Use of Common Household Materials in Passive Environmental DNA Collection

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Abstract

Environmental DNA (eDNA) has been at the forefront of emerging biomonitoring technology for **marine ecosystems**. The traditional method of eDNA capture involves active filtration of water through a filter membrane but is labor and resource-intensive. **Passive eDNA detection** offers an alternative approach, which requires submerging various materials to capture free-floating eDNA. Specifically testing commercially available materials, this experiment was designed to make passive sampling **more accessible and versatile** in its future applications. Four different candidate materials were tested, and all had similar performances at detecting **rusty crayfish** (*Faxonius rusticus*) eDNA in as little as **five minutes of submersion time**. However, **contamination** in the reagents used for the analysis reduces the confidence of the findings of the experiment.

Materials & Methods

Sampling was conducted at **Fall Creek** in Ithaca, NY on the week of July 8, 2024. The following inexpensive commercial items were chosen for testing: polyvinylidene fluoride (**PVDF**) filter paper (0.45um), black **KN95 face mask** (0.3um), and two types of 100% **cotton pads**. Two submersion times of **five minutes** and **24 hours** were tested for each material. One active filtration sample and a corresponding negative field blank was collected at the site. Three different sampling methods were tested during the experiment.

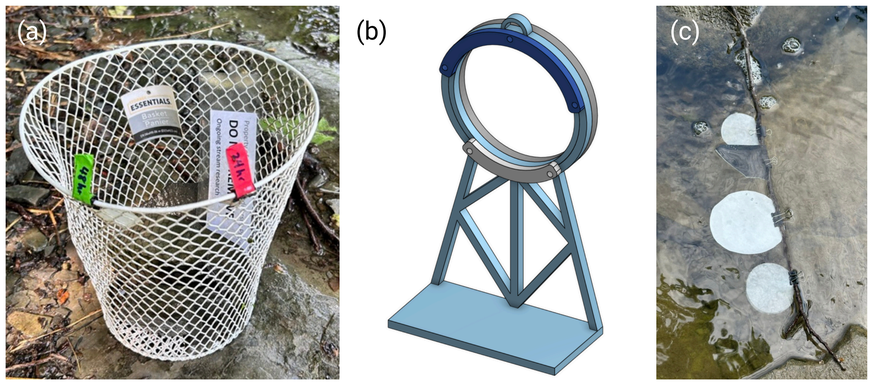

Fig 1.(a) Membranes clipped to mesh wire bucket. (b) 3D-printed stand to secure membranes between two plates. (c) Membranes clipped to small tree branch suspended across water surface.

Results & Discussion

A qPCR assay revealed all passive sampling materials observed amplification in FaRu amplicons for both submersion times. However, amplification was also observed in the non-template controls.

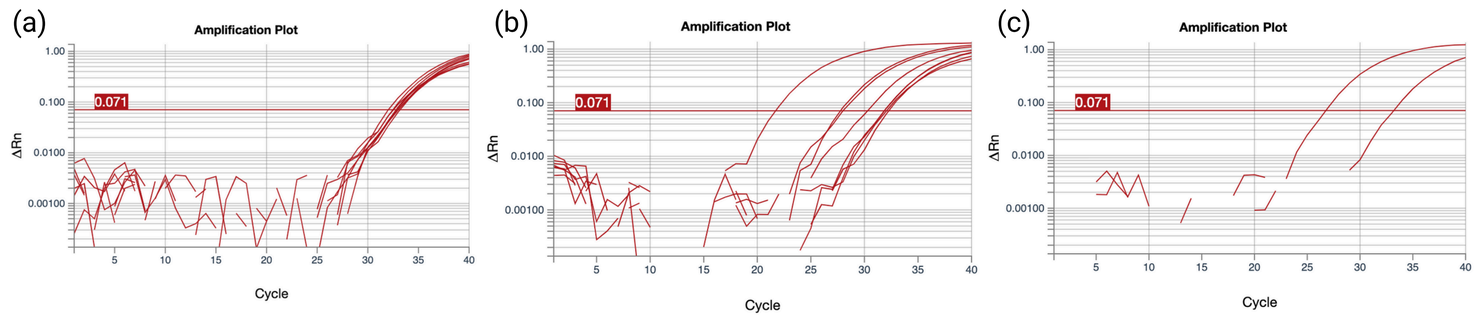

Fig 2.(a) For a submersion time of **five minutes**, all materials reached the detection threshold nearly simultaneously. (b) For a submersion time of **24 hours**, all materials observed amplification. For the two cotton pads, longer submersion time corresponded to **higher starting copy numbers**. (c) Both NTCs observed amplification, suggesting **contamination** during the qPCR plating process.

It is not possible to conclude with full confidence that the four materials tested are effective candidates for passive eDNA collection due to the **contamination** observed throughout the sampling and qPCR process. However, it is promising that all four material samples were measured to have **some success at eDNA capture** with as little as five minutes of submersion time. Further testing is required to determine **optimal sampling procedures, equipment, and decontamination measures** based on the target species and sampling environment.

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References

Beng KC, Corlett RT. Applications of environmental DNA (eDNA) in ecology and conservation: opportunities, challenges and prospects. Biodiversity and Conservation. 2020;29(7):2089-121.
Bessey C, Gao Y, Truong YB, Miller H, Jarman SN, Berry O. Comparison of materials for rapid passive collection of environmental DNA. Mol Ecol Resour. 2022 Oct;22(7):2559-2572. doi: 10.1111/1755-0998.13640. Epub 2022 Jun 1. PMID: 35570323; PMCID: PMC9544503.
Bockrath K, Grote A, Benson A-M, Mize E, Olsen J, Russ O, and Tuttle-Lau M. 2023. Environmental DNA (eDNA) Best Management Practices for Project Planning, Deployment, and Application. U.S. Fish & Wildlife Service. https://www.fws.gov/media/environmental-dna-edna-best-management-practices-project-planning-deployment-and-application
Chen X, Li S, Zhao J, Yao M. Passive eDNA sampling facilitates biodiversity monitoring and rare species detection. Environ Int. 2024 May;187:108706. doi: 10.1016/j.envint.2024.108706. Epub 2024 Apr 26. PMID: 38696978.
Chen X, Kong Y, Zhang S, Zhao J, Li S, and Yao M. Comparative Evaluation of Common Materials as Passive Samplers of Environmental DNA. Environmental Science & Technology 2022 56 (15), 10798-10807. DOI: 10.1021/acs.est.2c02506
Díaz-Ferguson EE, Moyer GR. History, applications, methodological issues and perspectives for the use of environmental DNA (eDNA) in marine and freshwater environments. Rev Biol Trop. 2014 Dec;62(4):1273-84. doi: 10.15517/rbt.v62i4.13231. PMID: 25720166.
Larson, E.R., Renshaw, M.A., Gantz, C.A. *et al.* Environmental DNA (eDNA) detects the invasive crayfishes *Orconectes rusticus* and *Pacifastacus leniusculus* in large lakes of North America. *Hydrobiologia* **800**, 173–185 (2017). https://doi.org/10.1007/s10750-017-3210-7
Simmons M, Tucker A, Chadderton WL, Jerde CL, and Mahon AR. 2016. Active and passive environmental DNA surveillance of aquatic invasive species. Canadian Journal of Fisheries and Aquatic Sciences. 73(1): 76-83. https://doi.org/10.1139/cjfas-2015-0262
"Rusty Crayfish." Western New York PRISM, Great Lakes Center, SAMC, 3 Mar. 2023, www.wnyprism.org/invasive_species/rusty-crayfish/.
New York State Department of Environmental Conservation. (n.d.). Fall Creek (DEC website). Retrieved September 13, 2024, from https://dec.ny.gov/places/fall-creek
U.S. Geological Survey. (n.d.). Fact sheet: Hydrilla (Hydrilla verticillata). National Aquatic Species Database. Retrieved September 13, 2024, from https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=214