



Helbing lab environmental DNA tools

Challenges for effective and responsive environmental management:

- Fish and wildlife are important contributors to ecosystem health and services
- Climate change and human activities can threaten ecosystems
- Building ecosystem resiliency and timely responsiveness requires a consistent source of accurate information about the ecosystems under consideration
- Traditional survey methods generally rely on direct observation of target species or taxa
- These methods can be invasive or destructive to target taxa or their habitats and suffer from biases often resulting in low detection rates and poor resolution data
- There is a need for providing more reliable and accurate data from ecological surveys for fish and wildlife populations to inform management decisions

Targeted environmental DNA (eDNA) testing:

- All animals have genetic material or DNA in their cells
- DNA is made up long strings of four different building blocks (nucleotides) that are arranged in in specific patterns or sequences
- Some parts of the DNA have sequences that distinguish between taxa
- All animals slough off DNA through skin, mucus, feces, etc. into their immediate environment
- Animals that live in or near water will leave some of their DNA behind for a little while
- eDNA is captured by filtering a scoop of water or analysing other environmental samples
- The eDNA can then be isolated and tested with a very sensitive technique called quantitative real-time polymerase chain reaction (qPCR); the technique that is used in forensics nowadays
- In essence, we are doing a kind of “CSI for fish and wildlife”
- We can determine whether or not the eDNA from a particular species of interest is detected
- The tests can be designed to detect at-risk taxa or even invasive ones
- In this targeted method, we typically test for one taxa at a time but multiple tests for different taxa can be performed per environmental sample

Advantages:

- Particularly good for detecting low density or difficult-to-observe taxa
- Non-invasive to the target taxa and their habitat
- Low risk of pathogen transfer between sites
- Highly accurate and reliable when using robust, validated eDNA tools
- More cost-effective and faster than traditional survey methods
- IntegritE-DNA™ tool is applied to all samples that ensures assessment of sample integrity

Caveats:

- eDNA technologies are a powerful tool in the environmental assessment and monitoring toolbox and, while transformative, should not be used in isolation
- Current eDNA technologies cannot determine life stage or age, whether organisms are alive or dead, or their absolute abundance (e.g. distinguish between one large fish and several small fish)



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Available Validated eDNA Tools

Species	Common Name	Assay code
<i>Ambystoma mavortium</i>	Tiger Salamander	eAMMV4
<i>Ammodytes personatus</i>	Pacific Sandlance	eAMPE5
<i>Anaxyrus (Bufo) boreas</i>	Western toad	eANBO5
<i>Anguilla rostrata</i>	American Eel	eANRO1
<i>Ascaphus montanus</i>	Rocky mountain tailed frog	eASMO9
<i>Ascaphus truei</i>	Coastal tailed frog	eASTR4
<i>Carassius auratus</i>	Goldfish	eCAAU1
<i>Catostomus catostomus (Chelhalis)</i>	Salish Sucker	eCACA2
<i>Clemmys guttata</i>	Spotted Turtle	eCLGU3
<i>Contia tenuis</i>	Sharp-tailed Snake	eCOTE3
<i>Crotalus oreganus</i>	Northern Pacific Rattlesnake	eCROR1
<i>Dreissenid species</i>	Zebra and Quagga Mussel	eDRspp1
eFish	Fish	eFish1
eMammal	Mammal	eMammal1
<i>Esox lucius</i>	Northern Pike	eESLU1
<i>Glyptemys insculpta</i>	Wood Turtle	eGLIN1
<i>Hypomesus pretiosus</i>	Surf Smelt	eHYPR4
IntegritE-DNA	Plant/algae	ePlant5
<i>Lithobates (Rana) catesbeiana</i>	North American bullfrog	eLICA3
<i>Lithobates (Rana) pipiens</i>	Northern leopard frog	eLIPI1
<i>Micropterus dolomieu</i>	Smallmouth Bass	eMIDO1
<i>Micropterus salmoides</i>	Largemouth Bass	eMISA2
<i>Oncorhynchus clarkii</i>	Cutthroat trout	eONCL4
<i>Oncorhynchus gorbuscha</i>	Pink Salmon	eONGO5
<i>Oncorhynchus kisutch</i>	Coho salmon	eONKI4
<i>Oncorhynchus mykiss</i>	Rainbow trout	eONMY5
<i>Oncorhynchus nerka</i>	Sockeye Salmon	eONNE2
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	eONTS5
<i>Pseudacris triseriata/maculata</i>	Boreal and Western Chorus Frog	ePSspp3
<i>Rana aurora</i>	Northern red-legged frog	eRAAU1
<i>Rana cascadae</i>	Cascades frog	eRACA2
<i>Rana luteiventris</i>	Columbia spotted frog	eRALU2
<i>Rana pretiosa</i>	Oregon spotted frog	eRAPR2
<i>Rhinichthys umatilla</i>	Umatilla Dace	eRHUM4
<i>Salvelinus confluentus</i>	Bull Trout	eSACO3
<i>Sorex bendirii</i>	Pacific water shrew	eSOBE4
<i>Spea intermontana</i>	Great Basin spadefoot	eSPIN1
<i>Tadarida brasiliensis</i>	Brazilian Free-Tailed Bat	eTABR1
<i>Thaleichthys pacificus</i>	Eulachon	eTHPA2
<i>Thymallus arcticus</i>	Arctic Grayling	eTHAR1



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