Using eDNA to estimate the distribution of native mussels

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Summary

- California Floater present downstream of Evanston in Wyoming
- Western Pearlshell present throughout the Bear River basin of Wyoming

Why use environmental DNA (eDNA)?

- Mussels are cryptic and often buried in the sediment
- Mussels slough DNA while filter feeding making them excellent for eDNA studies
- eDNA can identify mussel locations, but DNA fragments can be transported between 5 m and 12.3 km in streams

California Floater (*Anodonta californiensis/nuttalliana)*

- ≤130 mm length, thin shells
- Live 10-15 years in lotic and lentic habitats
- Bear River basin of Wyoming
- Considered critically imperiled (NV, AZ), imperiled (OR, WA, CA, UT, WY) or vulnerable (ID) throughout range


California Floater

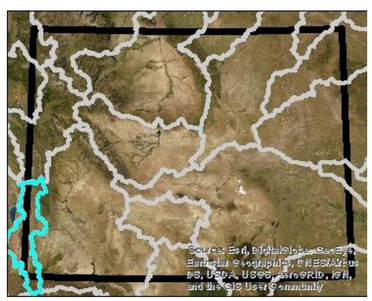
Western Pearlshell (*Margaritifera falcata)*

- ≤130 mm length, thick, kidney-shaped shells
- Live >100 years in lotic habitats
- Bear, Snake and Green River basins of Wyoming
- Considered critically imperiled (CA,NV, UT), imperiled (MT, ID) or vulnerable (WY, OR, WA) throughout range


Western Pearlshell

Study Area

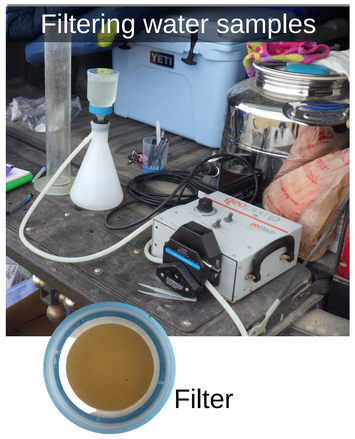
- Bear River basin in Wyoming
- Watersheds shown in grey are hydrologic unit code (HUC) 6




Collecting environmental DNA (eDNA) samples in the Bear River using sterile techniques

Methods

- Collected 1 L water using sterile procedures
- 0.45 µm cellulose nitrate filters
- Filtered blank of DI water every 5 samples
- eDNA extracted using multiplexing procedure (Rodgers et al. 2020)
- Measured water chemistry using calibrated YSI Professional Plus
- Recorded species and shell length when encountered



Results

- 136 sites from 10 streams and 1 reservoir
- Water chemistry did not explain the distribution of mussels (Table 1)
- eDNA concentrations ≤8500 copies DNA/L (Figure 1)
- ~1/3 samples contained mussel eDNA (Figure 2)
- California Floaters were detected downstream of Evanston and Western Pearlshells were detected throughout the basin (Figure 2)
- Shells of adult California Floater, and juvenile and adult Western Pearlshells were found

Table 1. The percent of samples positive for environmental DNA (eDNA), and minimum and maximum values of eDNA concentration [eDNA], water chemistry, habitat conditions and shell length at sites with California Floaters, Western Pearlshells and all sites sampled in the Bear River basin of Wyoming.

	California Floater		Western Pearlshell		All stream reaches	
Parameter	Min	Max	Min	Max	Min	Max
% samples positive	38%		32%		-	
[eDNA] (copies/L)	0	7593	0	8409	-	-
Temperature (°C)	9.4	20.8	9.0	16.3	7.1	20.8
Dissolved oxygen (% sat)	67.2	116.1	67.2	102.3	67.2	116.1
Dissolved oxygen (mg/L)	7.5	11.8	7.4	11.1	7.4	11.8
Specific conductivity (µS/cm)	271.7	738.0	187.6	550.8	145.6	791.0
pH	8.36	8.82	8.36	8.69	8.01	8.91
Stream depth (cm)	20	125	15	130	10	130
Stream width (m)	13.3	53	3.2	53	0.5	53
Shell length (mm)	65	99	34	94	-	-

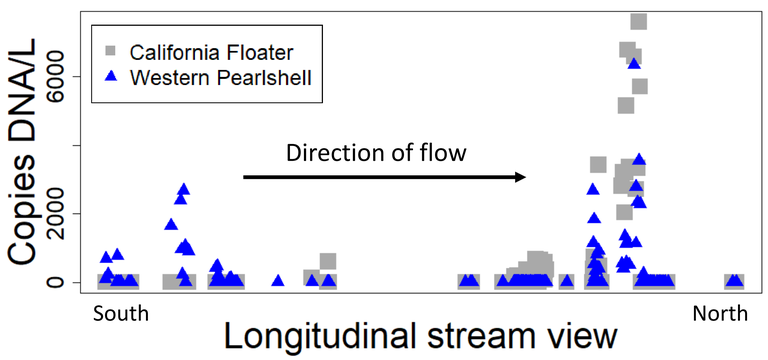


Figure 1. The concentration of environmental DNA (eDNA) varied along the length of the Bear River basin. Concentrations quickly changed from high to low suggesting that eDNA was quickly removed in the water.

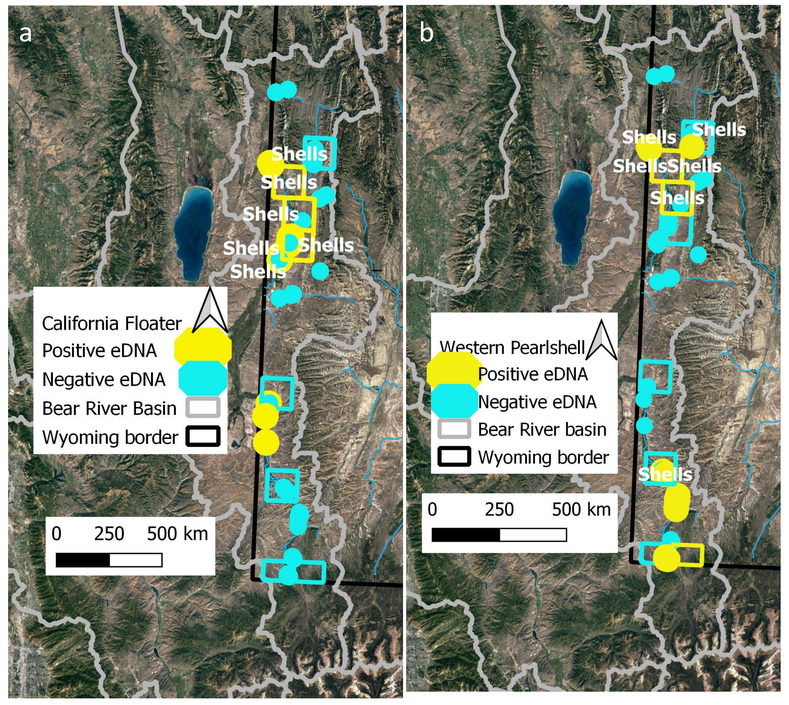


Figure 2. Presence and absence of a) California Floater and b) Western Pearlshell environmental DNA (eDNA) in water samples collected at 136 sites in the Bear River basin of Wyoming (HUC 6; grey outline). Squares indicated that a positive or negative eDNA result was within that area. Shells were found at labeled locations.

Discussion

- New locations for California Floater and Western Pearlshell
- Higher eDNA concentrations likely means more mussels (Shogren et al. 2019)
- Biofilm can remove eDNA quickly (Shogren et al. 2018) and biofilms were often well-developed in the Bear River basin.
- Only found adult California Floater shells suggesting a lack of juveniles and reproduction
- Western Pearlshell appeared to reproduce in the Bear River basin

Future plans

- Visual and tactile surveys for California Floaters prioritized by eDNA concentrations
- Study reproduction to estimate what is limiting California Floater

Acknowledgements

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Literature Cited

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