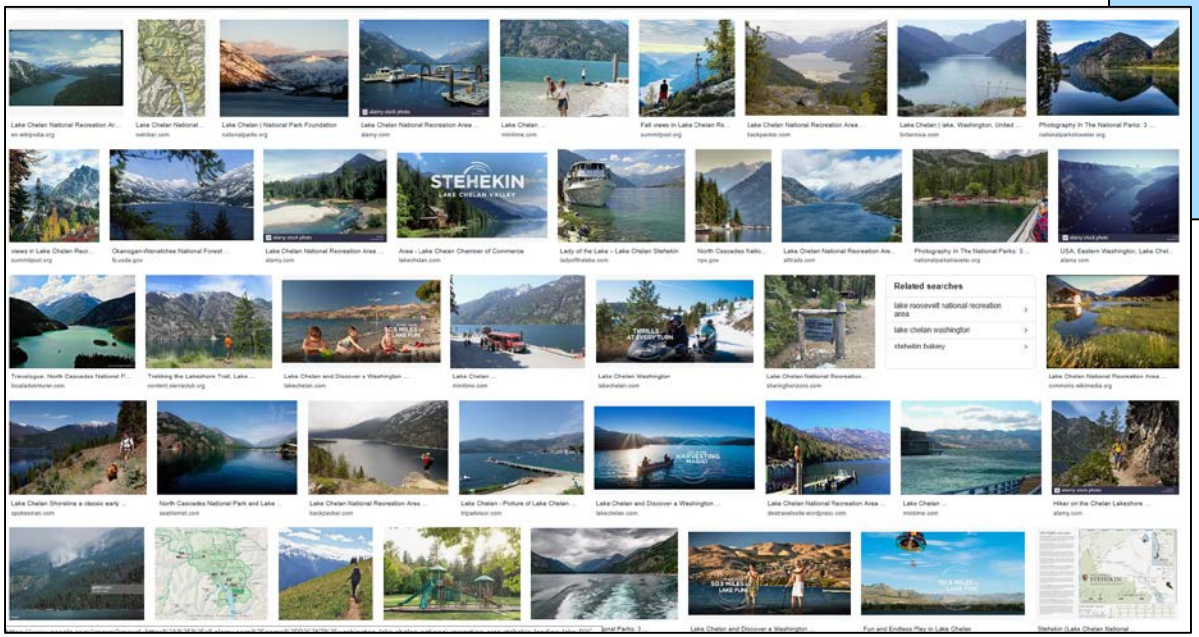
January 23, 2019 Columbia Basin Team Meeting, Portland, OR



- Ultra-oligotrophic lake on the east slope of the Cascades in north central Washington
- Third deepest lake in the United States, 53 miles long
- Characterized by two zones
  - Upper Lucerne basin – forested; owned and managed by the USFS and NPS, 1,486 ft. max depth
  - Lower Wapato basin - shrub-steppe; substantial private ownership, 400 ft. max. depth
- All surface water discharged is FERC license with the Chelan County PUD
- Significant tourism, tree fruit and wine grape agriculture, recreational amenities, lakeside homes, wineries, residential development

Lake Chelan: “Four Seasons of Recreation”



- 2018 Chelan county visitors spent an estimated $647 million on direct travel spending (accommodations, food, transportation, entertainment, etc.) (WA Tourism Alliance 2019)
- Invasive species (aquatic and terrestrial) pose the greatest risk to Michigan’s tourism industry (Nicholls 2012)

AIS Known to Occur in Lake Chelan

- Invertebrates
  - Asian clams, Chinese mystery snails
- Fish
  - Bluegill, black crappie, smallmouth and largemouth bass, channel catfish, lake trout, tench, pumpkinseed
- Aquatic Plants
  - Eurasian watermilfoil, curlyleaf pondweed

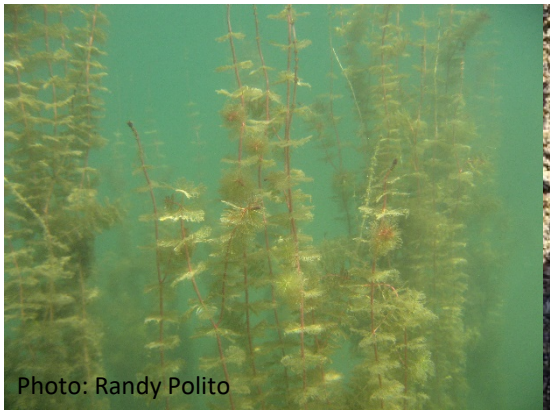


Photo: Randy Polito


Photo: Phil Long, Chelan Research Institute


Photo: Lake George Association

AIS of Concern to Lake Chelan

- Invertebrates
  - Quagga/zebra (QZ) mussels, New Zealand mudsnail
- Fish
  - Northern pike
- Aquatic Plants
  - Flowering rush


Photo: Colorado Parks and Wildlife

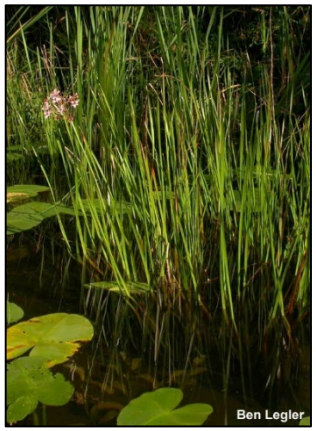

Ben Legler


Photo: Robyn Draheim


Photo: WDFW

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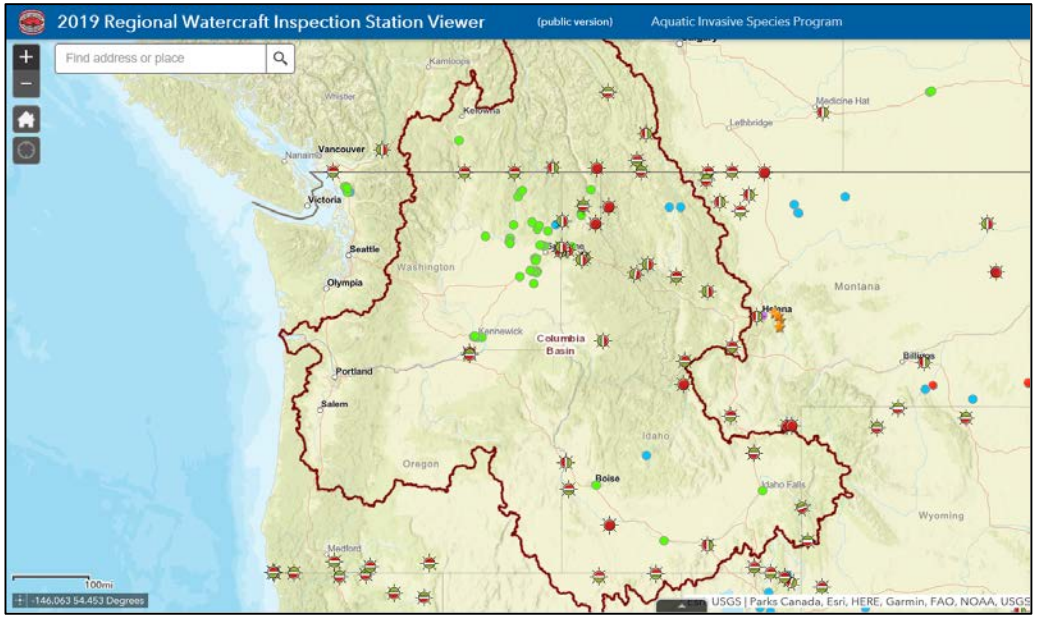
Goals and Objectives

- Assist the Lake Chelan Planning Unit in its efforts to prevent AIS infestations from occurring in Lake Chelan

- Evaluate the level of risk of an AIS infestation by analysis of vulnerability and habitat suitability variables associated with Lake Chelan

Regional Boat Inspections

- Washington, Idaho, Oregon inspection stations
  - WA: >57,000 inspections at two launches bet. 2018 and 2019 - three watercraft came from infested waters (Lake Mead and Lake Powell) and were headed to Lake Chelan
- Whatcom Boat Inspection Program
  - In 2018 – 12,444 boats inspected from 806 waterbodies from 47 states or provinces; *including 74 mussel infested waters*
  - Lake Chelan one of the top 10 previously visited lakes
  - Interstate movement of multi-taxa AIS



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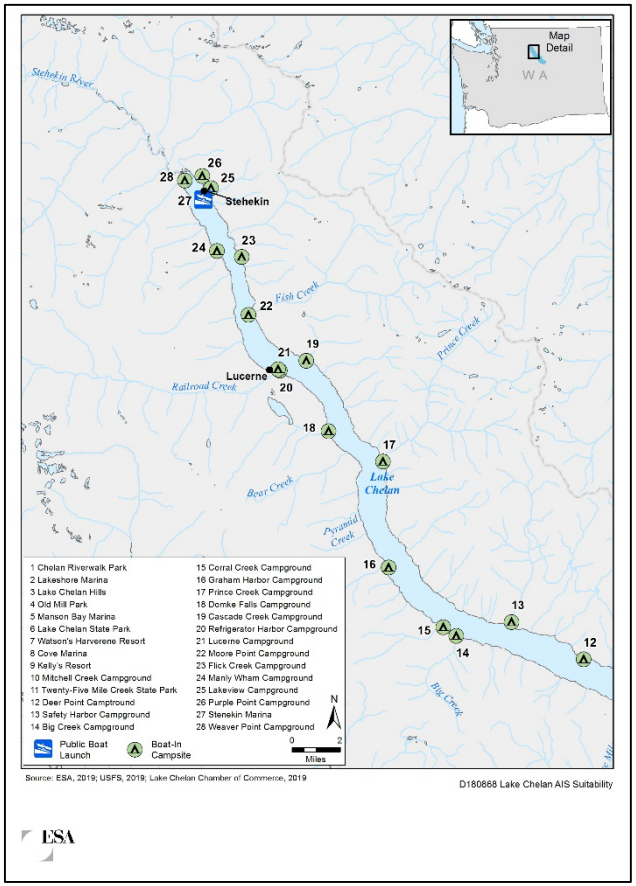
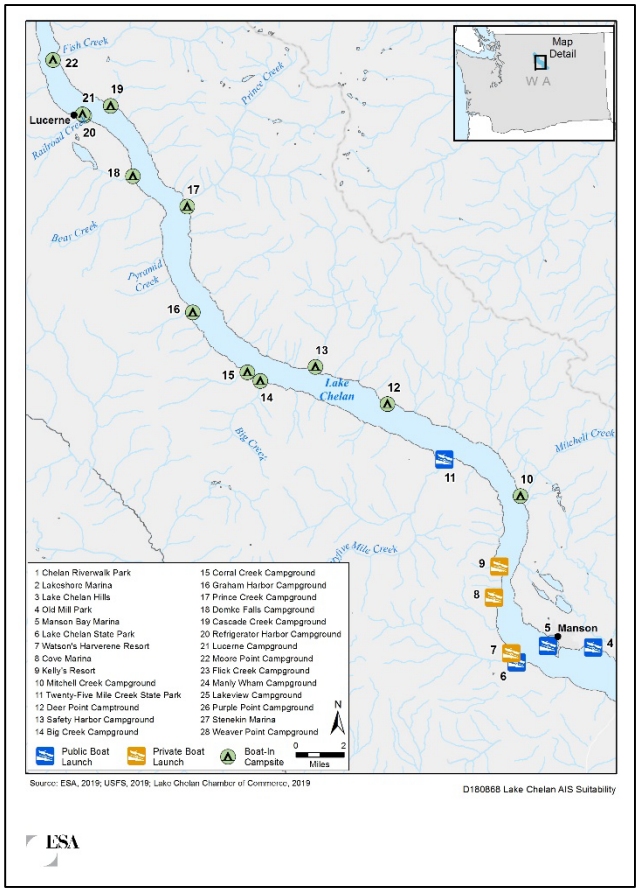
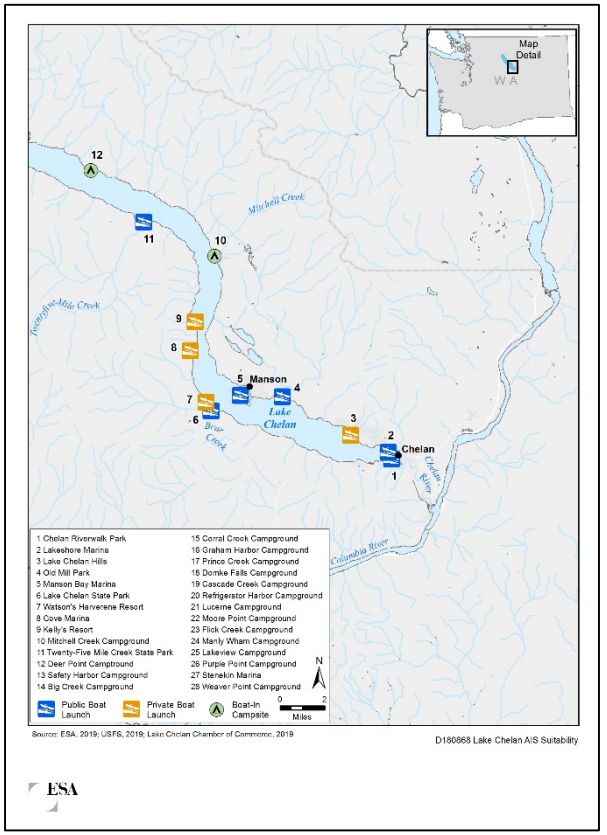
Lake Chelan Boat Launches







Lake Chelan Boat Launch Usage

- 5 Major public boat launches serving Lake Chelan

  Chelan River Park (no fee)
  + Lakeshore Marina (moorage and launch fees)
  + Lake Chelan State Park (launch fee)
  + Old Mill Park (launch fee)
  + Twenty-five Mile Creek State Park (launch fee)

  ~4,800 Daily permits and launches per year

- NPS and USFS Federal Dock Permits
  - Sell on average 1,267 permits over the past 6 years (minus 2015)

Conditions Favoring QZ Establishment

- Number of Introductions
  - Including transport and releases
- Propagule Pressure
- Food Availability
- Suitable Substrate
- Environmental conditions
- Water Quality
  - Optimal pH
    - Larval survival pH of 8.4
    - Adult growth 7.4 to 8.0
  - Temperature
    - Spawning 12°C
    - Egg release 17 to18°C
    - Larval development 20 to 22°C
    - Adult tolerances 20 to 25°C
  - Dissolved Calcium


Photo: Marty Wise

Dissolved Calcium and Mussel Establishment

- Waters with Ca ≤ 12 mg/L have been deemed “low risk” (Cohen 2007, Whittier et al. 2008)
- Uncertainty in assigning single parameter to risk
  - Low Ca waters (12 – 15 mg/L; Lake Tahoe) can support mussels through key life stage and life history processes (Chandra et al. 2009)
  - Quagga mussels have higher risk of establishment in low calcium lakes if habitats exist with slightly elevated Ca, emphasizing the vulnerability of water-body in the 12 to 15 mg/L Ca range (Davis et al. 2015)


Photo: Brant Allen, UC Davis

- Calcium “hot spots” ?
  - Asian clam beds (Chandra et al. 2009)
  - Streams
  - Concrete piers

Dissolved Calcium in Lake Chelan

- Measured from the nearshore environment of Lake Chelan since 2016
  - Ranged from 6.95 to 7.50 mg/L (Source: WDFW)
- Areas with the greatest calcium-rich rocks are associated with Twenty-five Mile Creek, Big Creek, and Bear Creek
- However…Mitchell Creek
  - 82 mg/L unknown if results are dissolved or calcium carbonate (Pelletier et al. 1989)
  - 36 mg/L (Phil Long, 2019, personal communication)

Overview USBR Risk Assessment Tool [1]

- Calculates a weighted “risk” score based on each parameters importance
- Risk values were assigned as high (4), moderate (3), medium (2), and low (1)
- Score Risk Ranges
  - High 76 to 100
  - Moderate 51 to 75
  - Medium 26 to 50
  - Low 0 to 25

[1] *Developed by Heidi McMaster, Invasive Species and IPM Coordinator for the Pacific Northwest Regional Office of the Bureau of Reclamation (USBR)*

USBR Chelan Risk Assessment

Parameter	Units	Data	Risk Value	Source
Dissolved calcium	mg/L	7.26	1	WDFW
pH	--	8.1	4	WDFW
Total phosphorus	µg/L	8.1	2	EIM (‘16-’18)
Secchi disk transparency	m	6.6	2	WDFW
Dissolved oxygen	mg/L	9.2	4	WDFW
Temperature	°C	18.1	4	WDFW
Conductivity	µS/cm	49.5	2	EIM(‘07)
Alkalinity, Total as $CaCO_3$	mg/L	18.3	1	EIM (‘16-’18)
Hardness	mg/L	n/a	1	No data
Chlorophyll	µg/L	1.1	1	EIM (‘16-’18)
Total nitrogen	µg/L	151	3	EIM (‘16-’18)
Number of boat launches	--	>5	4	Mapping
Restrictions on motorized watercraft	--	No	4	WDFW
Presence of boat moorage	--	Yes	4	WA State Parks, NPS, USFS
Number of water-based events	--	>1 per year	4	Chamber of Commerce
Endangered/threatened species present	--	No	1	USFW IPaC
Number of hydropower facilities & water intakes	--	>10	4	City of Chelan, Lake Chelan Reclamation District, Phil Long

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Score 74 = Moderate Risk

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WDFW Chelan Risk Assessment

Parameter	Score
Dissolved Calcium	1
Public	4
# Boat Ramp	4
Boat Ramp Paved	4
Boat Ramp w/Dock	1
Motorized Watercraft Allowed	4
Speed Limit > 10 mph	4
Moorage	4
Private Docks	4
Access Year Around	1
Ease of Access	4
In Columbia River Basin	1
Water Body Size	4
Fish Stocked	1
Hatchery/Net Pen	4
2018 Fishing Tournaments	4
2018 Motorized Watersport Tournaments	0
Boatyard	4
Hydropower/Flood Control	4
Irrigation	4
Municipal Water	4
Proximity to Source Population	2

Score 67 = Monitoring Frequency of 3x/year

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Conclusions/Questions

- Sheer number of boats coming to lake Chelan = high risk for **introduction**
- Do localized environmental conditions affect potential AIS **establishment**?
- Other AIS taxa
  - Presence of one AIS could favor establishment of others
  - Emphasize multi-taxa prevention
- Sediment types and available substrates?

Data Gaps and Recommendations

- Continue/expand on WDFW monitoring efforts
  - Targeted monitoring at tributaries, small lakes, irrigation returns, Asian clam beds
  - Flow measurements at major tributaries to estimate loading and seasonality
- Funding
  - Longer-term, public-private partnerships, federal match
- Conduct a lake-wide survey during low water periods for multi-taxa
- Citizen science
  - Owners of piers, boatlifts, buoys, docks

Photo: Lake Whatcom

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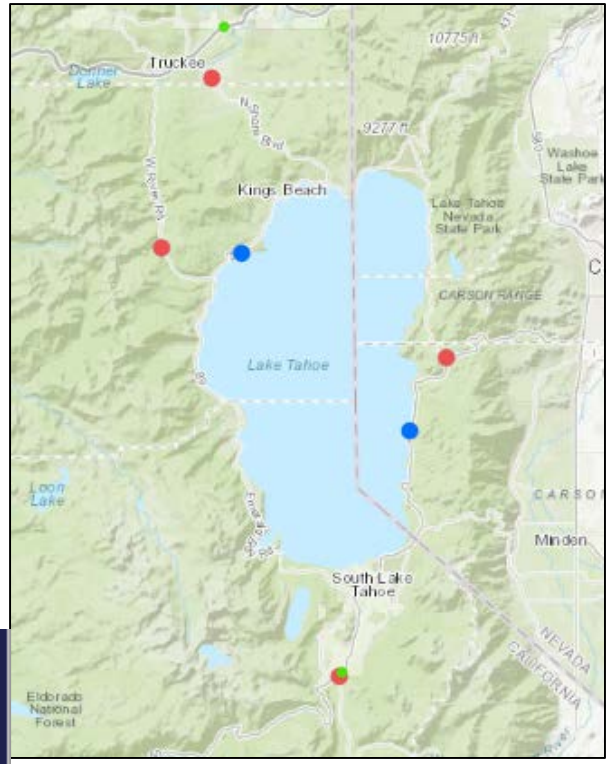
Data Gaps and Recommendations, *cont.*

- Boat Inspection and Decontamination
  - Catch traffic from Seattle, Canada, and Spokane areas
  - Off site locations (Tahoe)?
  - Whatcom Boat Inspection Program
- Boater/Watercraft Survey
  - Boater usage (to/from)



Acknowledgements

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