Broadscale distribution, abundance, and habitat association of the Asian clam (*Corbicula fluminea)* in the lower Columbia River, USA

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ABSTRACT

The Asian clam, *Corbicula fluminea*, is an invasive freshwater bivalve that has established populations throughout the world, including the Pacific Northwest, USA, and which is thought to have deleterious effects on natural and human systems. During 2017-2020 we collected adult and juvenile *C. fluminea* from 15 mid-channel and 26 shore-based sampling locations throughout the lower Columbia River to elucidate the association of *C. fluminea* with habitat characteristics, including dissolved O_2, pH, temperature, salinity, specific conductivity, depth, geographic location, chlorophyll-*a* concentration, bank slope, and sediment composition (granulometry, TOC). Here, we present preliminary results on the distribution and abundance of *C. fluminea* in the lower CR. Our ongoing study will provide a better understanding of the basic biology and ecology of this global invader, as well as provide natural resource managers with information on where, when and why this bivalve invades temperate river ecosystems.

Figure 1: Adult *C. fluminea* individual

BACKGROUND

The Columbia River (CR) and its impounded lacustrine areas represent a heavily invaded ecosystem[1 2] first colonized by *C. fluminea* in 1938 via human transmission[3]. *C. fluminea* has become well established in the CR, with densities up to 722 individuals m-² and 500 individuals m-² in main-channel[4] and near-shore areas[5], respectively. *C. fluminea* establishes quickly in novel lentic/lotic environments due to its hermaphroditic reproduction[6] and can alter ecosystems by outcompeting native taxa (i.e., Unionidae)[7], affecting sediment dynamics through bioturbation[8], or filtering out up to 70% of phytoplankton from the seston[9]. Mucoid secretions by *C. fluminea* larvae can clog pipes and heat exchangers where population densities are high[10], contributing to over $1B in annual invasive bivalve remediation costs globally[11]. Despite these 80+ years of occurrence, a limited body of literature concerning the ecology of *C. fluminea* in the CR exists, particularly regarding its habitat association. It is known that adult *C. fluminea* abundance in the lower CR is positively related to chlorophyll-*a* concentration and temperature[5], while its larval abundance is related to water temperature[12]. Our ongoing study will expand the existing body of research on *C. fluminea* by addressing the following research questions.

RESEARCH QUESTIONS

1. **What is the broadscale distribution and abundance of *C. fluminea* in the lower CR?**

2. **What environmental variables are the best predictors of *C. fluminea* abundance?**

3. **How does *C. fluminea* condition vary spatially in relation to environmental variables?**

STUDY AREA - LOWER COLUMBIA RIVER

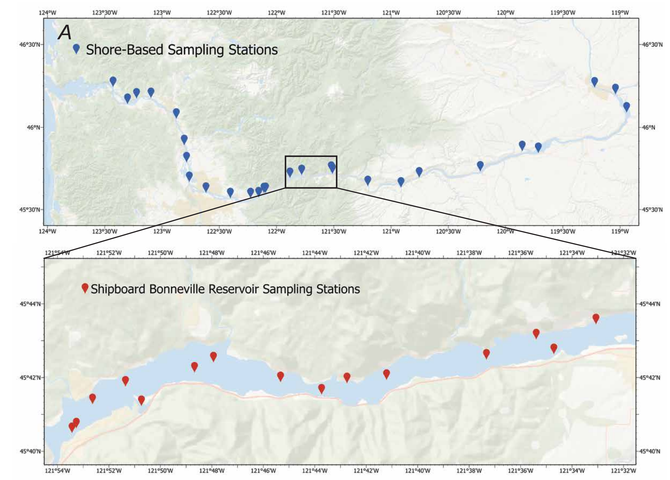

Figure 2: A) Shore-based CR sampling stations B) Shipboard Bonneville Reservoir sampling stations

METHODS

• **Shore-based sampling:** Triplicate samples taken at 5m intervals at 30cm water depth

o All *C. fluminea* individuals within 1m² sample quadrat collected from top 15cm of substrate

o Chlorophyll-*a* sample, sediment samples, and environmental recordings taken at each subsample

• **Shipboard sampling**: Ponar grab sampler deployed from research vessel deck to reservoir bed at each station until three successful (sediment-containing) deployments collected, or *C. fluminea* found present within a sample.

o *C. fluminea* from within each grab were collected alongside chlorophyll-*a* sample, sediment sample, and environmental recordings

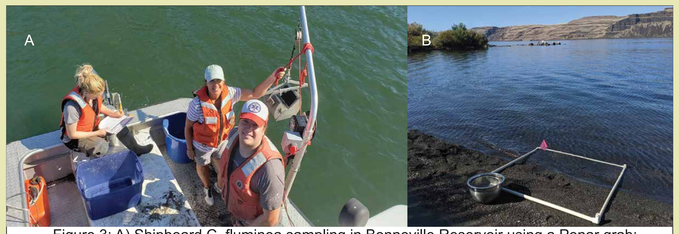

Figure 3: A) Shipboard C. fluminea sampling in Bonneville Reservoir using a Ponar grab; B) Shore-based sampling utilizing a 1 m² quadrat

RESULTS - DISTRIBUTION AND ABUNDANCE

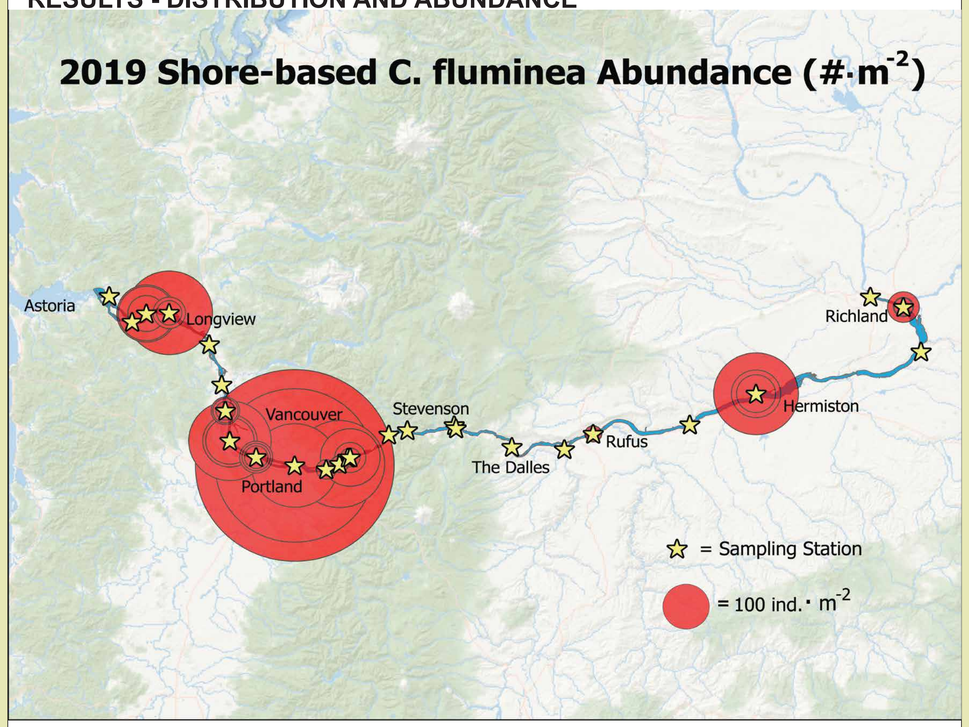

Figure 4: Abundance of *C. fluminea* in the lower CR in 2019 (nested circles represent values from triplicate samples at each sampling station).

SUMMARY OF RESULTS AND FUTURE DIRECTIONS

A majority of 2019 shore-based sample sites with abundances of >100 *C. fluminea* ind. m-² were located west of Bonneville dam, with the majority of sample sites with zero *C. fluminea* abundance located to the east. Sample stations featuring the highest *C. fluminea* abundances in 2019 included Blurock Landing near Vancouver, WA (avg. 117 ind. m-²), Sandy River confluence near Gresham, OR (avg. 342 ind. m-²), and Crow Butte Park near Paterson, WA (avg. 182 ind. m-²). These results are generally consistent with previous studies and represent the broadest spatial scale of *C. fluminea* sampling in the CR to date

2020 shore-based sampling is ongoing, with future work to include:

• Qualitative sediment characterization by soil type, quantitative sediment characterization by size fractionization, clay/silt content (granules <125um diameter), and TOC content

• Quantification of *C. fluminea* condition at each sample site via length:mass ratio

• Mixed-model regression analyses to explore relationships between *C. fluminea* abundance and condition (dependent variables) with environmental variables (predictor variables) for each dataset (shipboard & shore-based)

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