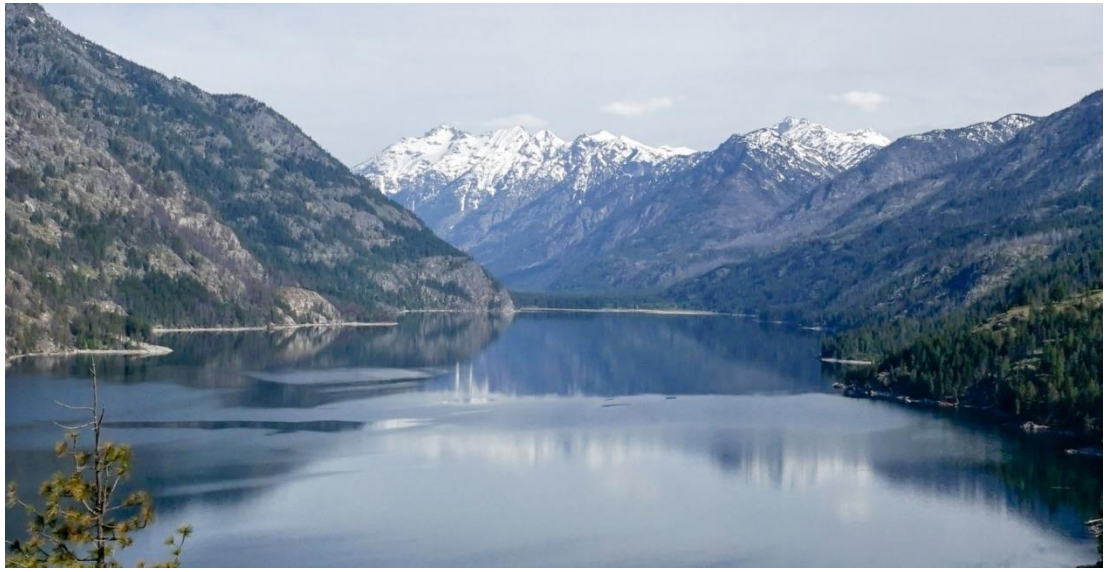
Lake Chelan Vulnerability and Habitat Suitability Analysis for Aquatic Invasive Species



Toni Pennington
Environmental Science Associates

Shannon Brattebo
Tetra Tech

October 30, 2019; revised 12/10/10

AIS: The Players

- 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

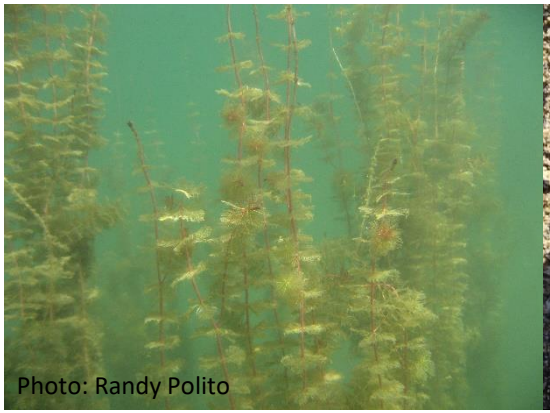


Photo: Randy Polito


Photo: Phil Long, Chelan Research Institute


Photo: Lake George Association

AIS: The Players, *cont.*

- 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


Photo: WDFW

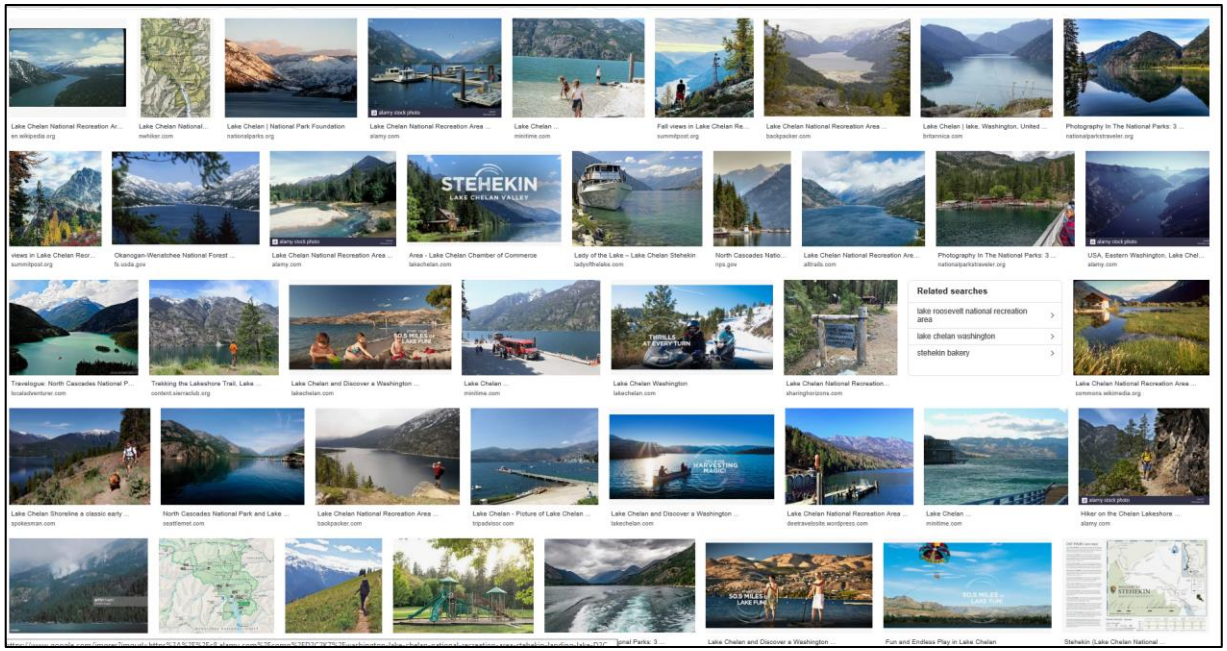

Ben Legler


Photo: Robyn Draheim

ESA 50 YEARS 1969-2019

Impacts of AIS

- Recreation

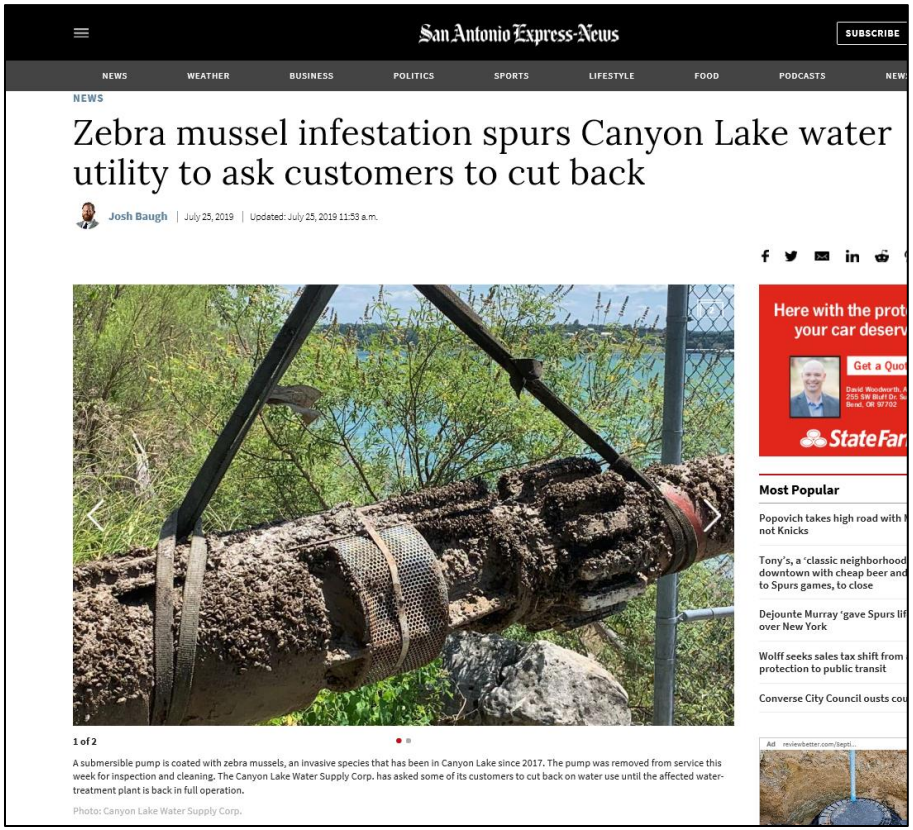


  - Invasive species (aquatic and terrestrial) pose the greatest risk to Michigan's tourism industry (Nicholls 2012)
  - "Four Seasons of Recreation"
    - 2017 Chelan county visitors spent an estimated $562 million on accommodations, food, transportation, entertainment, etc. (Dean Runyan Associates 2018)

Impacts of QZ Mussels

- Filter feeders
  - 1 L per day
  - Water quality, clarity
  - Human health
- Attachment to substrates
  - Water conveyance
  - Clogs pipes
  - Hydropower
- Aesthetics
  - Decomposing shells
  - Recreation

Photo: El Dorado Irrigation District


San Antonio Express-News

SUBSCRIBE

NEWS WEATHER BUSINESS POLITICS SPORTS LIFESTYLE FOOD PODCASTS

NEWS

Zebra mussel infestation spurs Canyon Lake water utility to ask customers to cut back

Josh Baugh | July 25, 2019 | Updated: July 25, 2019 11:53 a.m.

1 of 2

A submersible pump is coated with zebra mussels, an invasive species that has been in Canyon Lake since 2017. The pump was removed from service this week for inspection and cleaning. The Canyon Lake Water Supply Corp. has asked some of its customers to cut back on water use until the affected water-treatment plant is back in full operation.

Photo: Canyon Lake Water Supply Corp.

Most Popular

Popovich takes high road with N not Knicks

Tony's, a 'classic neighborhood downtown with cheap beer and to Spurs games, to close

Dejounte Murray 'gave Spurs lif over New York

Wolff seeks sales tax shift from protection to public transit

Converse City Council ousts cou

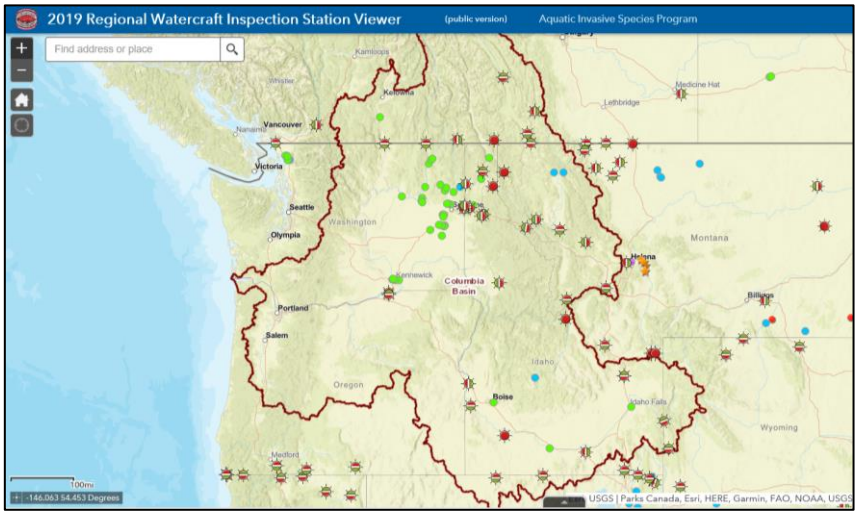
TETRA TECH

ESA 50 YEARS 1969-2019

Pathways of Introduction

- **Pathways** describe the means and routes by which invasive species are introduced into new environments.
  - Natural: wind, waves, currents, wildlife
  - Human Activity: recreational equipment, boats, floatplanes

Regional Boat Inspections



- Washington Inspection Stations
  - WA-ID border and WA-OR border
  - WDFW inspected 32,502 watercraft between 2016 and 2019:
    - 21,625 at Spokane Check Station
    - 9,429 at Plymouth Check Station
    - 887 Diamond Lake Partners
    - 539 WDFW Officers
    - 1 WA State Patrol
  - 16 watercraft with mussels
  - July – Jet boat from Lake Mead headed to Lake Chelan
    - Decontaminated at Mead and had been 2 days out of water
  - August - wakeboat from Lake Powell with standing water in ballast
  - August – Two personal watercraft from Lake Powell headed to Lake Chelan with standing water (decontaminated)

WDFW Inspection Stats 2016 to 2019

2016/2017/2018/2019 Inspection Station Information Statistics

Total Number of Check Station Days 2015	Total Number of Check Station Days 2016	Total Number of Check Station Days 2017	Total Number of Check Station Days 2018	**Total Number of Check Station Days 2019
?	86	216	469	559

**includes concurrent roving stations

No. of Boats Inspected 2015	No. of Boats Inspected 2016	No. of Boats Inspected 2017	No. of Boats Inspected 2018	**No. of Boats Inspected 2019
993	2,180	9,054	24,645	32,502

**includes inspections at concurrent roving stations

# of Mussel fouled Boats found 2015	# of Mussel fouled Boats found 2016	# of Mussel fouled Boats found 2017	# of Mussel fouled Boats found in 2018	# of Mussel fouled Boats found in 2019
0	0	0	18	16

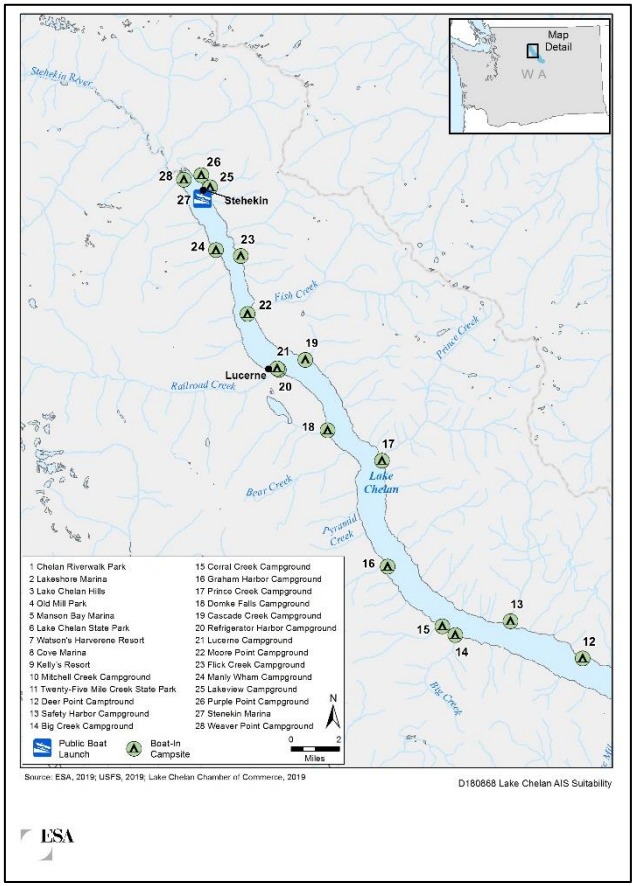
Source: Sgt. Pamela Taylor

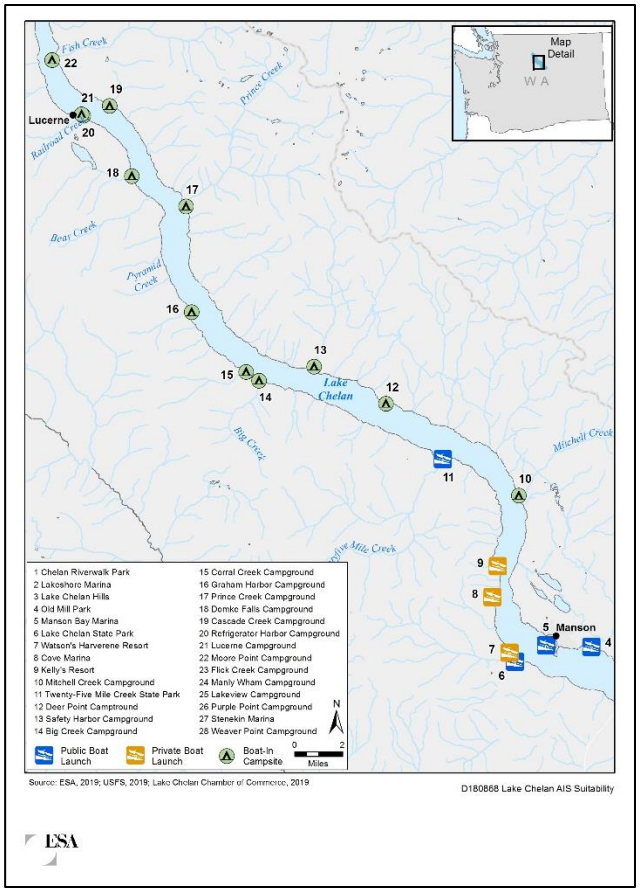
Regional Boat Inspections, *cont.*

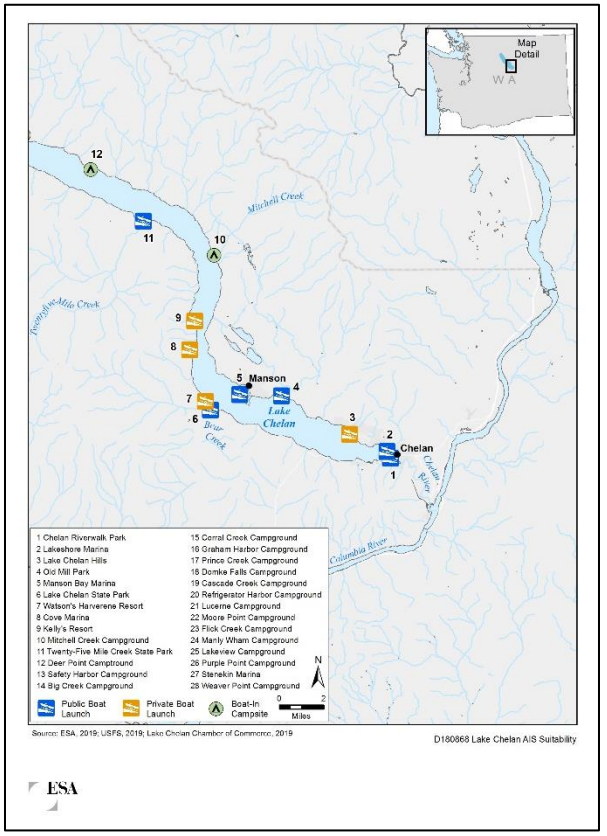
- Lake Whatcom and Lake Samish inspection stations
  - In 2018 – 12,444 boats inspected from 267 waterbodies from 29 states or provinces; *including 14 from mussel infested waters*
  - 65 boats directly from Lake Chelan
  - 387 boats previously at Lake Chelan at some time
  - None of the 452 boats that had visited Lake Chelan prior to inspection had home residences at or near Lake Chelan

- Idaho Department of Agriculture
  - 2009-2013
    - 56 boats heading to Lake Chelan
    - 143 boats previously at Lake Chelan
  - 2015
    - 16 boats heading to Lake Chelan
    - 35 boats previously at Lake Chelan
- Watercraft owners ARE traveling to Lake Chelan to recreate!

Lake Chelan Boat Launches







TETRA TECH

Boat Launch Usage – The Numbers

- 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 QZ Establishment – The Working Paradigm

- Waters with Ca concentrations ≤ 12 mg/L have been deemed "low risk" for establishment, growth and reproduction (Cohen 2007, Whittier et al. 2008)
- However, very low calcium waters (12 – 15 mg/L; Lake Tahoe) can support mussels through key life stage and life history processes
- Small differences in calcium concentrations (e.g. 9 vs 12 mg/L) can improve survival, growth, and reproduction potential (Davis et al. 2015, Chandra et al 2009)
- Calcium "hot spots"
  - Asian clam beds

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)

Back to Substrates…

- There are a combined 1,336 permitted piers, boatlifts and buoys on the lake. This includes several large marinas that have more than one boat slip even though they are only given one permit
- Unknown are how many private docks provide potential habitat for attachment though this could be evaluated through a desktop GIS exercise.

Overview Risk Assessment Tool [1]

- Parameters Considered
  - Dissolved calcium
  - pH
  - Total phosphorus
  - Secchi disk transparency
  - Dissolved oxygen
  - Temperature
  - Conductivity
  - Alkalinity
  - Hardness
  - Chlorophyll
  - Total nitrogen
  - Number of boat launches
  - Restrictions on motorized watercraft
  - Presence of boat moorage
  - Number of water-based events
  - Endangered/threatened species present
  - Number of hydropower facilities and water intakes

- 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)*

Chelan Risk Assessment – Score 74 = Moderate Risk

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

Data Gaps and Recommendations

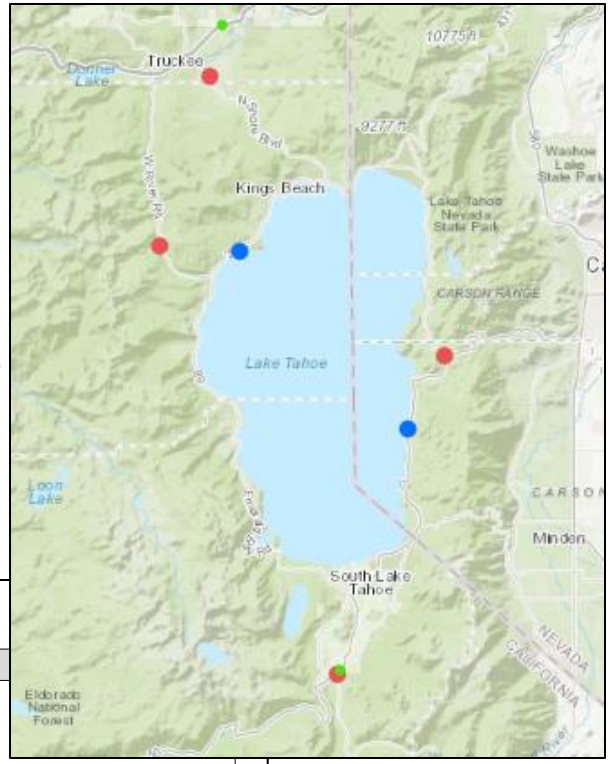
- Funding
  - Longer-term AIS or WQ monitoring outside WDFW efforts
  - Public-private partnerships
  - Matching funds from the Aquatic Nuisance Species Task Force
  - Other “models”
- Continue/expand on WDFW monitoring efforts, including
  - Substrate monitoring – adults
  - Tow sampling – veligers
  - eDNA analysis – presence
  - Visual shoreline surveys
  - Petit Ponar grab samples
- Conduct a lake-wide survey during low water periods
  - Document location, size, and density of established Asian Clam beds
  - Opportunity to monitor for other aquatic invasive animals such as zebra/quagga mussels, New Zealand mudsnails, crayfish, and Chinese mystery snail

Data Gaps and Recommendations, *cont.*

- Sediment Types and Available Substrates
  - More detailed information piers, sediment types around the lake
- Water Quality (AIS-focused)
  - Flow measurements at major tributaries to estimate loading and seasonality
  - Continue/expand targeted monitoring at tributaries, nearshore areas downstream of tributaries, small lakes, irrigation returns, and near large Asian clam beds
    - Dissolved calcium, temperature, pH, conductivity, chlorophyll *a,* Secchi depth transparency
    - 4 x per year (quarterly basis to capture seasonality)

Data Gaps and Recommendations, *cont.*

- Boater/Watercraft Survey
  - Information on current boater usage, including point of origin and planned destination within the lake itself
- Boat Inspection and Decontamination
  - Catch traffic from Seattle, Canada, and Spokane areas
  - Off site locations?



Lake Whatcom Management Program Vessel Survey Form

Data Entry Information: Survey ID:_____ Date Entered:_____ Staff:_____

Date:_____ **Time:**_____ **Surveyor:**_____ **WB:** Lake Whatcom **Site:** _____

State Registration #:_____ **Zip Code:**_____ **License Plate:**_____

Vessel Type: Fishing ☐ Wakeboard ☐ Sailboat ☐ Other Power ☐ PWC ☐ Non-motorized ☐ Trailer ☐

Last waterbody where launched:_____ **Date:**_____

Other waterbodies visited:_____

Where plan on launching next (waterbody, state/province):_____

Do you clean boat/trailer between uses? YES ☐ NO ☐

AIS Knowledge: Z/Q Mussels ☐ Other ☐ _____ From where?_____

Clean, Drain Dry Awareness: YES ☐ NO ☐ If YES, from where?_____

Repeat Boater: YES ☐ NO ☐ **Lake Whatcom ONLY:** YES ☐ NO ☐

TETRA TECH

ESA 50 YEARS 1969-2019

Recommendations, *cont.*

- AIS and Aquatic Plant Survey
  - Comprehensive AIS survey during spring low water
  - Aquatic plant survey in Lucerne Basin or tributaries and increase frequency of surveys every 3 to 5 years
- Potential education opportunity coupled with citizen science
  - Can owners of piers, boatlifts, buoys, docks, etc. be given the necessary information and tools to survey their property for mussels
  - Provide them with easy to follow instructions (SOPs)
  - Data collected would be incredibly valuable and provide opportunity for rapid response

Conclusions

- Sheer number of boats coming to lake Chelan = high RISK for **introduction**
- Localized environmental conditions could affect potential AIS habitat
- Consider impacts of AIS other than QZ mussels
- Presence of one AIS could favor establishment of others
- Emphasize multi-taxa prevention
- Recommend prioritizing data gaps in an effort to move toward a cohesive AIS program

Acknowledgements

Chelan County Natural Resources Department

Lake Chelan Planning Unit Partners

National Park Service

U.S Bureau of Reclamation

Special thanks to Heidi McMaster, USBOR

TETRA TECH

ESA 50 YEARS 1969-2019