Realgymnasium Rämibühl
Kantonsschule / IB World School

Maturitätsarbeit im Fach Biologie
IMPULS-Ausstellung 2023

Identification of invasive invertebrates in freshwater using e DNA

An investigation on the correlation between the spatial distribution of *Dreissena polymorpha* and *Dikerogammarus villosus* environmental DNA in the river Limmat and the Lake of Zurich.

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Aim and Introduction

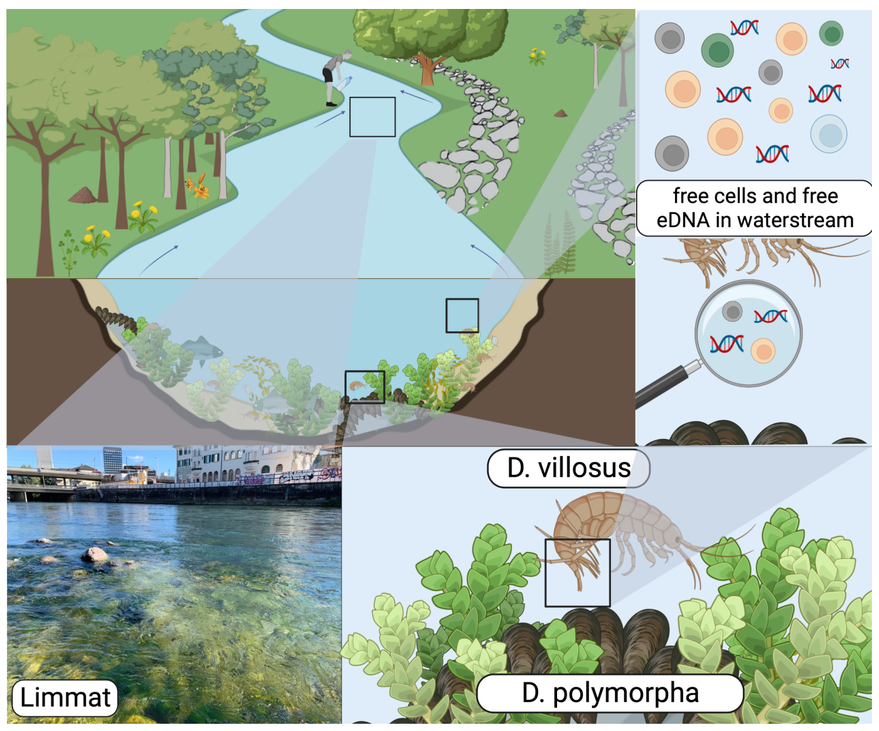
With the intensification of climate change, the invasion of **Swiss** freshwater bodies by **alien species** will become a rising phenomenon. Therefore, time- and cost-efficient **monitoring** of these organisms will be crucial to anticipate their impacts on fluvial **biodiversity**.

This Maturitätsarbeit aims to evaluate if the detection of **environmental DNA** by real-time quantitative **PCR** is a promising method to detect a potential correlation between the presence of two invasive species (*D. villosus* (amphipod) and *D. polymorpha* (mussel)) in the **Lake of Zurich** and the **Limmat**.

Hypothesis: There is a **positive** correlation between the spatial distribution of *D. polymorpha* and *D. villosus* eDNA. The amphipod feeds on biomass accumulated by *D. polymorpha.*

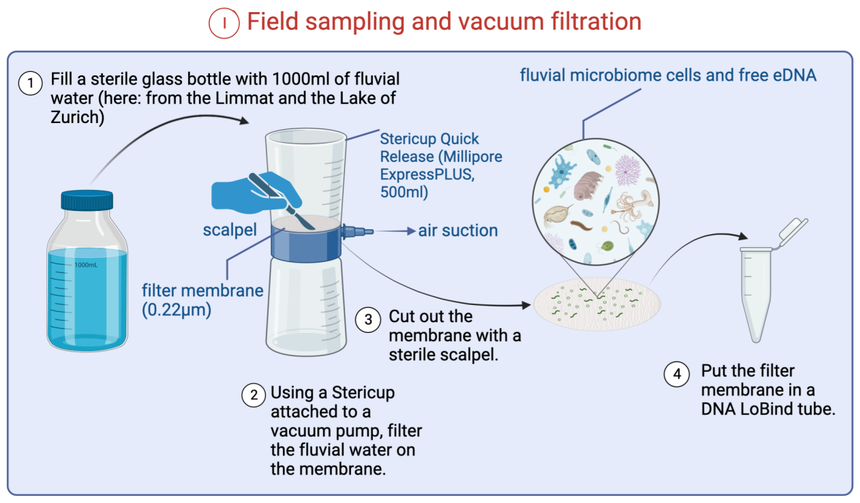
Sites: Werdinsel, Letten, Frauenbadi, Tiefenbrunnen

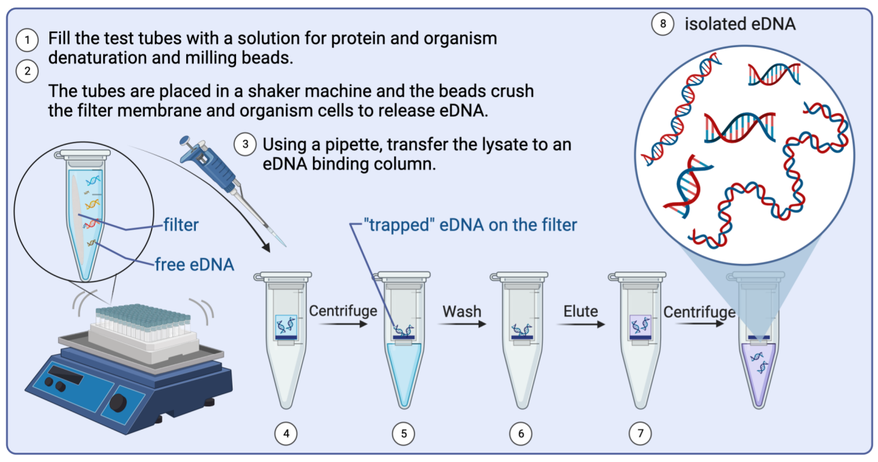
eDNA: Discovering New Horizons



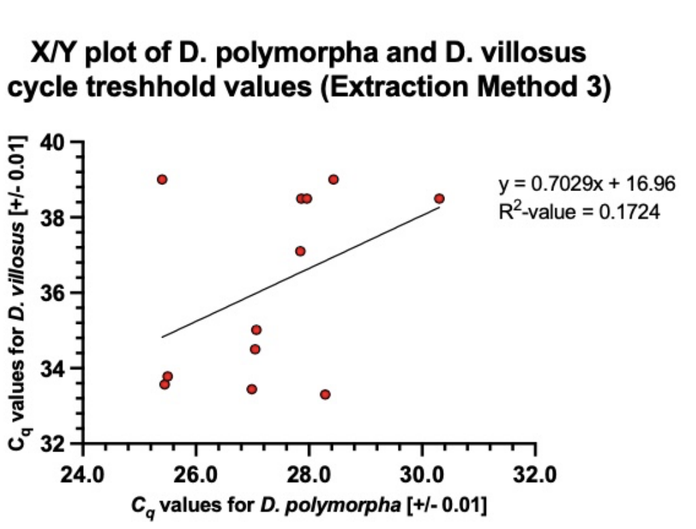
An up-and-coming field is currently developing around **environmental DNA**. "eDNA refers to the total pool of DNA isolated from the environment and is composed of both **organismal** (whole individuals that were probably alive at the time of sampling) and **extraorganismal** DNA (material shed from organisms)."

Experimental Design: Conceptualization

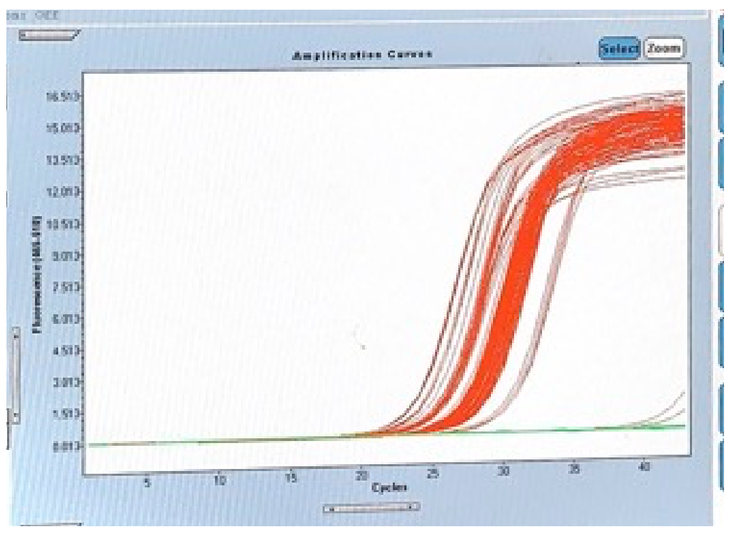




Results and Discussion



Graph 1: X/Y plot of Cq values for *D. polymorpha* and *D. villosus* including linear regression

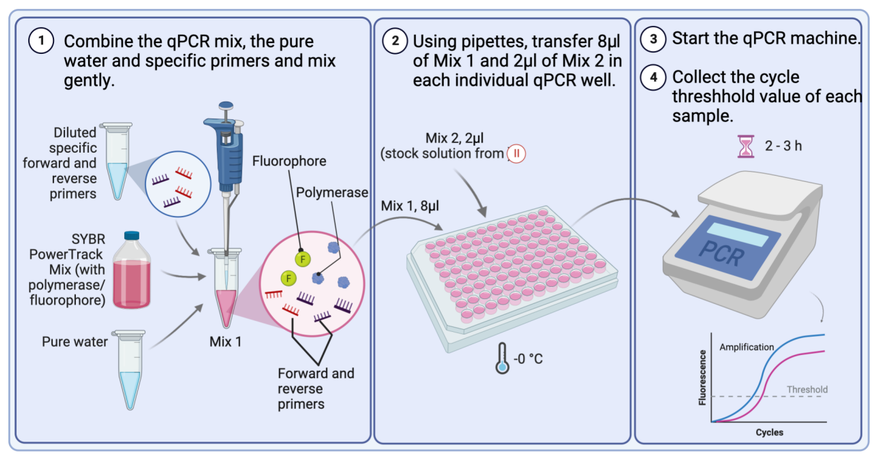


Graph 2: Cq values of *D. polymorpha* for qPCR

This experiment was performed using three different **extraction** protocols. The best performance in terms of price, efficiency, and eDNA yield extracted was the **Modified DNA Easy PowerWater Kit** (using a TissueLyser II machine instead of vortexing for cell lysis, Graph 2).

Graph 1 shows **no** significant correlation between the Cq values of *D. villosus* and of *D. polymorpha* for the **Modified DNA Easy PowerWater Kit** at the 95% confidence level using linear regression (p-value 0.1796 ≥ 0.05). Cq value stands for cycle amplification value and is a relative indicator of eDNA abundance. Indeed, the higher the Cq value at which the organisms were detected, the smaller the initial *D. polymorpha* and *D. villosus* eDNA **concentration** in the analyzed sample. Indeed, suppose an initially small eDNA yield in the solution is amplified. In that case, it will need **more** amplification cycles to be detected by the qPCR machine and will have a higher Cq value.

Following this experimental pipeline, eDNA from *D. polymorpha* and *D. villosus* was reliably detected on three sampling sites, confirming their **co-occurrence** in the freshwater bodies investigated. However, although previous observations suggested that both species could interact in the biome for micronutrient supply and habitat preferences, no significant positive correlation between their eDNA levels was found, suggesting **no quantitative association** between both species at present.



Conclusion and Outlook

In this Maturitätsarbeit paper, I immersed myself in the world of **biotechnology** by extracting eDNA to characterize biome interactions in my **local** environment. The availability of technologies around eDNA will rise **exponentially** in the following years, allowing **cost-efficient** experiments to characterize aquatic ecosystems with non-invasive methods. This Maturitätsarbeit is considered a **case study** to prove that nowadays, a **high-school** student can experiment with such **eDNA** with minimal technical support.

Acknowledgments

I would like to acknowledge the help of the University of Zurich (**UZH**) in giving me access to all materials.