Aquatic Invasive Species Research at FLBS

Early detection of aquatic invasive species: preventing ecosystem and economic collapse

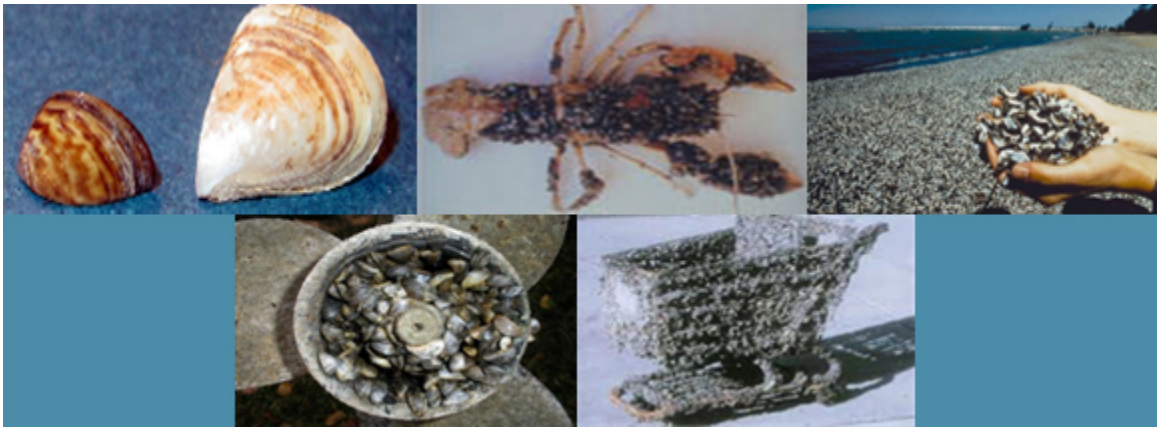

Figure 1 (a) zebra & quagga mussels; (b) encrusted boat propeller; (c) a crayfish encrusted with zebra mussels; (d) millions of handfuls of dead zebra mussel shells littering beaches making it difficult to walk on or use the beach; (e) a shopping cart pulled from a mussel lake in the Midwest;

Background

Early detection of Aquatic Invasive Species (AIS) offers the best (and often only) chance of eradication and prevention of spread. This is particularly true for zebra and quagga mussels, as they have never been eradicated from a large water body once broadly established.

Here at the Flathead Lake Biological Station, we have developed powerful and highly sensitive environmental DNA (eDNA) tests for early detection of invasive zebra and quagga mussels (as well as other AIS). These mussels are two of the world's most problematic biological invaders (Figure 1). They are colonizing and devastating lakes and rivers across North America and might soon invade Montana and the Columbia River drainage.

These mussels reproduce and spread prolifically and cost the U.S**. billions of dollars** each year. They require expensive annual maintenance as they clog water intakes and damage equipment by attaching to anything, including boat motors and can even get inside engine cooling systems. They have repeatedly impacted ecosystems by consuming the majority of available food (e.g., plankton), collapsing fisheries, smothering native mussels and crayfish (Figure 1), and littering beaches with their sharp shells that cut the feet of children and animals.

Recent advances in genetic technologies allow detection a species' DNA in water samples making it feasible for sensitive, rapid and early detection of tiny organisms (e.g., larvae), their excrement, or cells sloughed (Beja-Pereira et al. 2009; Blanchet 2012; Allendorf et al. 2013). This allows early detection of the initial colonists (usually transported on trailered boats) which vastly improves managers' ability to prevent colonization and spread.

Our research is leading the way to develop, refine, and apply field sampling protocols and laboratory eDNA tests for the early-detection of invasive mussels from plankton tow samples from lakes and streams in Montana and the Pacific North West.

The Need

We still need funding each year to collect samples from various locations around Flathead Lake (and other lakes) and to pay for the supplies and labor of our expert technicians and student assistants. The total funding needed for maximum protection of Flathead Lake is approximately $40,000 per year. This would pay for **sampling and testing several times from each of multiple locations** (high risk locations such as boat ramps and marinas) throughout summer. However, smaller amounts would allow for some monitoring, (e.g. of a few key hot spots). We greatly need your engagement and financial assistance with this effort to protect Flathead Lake from invasion.

An endowment of approximately $850,000 would pay for maximum protection (via frequent eDNA monitoring) of Flathead Lake for invasive mussels long into the future.

Additional information

We also have developed sensitive tests for early detection of Eurasian watermilfoil, an aquatic plant that rapidly invades streams and lakes and leads to reduced property values of 13-19% (Horsch & Lewis 2009; Zhang & Boyle 2010, Olden and Tamayo 2014). It can choke off water ways making them impassible to swimmers and boats (fouling propellers). Thick masses of these plants have even **entangled and drowned young children and pets**.

We also have eDNA tests for invasive **brook trout, lake trout, northern pike, bass, mud snails**, and more. The same water (or plankton tow) sample can be used to test for multiple species.

We are building water sample archives and conducting monitoring required for long-term surveillance to prevent spread of many invasive species. We can develop eDNA tests for any other aquatic species, including emerging infectious pathogens that harm fish, wildlife, and humans.

Finally, we are developing tests to detect presence of **native fish (bull trout)** in stream water samples which will help managers monitor their distribution and abundance which is crucial for species management.

In short, this environmental DNA technology is changing the field of ecology and how we monitor and manage our aquatic resources. **Please join our efforts today**.