

# The benefits and challenges of using environmental nucleotides for fish passage species detection and enumeration

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# Hydropower dams present barriers to fish movement





# Hydropower dams and fish passage





# Hydropower dams, fish passage, and recreation





# How do we know what species use the fish passages?



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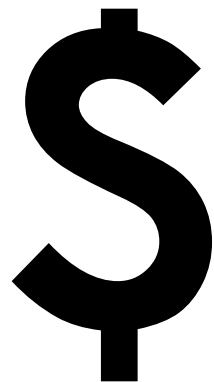
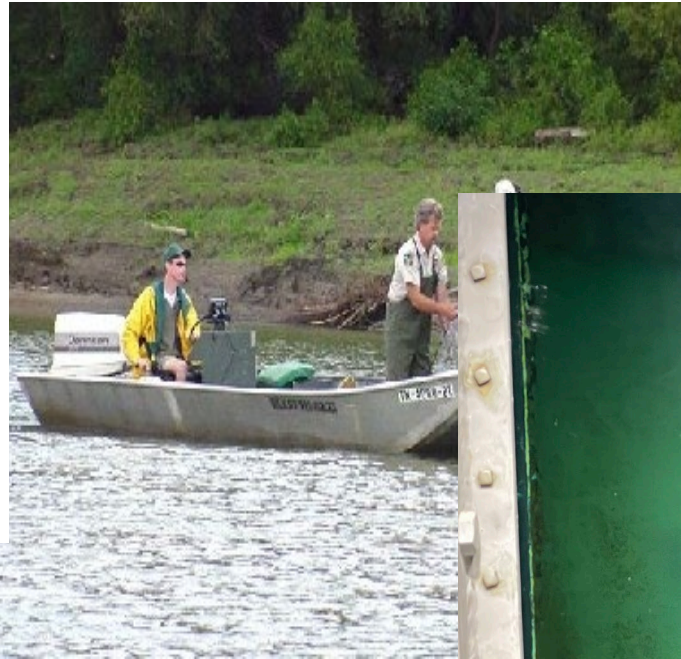


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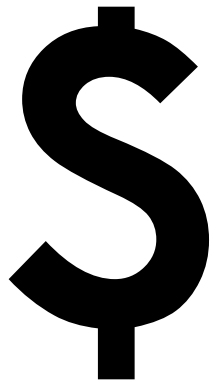


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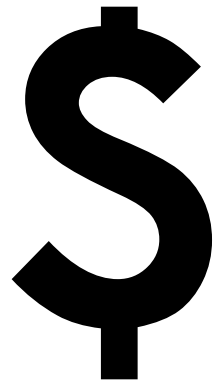


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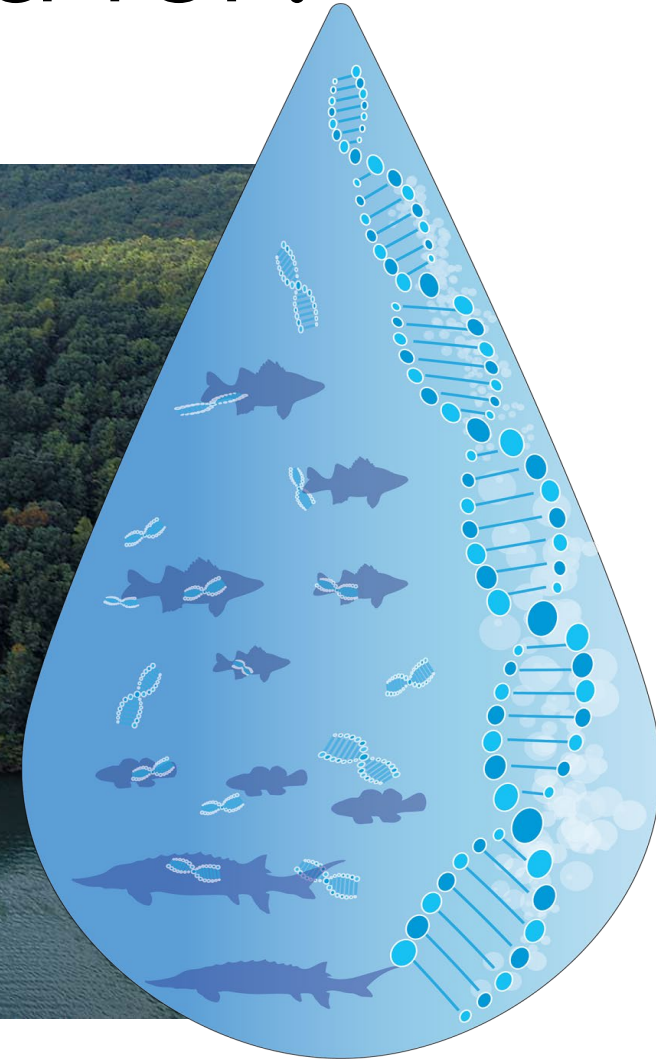


# How do we know what species use the fish passages?





# eDNA/eRNA – What is it good for?



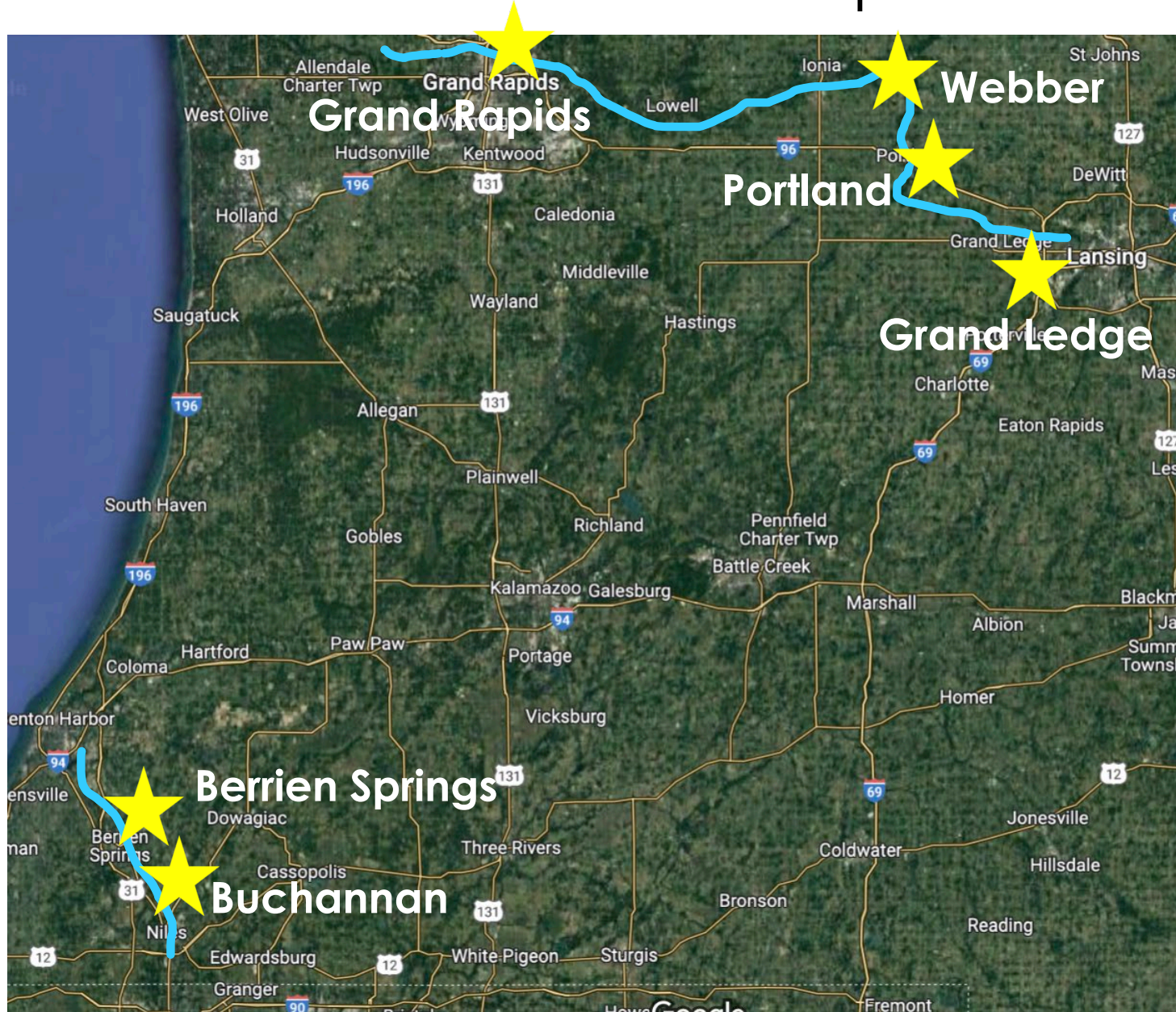


- Environmental DNA (eDNA)
  - Organismal DNA deposited into the environment
    - Cellular sloughing, gamete and waste excretion, senescence
    - Air, soil, honey, water
- Environmental RNA (eRNA)
  - Only from living organisms
  - Degrades quickly
- Biodiversity
  - Which species
  - How many individuals
  - Species distributions





# Michigan Dams - Grand and St. Joseph Rivers





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# Berrien Springs Hydropower Dam and Fish Ladder





# Every site – 3 samples + negative control



3 sampling events

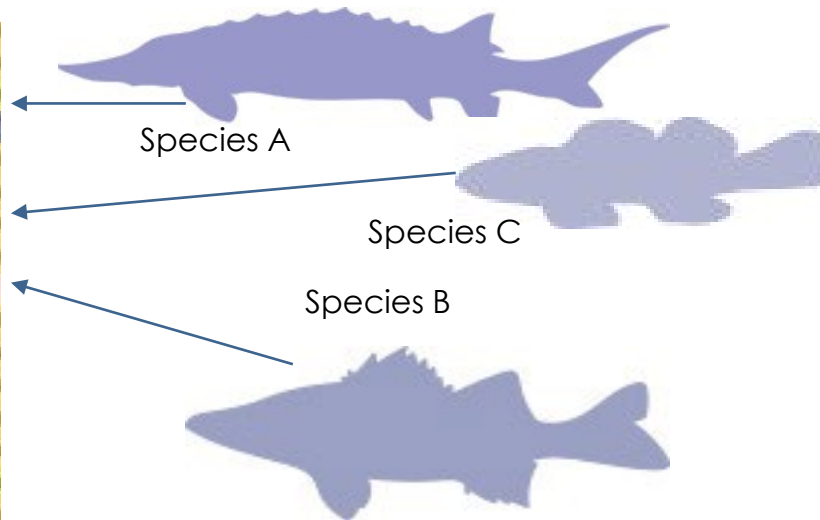
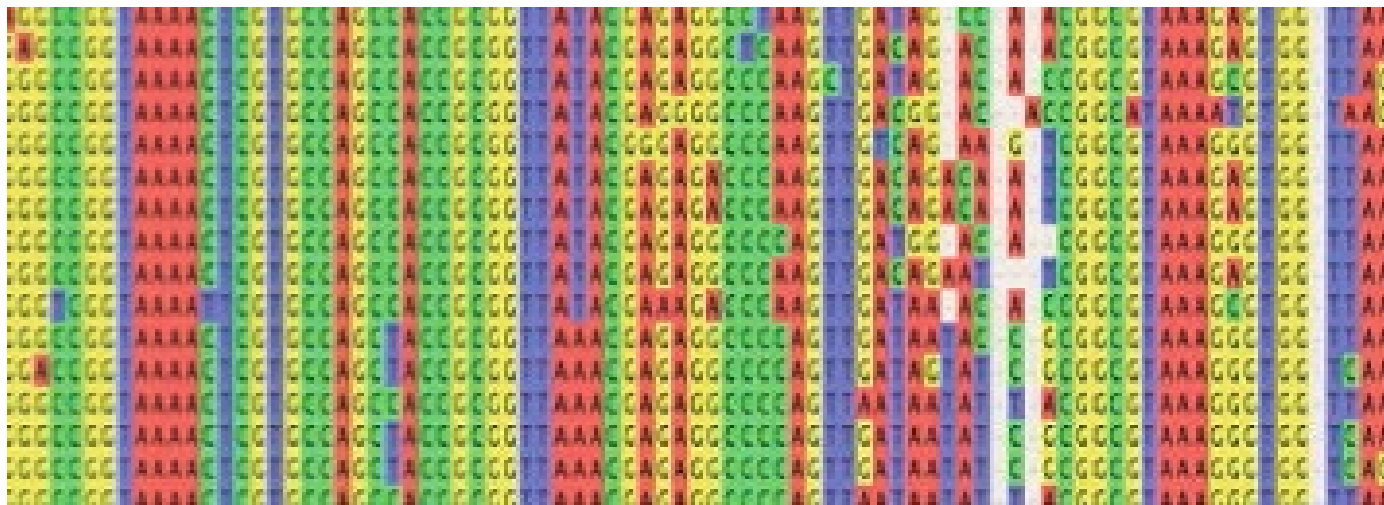
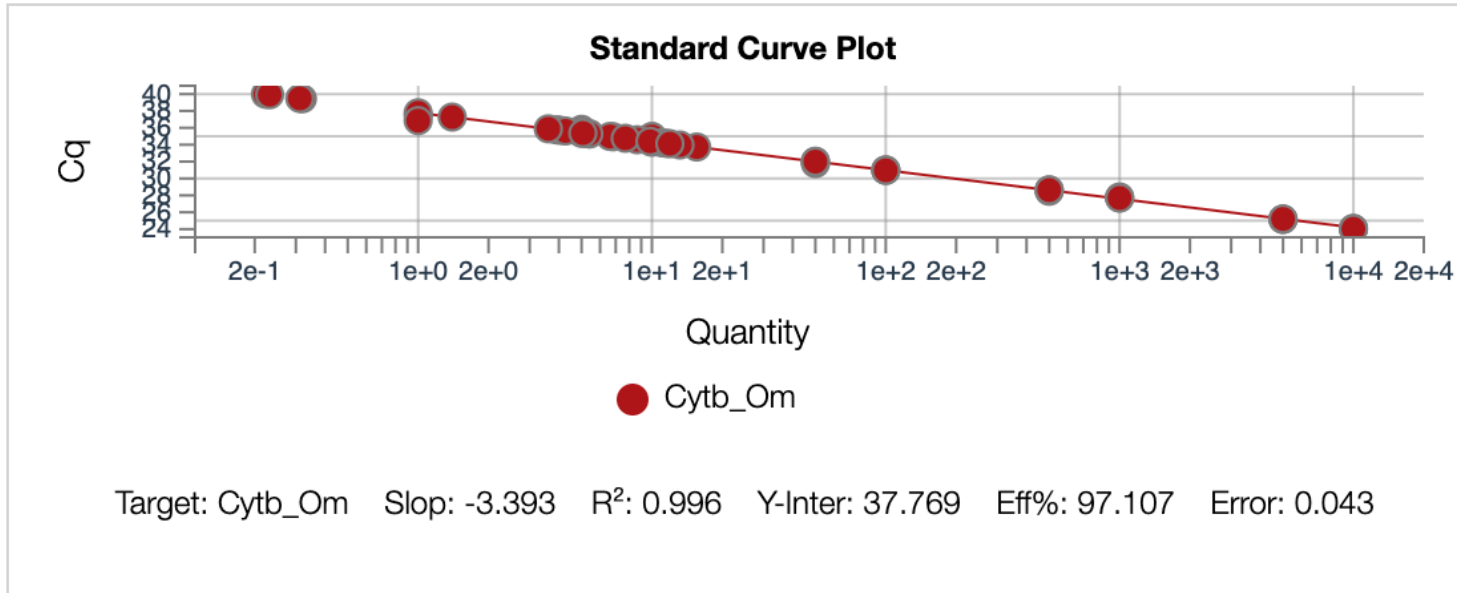
August

September

October



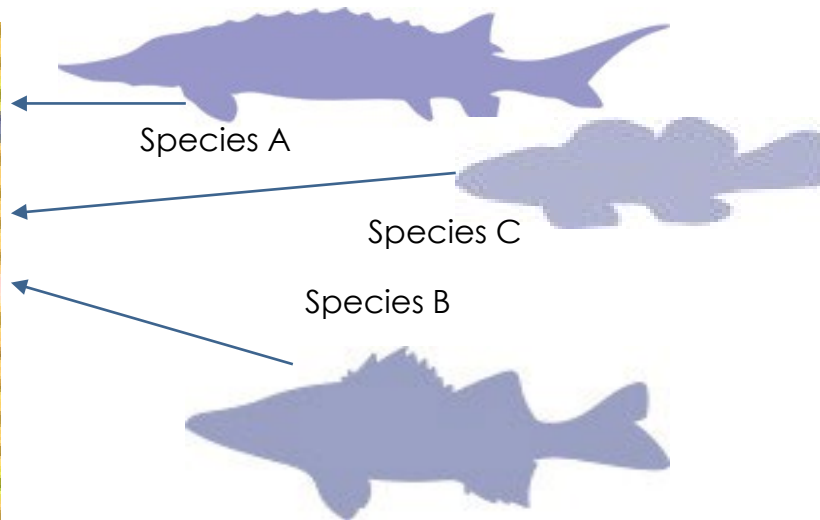
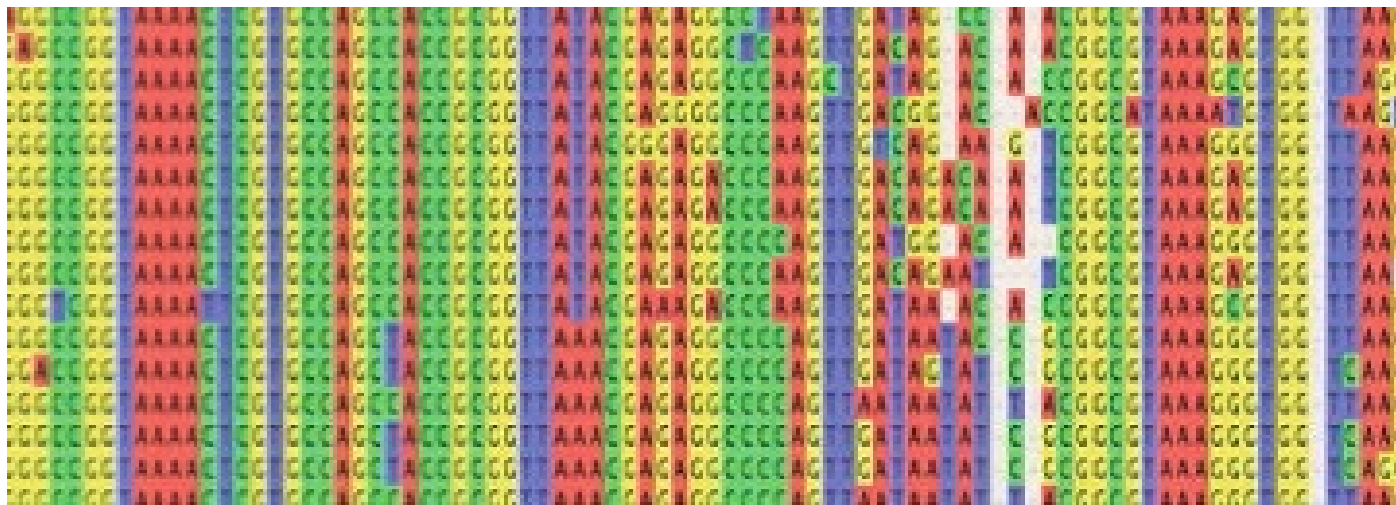
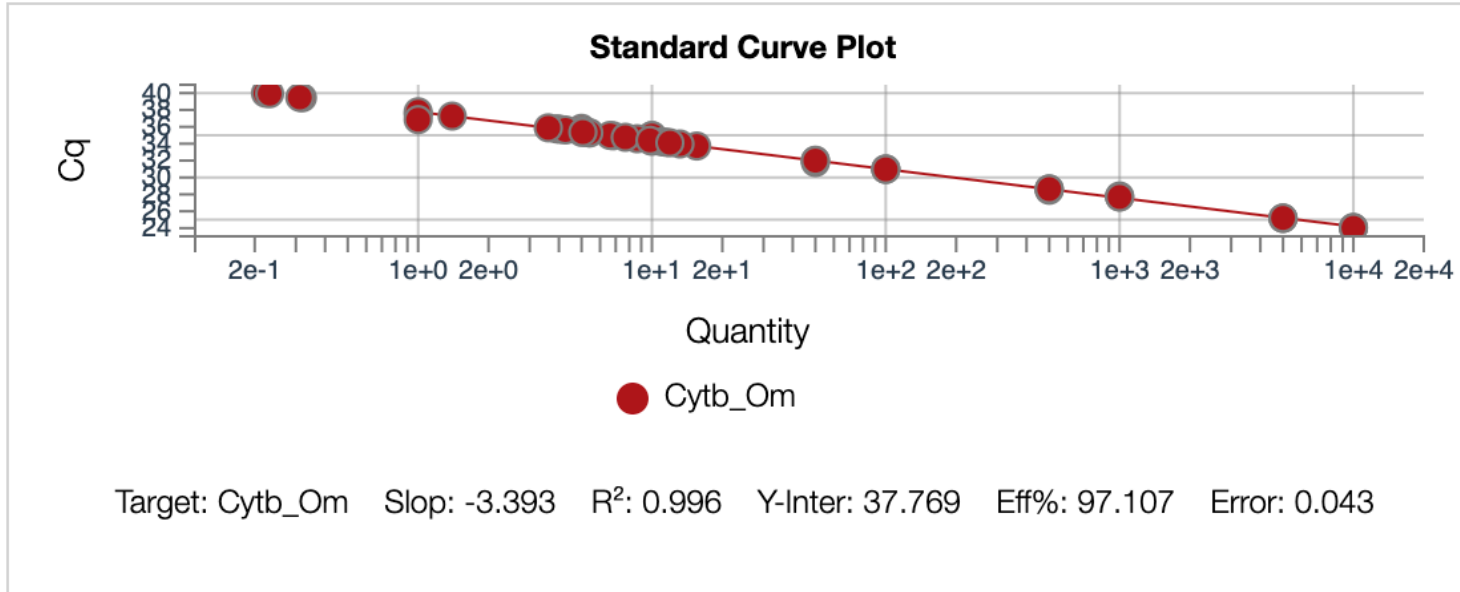
# qPCR and metabarcoding





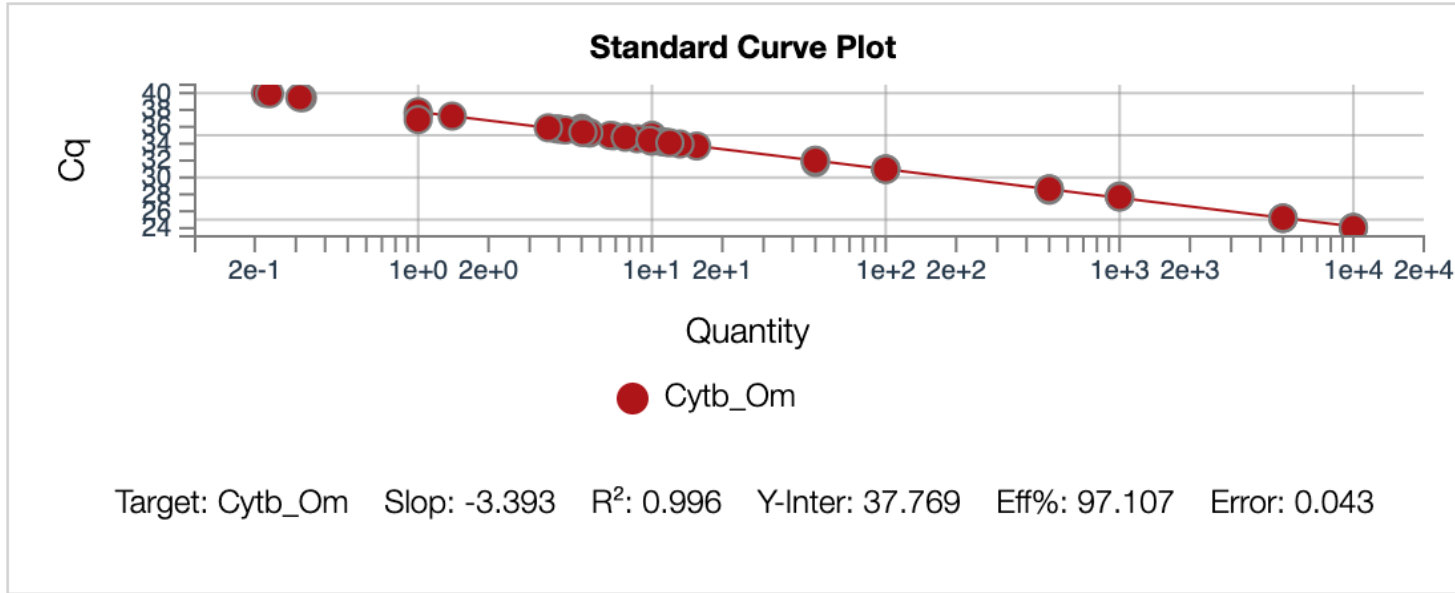
# qPCR and metabarcoding

- Single genes
- Single species
- Relative abundance estimates

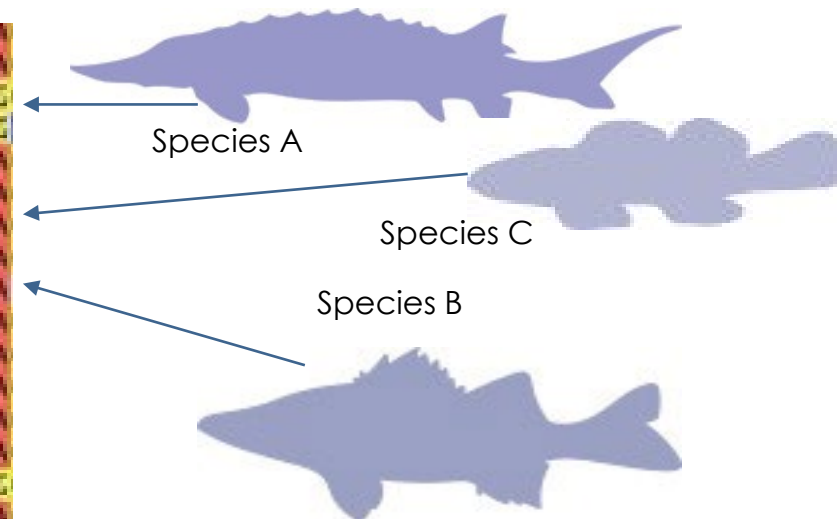
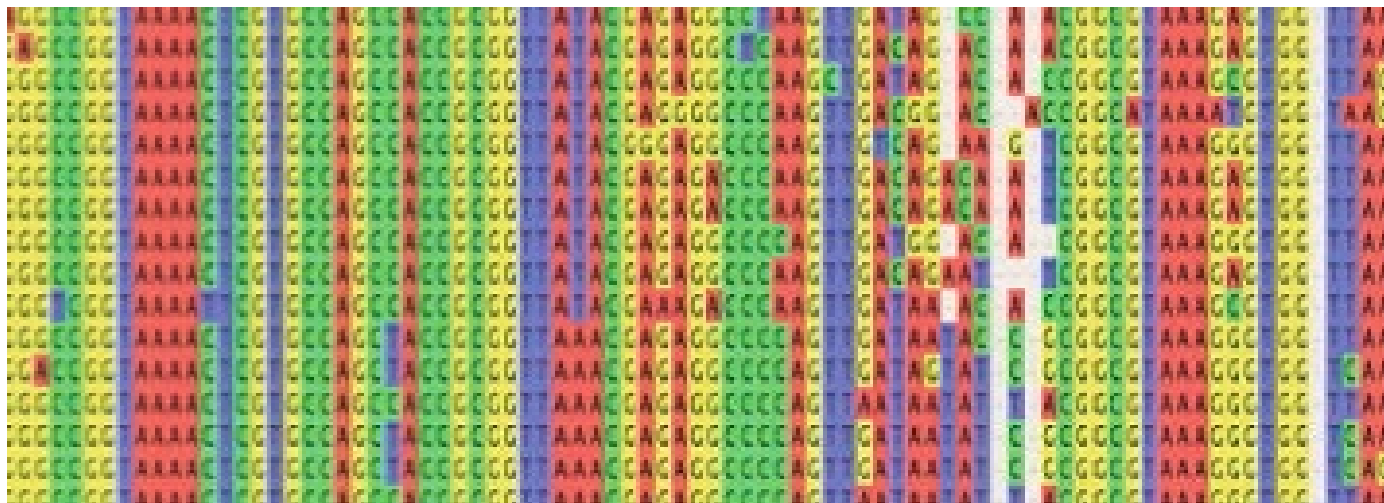




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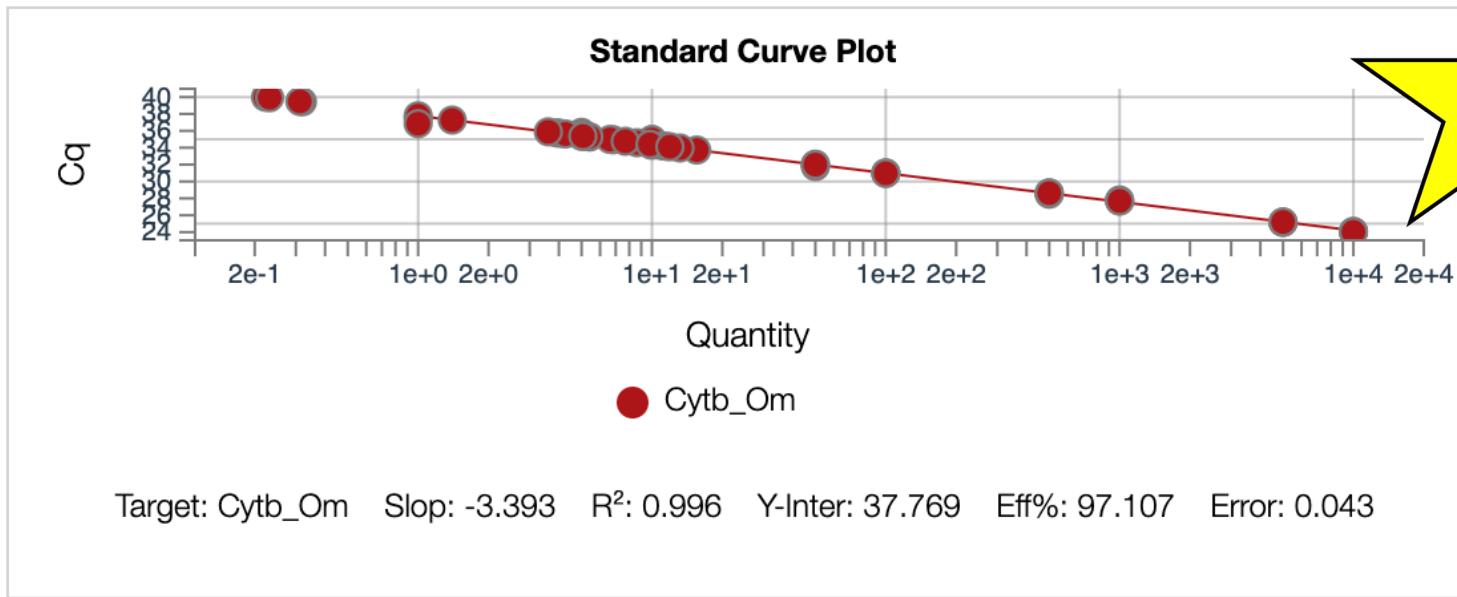


- Single genes
- Single species
- Relative abundance estimates
  
- Multi-species
- Read counts

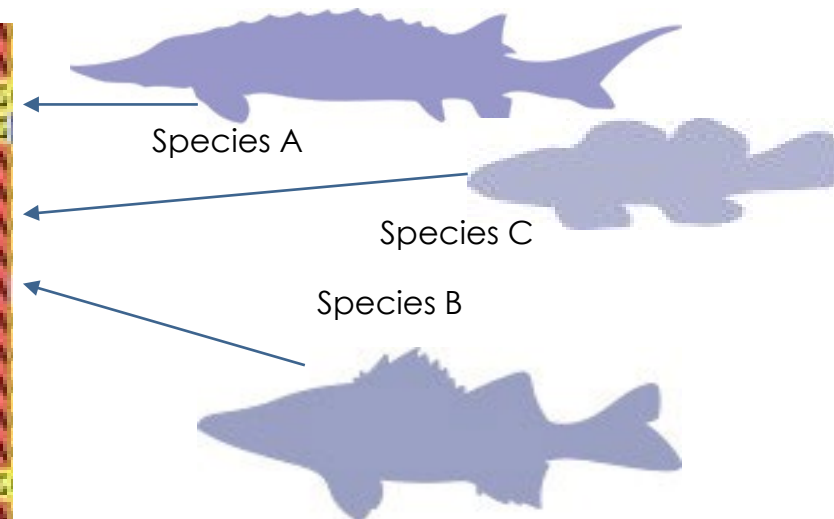
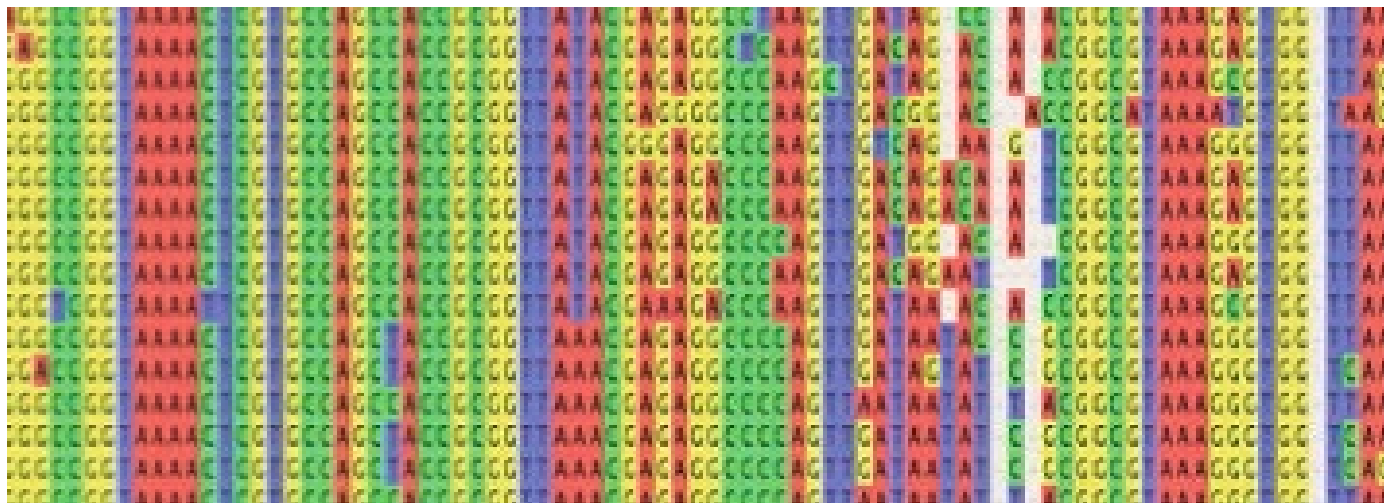




# qPCR and metabarcoding



*Oncorhynchus mykiss*  
Cytochrome B





# Fish Widow Videos



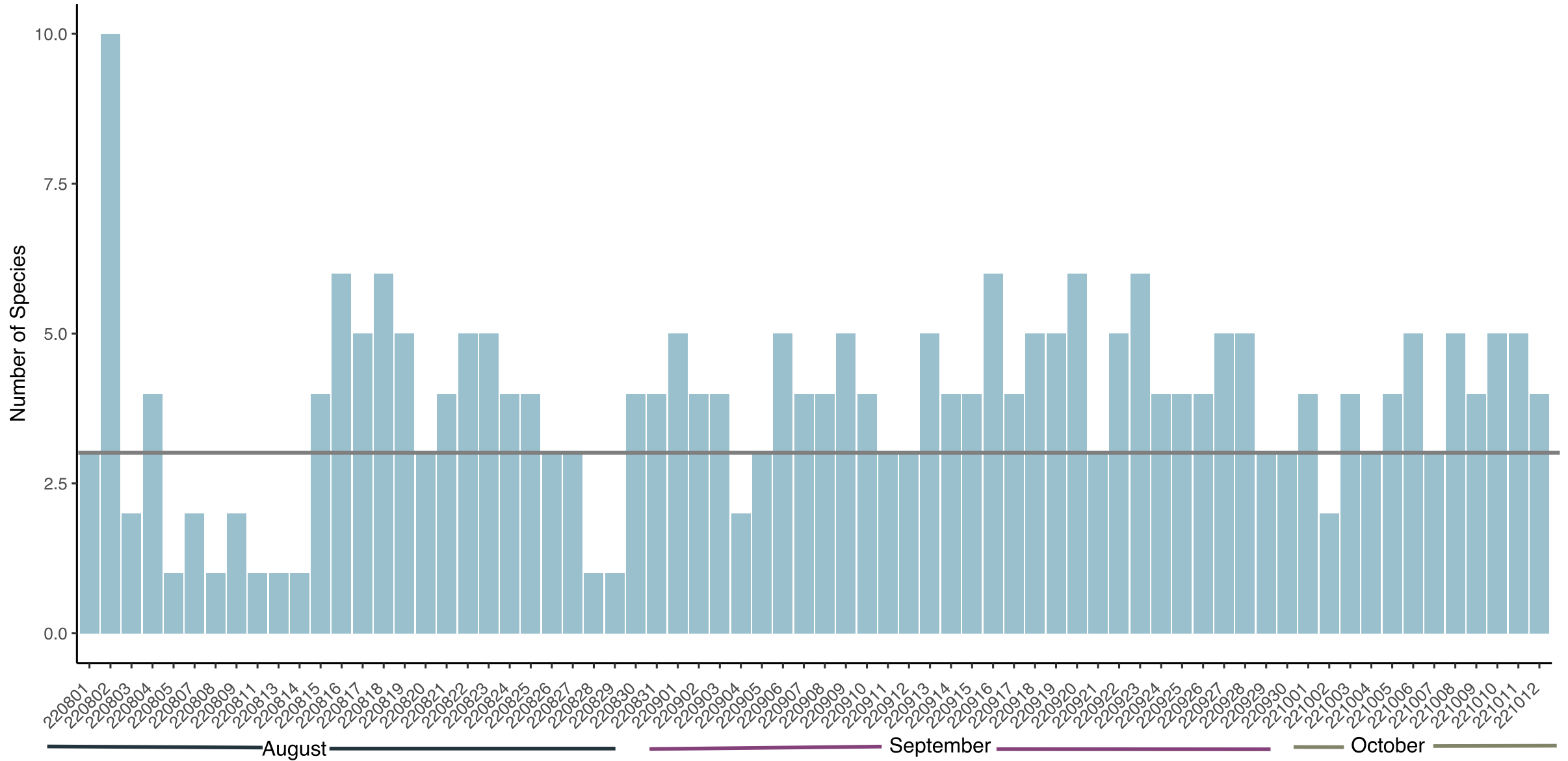


# Fish Widow Videos



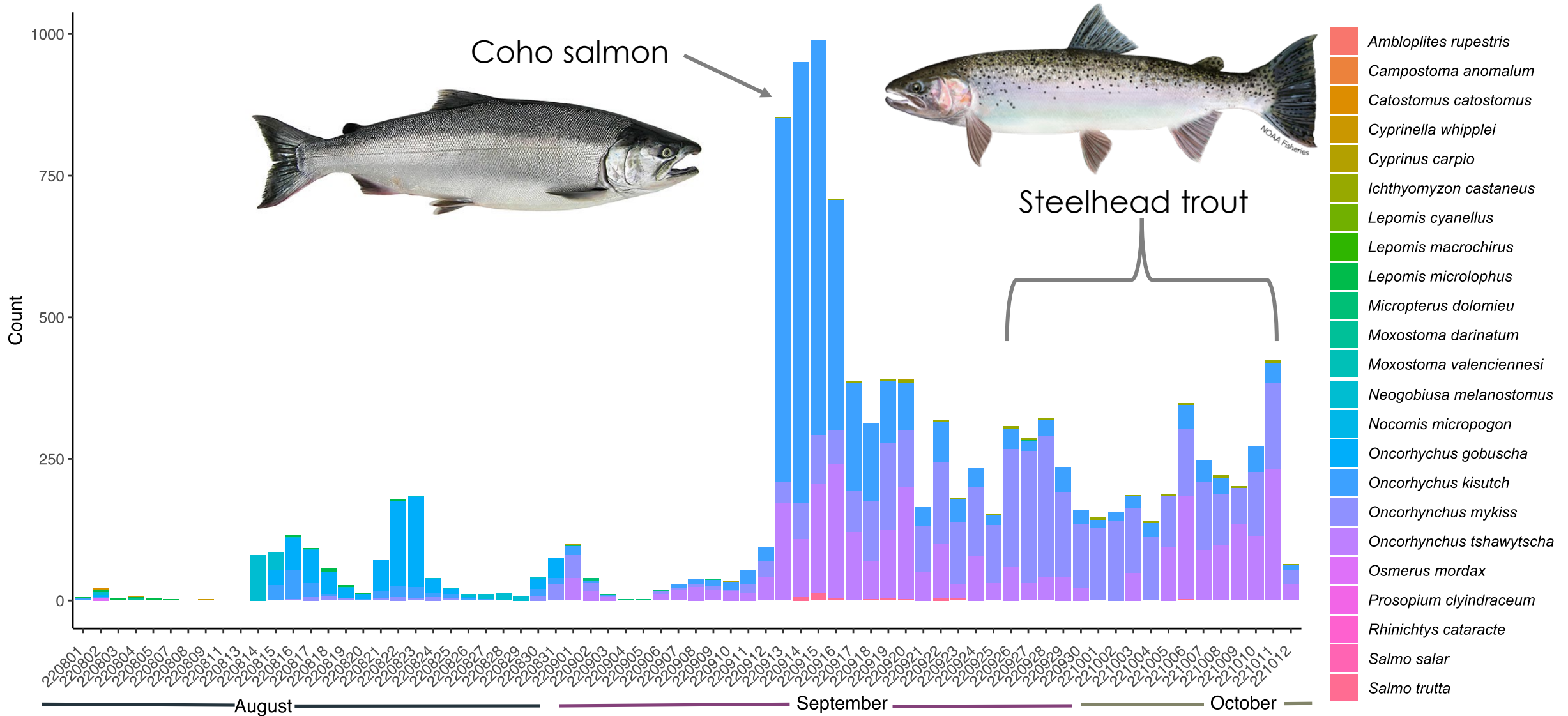


# Species diversity from videos



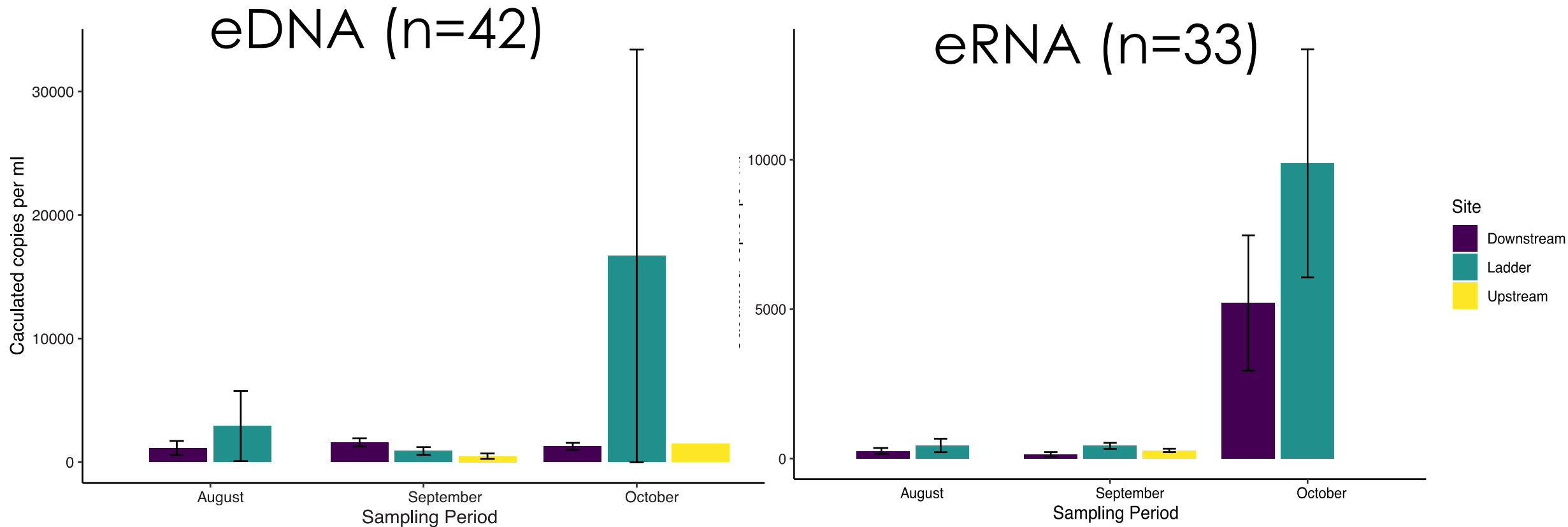


# Count data from videos





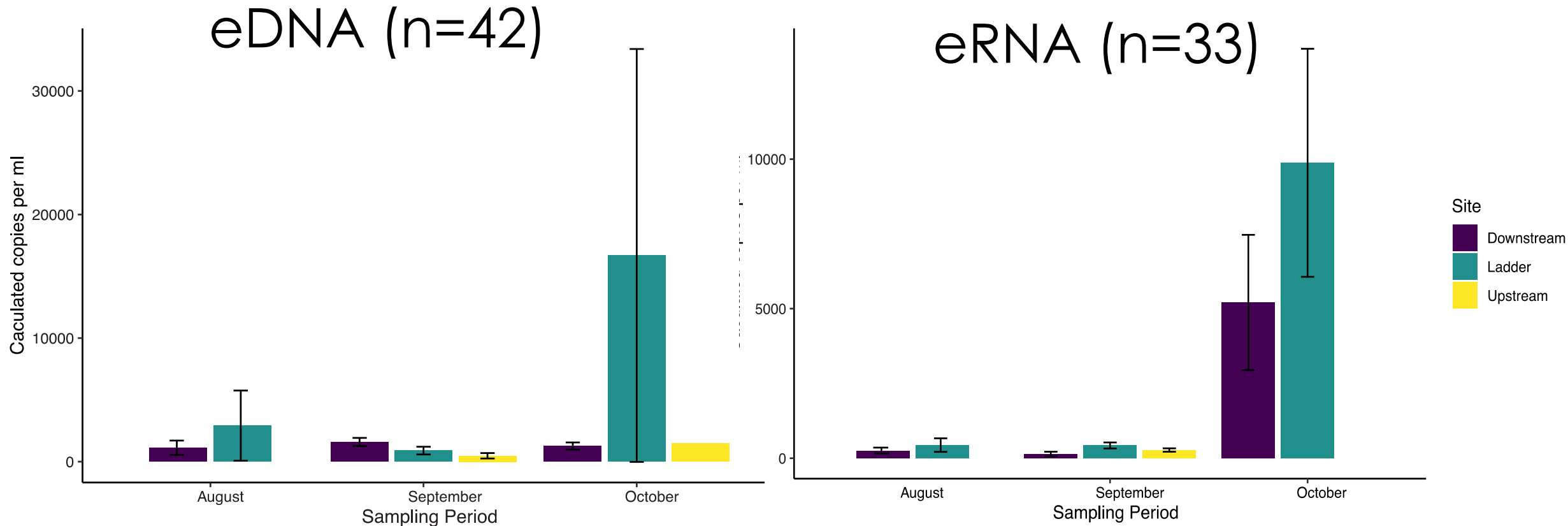
# More detection and higher copy number of eDNA compared to eRNA





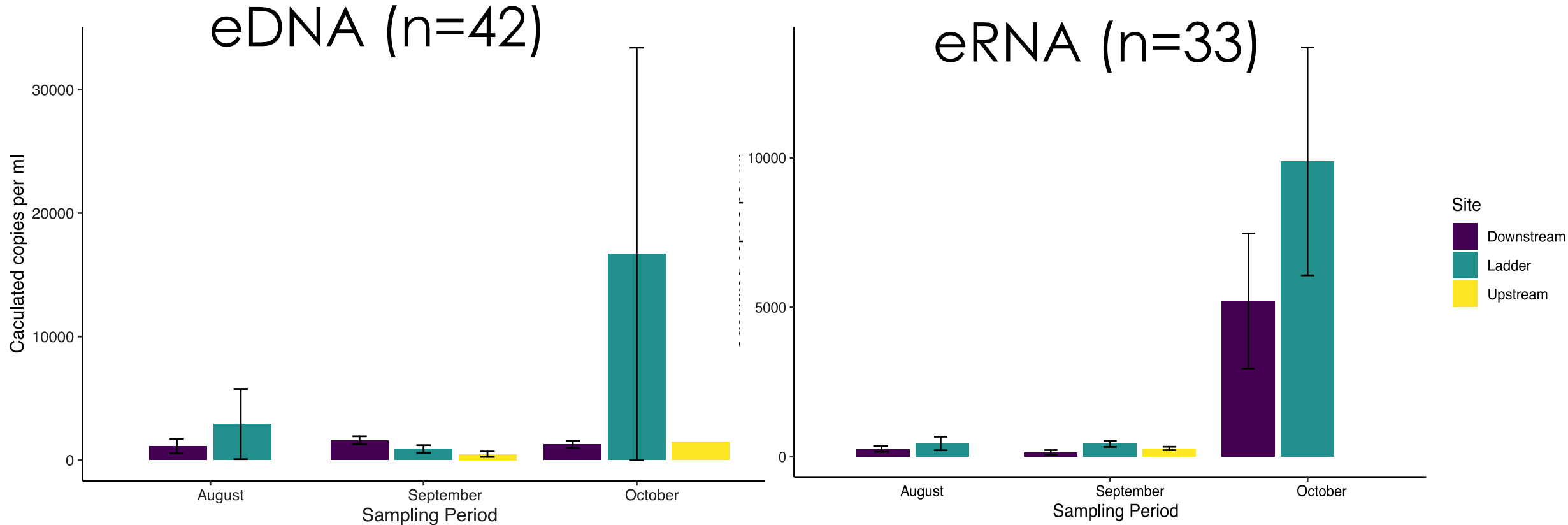
# More detection and higher copy number of eDNA compared to eRNA

- Relic eDNA signal?



# More detection and higher copy number of eDNA compared to eRNA

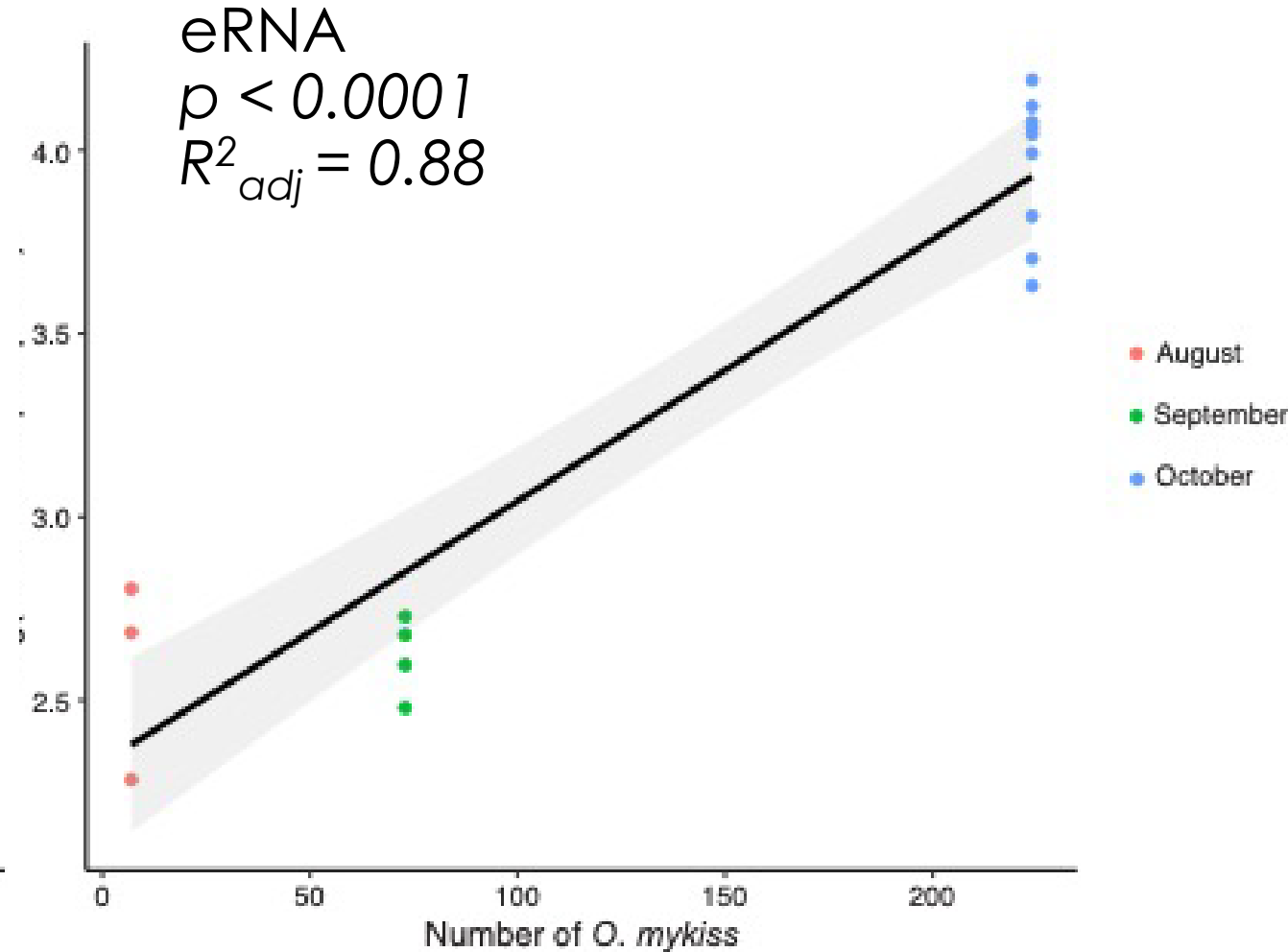
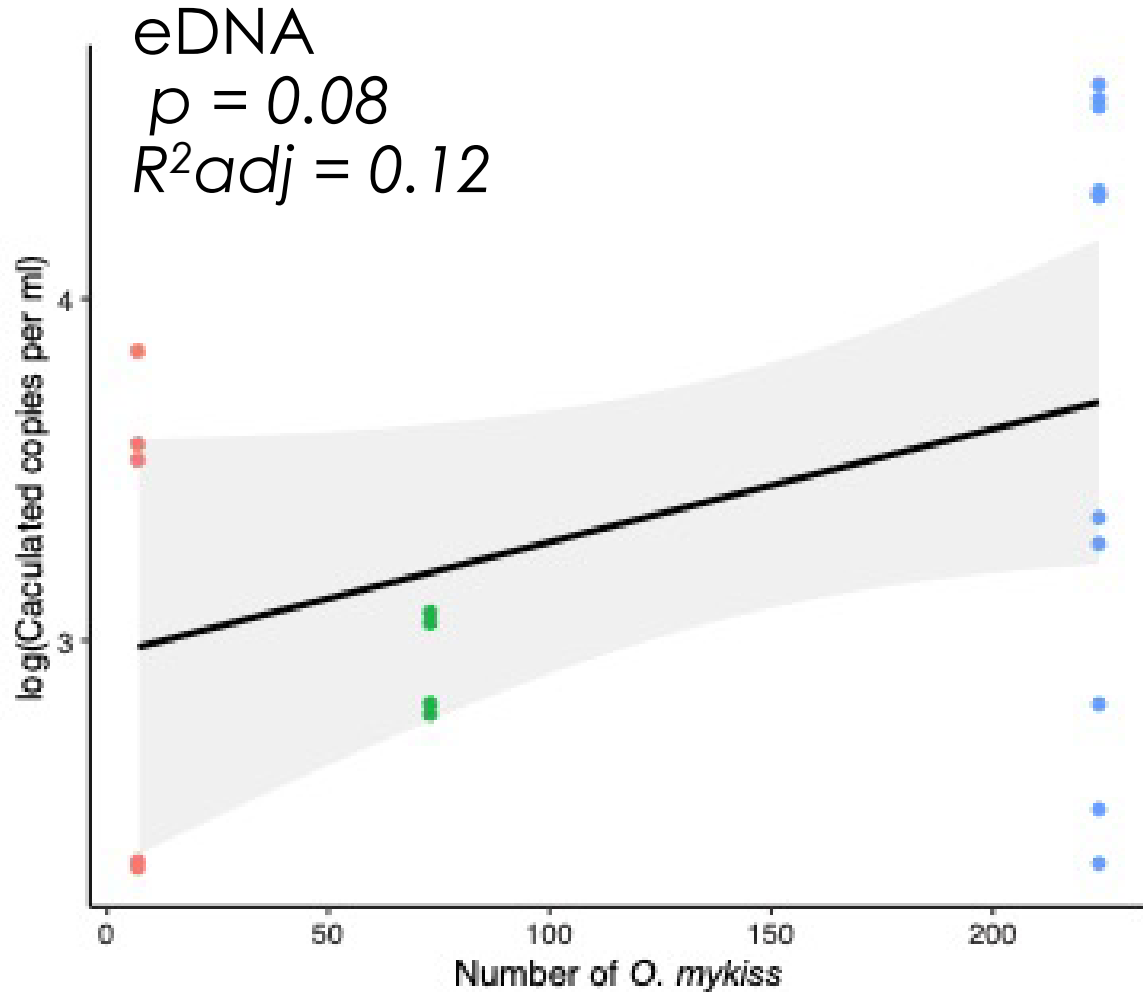
- Relic eDNA signal?
- Rapid eRNA degradation?





# eRNA copy number, better for relative abundance estimates?

Log(Copy Number) ~ Count/Discharge



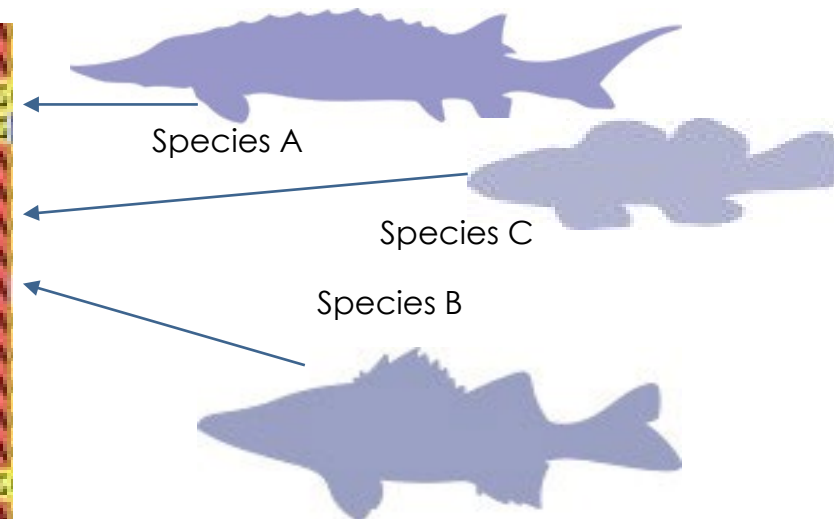
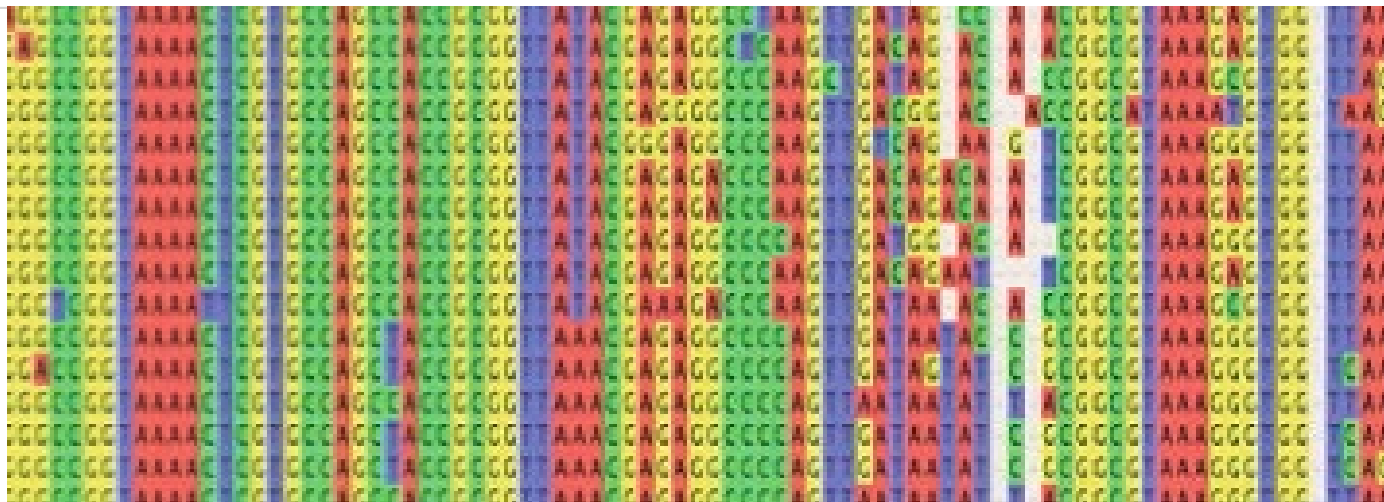
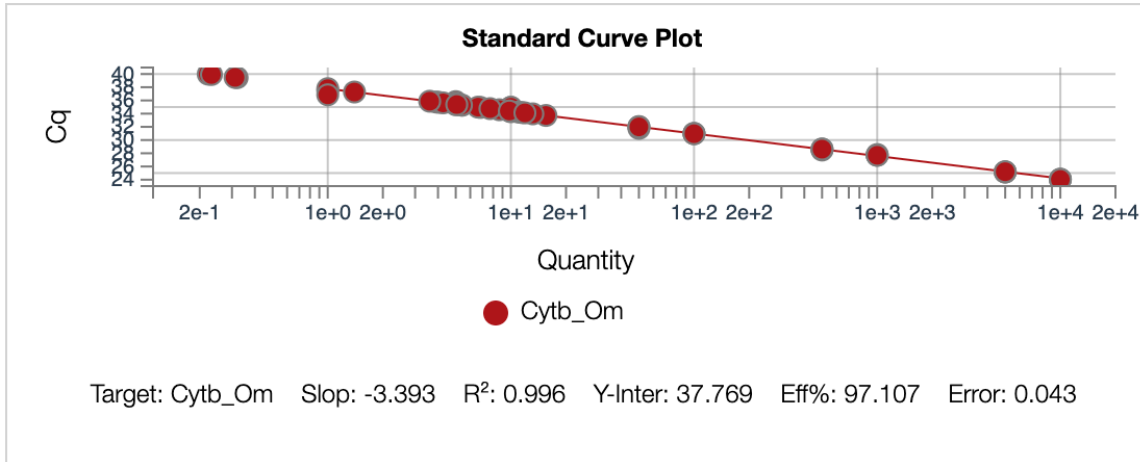
# Further analyses – American Fisheries Society



*Ictalurus punctatus*



*Micropterus salmoides*





# Acknowledgements



U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

