

## Recommendation for the Use of All Available Technologies Including eDNA for Early Detection of Invasive Mussels in Montana

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Invasive mussels pose a dire threat to the economic and ecological health of Montana. To meet this challenge, the Flathead Lake Biological Station advocates for the use of all available approaches, including both environmental DNA (eDNA) and microscopy as complementary monitoring and detection techniques. Of particular importance is *early* detection, which provides the best and perhaps the only opportunity for containment and eradication. Here we summarize our perspectives.

We recognize that microscopy is a strong technique for detecting veligers (i.e., mussel larvae) during the summer spawning season (July/Aug). However, the utility of microscopy is only high for ~2-3 months/year – after veligers have been produced by mature mussels and are in their free-floating stage, prior to settling and attachment onto surfaces. In contrast, *eDNA detection techniques can be used for a much longer period each year* (even the entire year) because, if invasive zebra/quagga mussels are present in any life stage (larval or adult), their DNA will be present in the water. Thus, eDNA monitoring can be more effective than microscopy because, not only can it detect the veligers themselves during the spawning season (like microscopy), but throughout the year eDNA methods can detect DNA from adult mussels as well as from non-viable veligers after they die and decompose. Furthermore, *highly sensitive eDNA analysis can detect sloughed cells and feces from adult populations if present, and can be used to identify the species of mussel present; it is not necessary to collect a complete organism.*

Environmental DNA detection techniques therefore expand the time period and mussel life stages during which detection of invasive mussels is possible, not just when veligers are present during and immediately after the spawning season. It is important to point out that *early detection is key to the possibility of success of containment and eradication.* These mussels have never been eradicated once well established in a large water body. Thus, extensive monitoring efforts and associated early detection can help focus limited resources on immediate localized action which offers the only hope with current response and eradication technologies. Although a valid monitoring and detection technique, *veliger assessment through microscopy is not an effective EARLY detection technique* because, for veligers to be present in large enough numbers for microscopy to find the “needle in the haystack”, there is usually already a reproducing population of adults established in the water body. *Environmental DNA detection however offers the possibility of detection long before a significant number of adults is established.*

In summary, eDNA methods provide a number of powerful features that should motivate their adoption in a multi-pronged program of response to invasive mussels. eDNA methods:

- increase the time window during which mussels can be detected,
- have the ability to detect mussels at any life stage, from only a few cells, or even from mussel feces,

- can identify the species of mussel present, and
- greatly increase the chance of EARLY detection.

For these reasons, we encourage the State of Montana to incorporate eDNA monitoring and detection techniques for invasive mussels into their statewide plan, as a complementary technique to traditional microscopy. As background, below we list a number of recent peer-reviewed reviews supporting the use of eDNA in environmental monitoring. We welcome any questions or further inquiries that might arise.

Sincerely,

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Supporting Scientific Publications:

- Bohmann, Kristine; Evans, Alice; Gilbert, M. Thomas P.; et al. 2014. Environmental DNA for wildlife biology and biodiversity monitoring. *TRENDS IN ECOLOGY & EVOLUTION* 29: 358-367
- Rees, Helen C.; Maddison, Ben C.; Middleditch, David J.; et al. 2014. REVIEW The detection of aquatic animal species using environmental DNA - a review of eDNA as a survey tool in ecology. *JOURNAL OF APPLIED ECOLOGY* 5: 1450-1459
- Diaz-Ferguson, Edgardo E.; Moyer, Gregory R. 2014. History, applications, methodological issues and perspectives for the use of environmental DNA (eDNA) in marine and freshwater environments. *REVISTA DE BIOLOGIA TROPICAL* 62: 1273-1284.