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Background

- **Allochthonous organic matter** in aquatic systems is an important **source of energy** that contributes significantly to ecosystem metabolism and energy flows.
- Essential fatty acids such as long chain Polyunsaturated fatty acids (LC-PUFAs) are not available/can only be found in **small quantities** in **allochthonous** energy sources.
- Aquatic insect shredders rely on allochthonous energy sources (Fig 1) and require essential fatty acids that **cannot** be synthesized *de novo* and must be obtained through their **diet**.

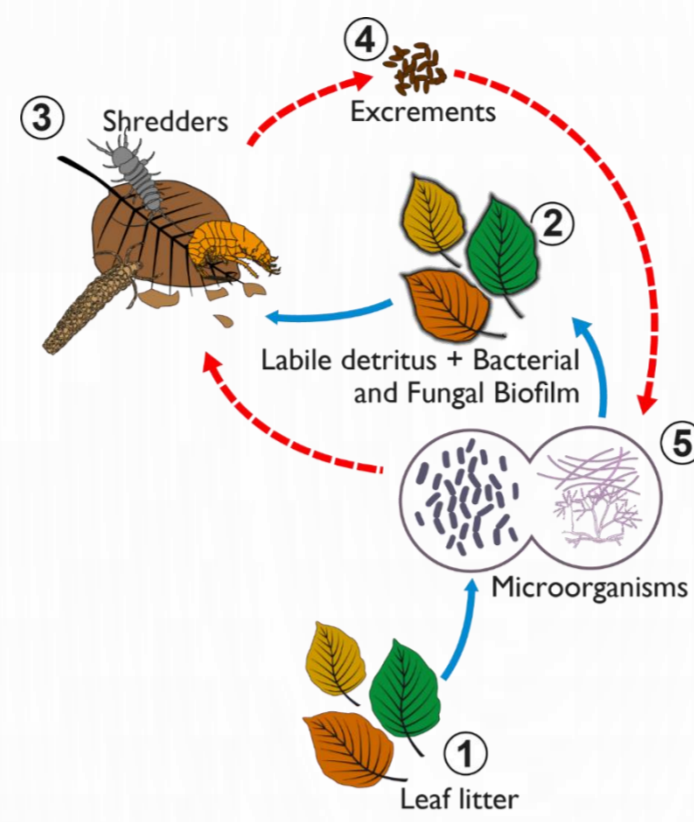


Fig 1: Various pathways during leaf processing in streams. Figure adapted after (Bernabé et al. 2018)

Objective: Investigate how the fatty acid (FA) composition of terrestrial organic matter (tOM) varies, together with the history of tOM pre-colonization; and how this is related to the FA composition of the shredder consumers.

Hypothesis: Microbial colonization under oxic conditions improves the FA composition of tOM (leaf diets) and thus increases the availability of essential FAs for shredder consumers.

Results

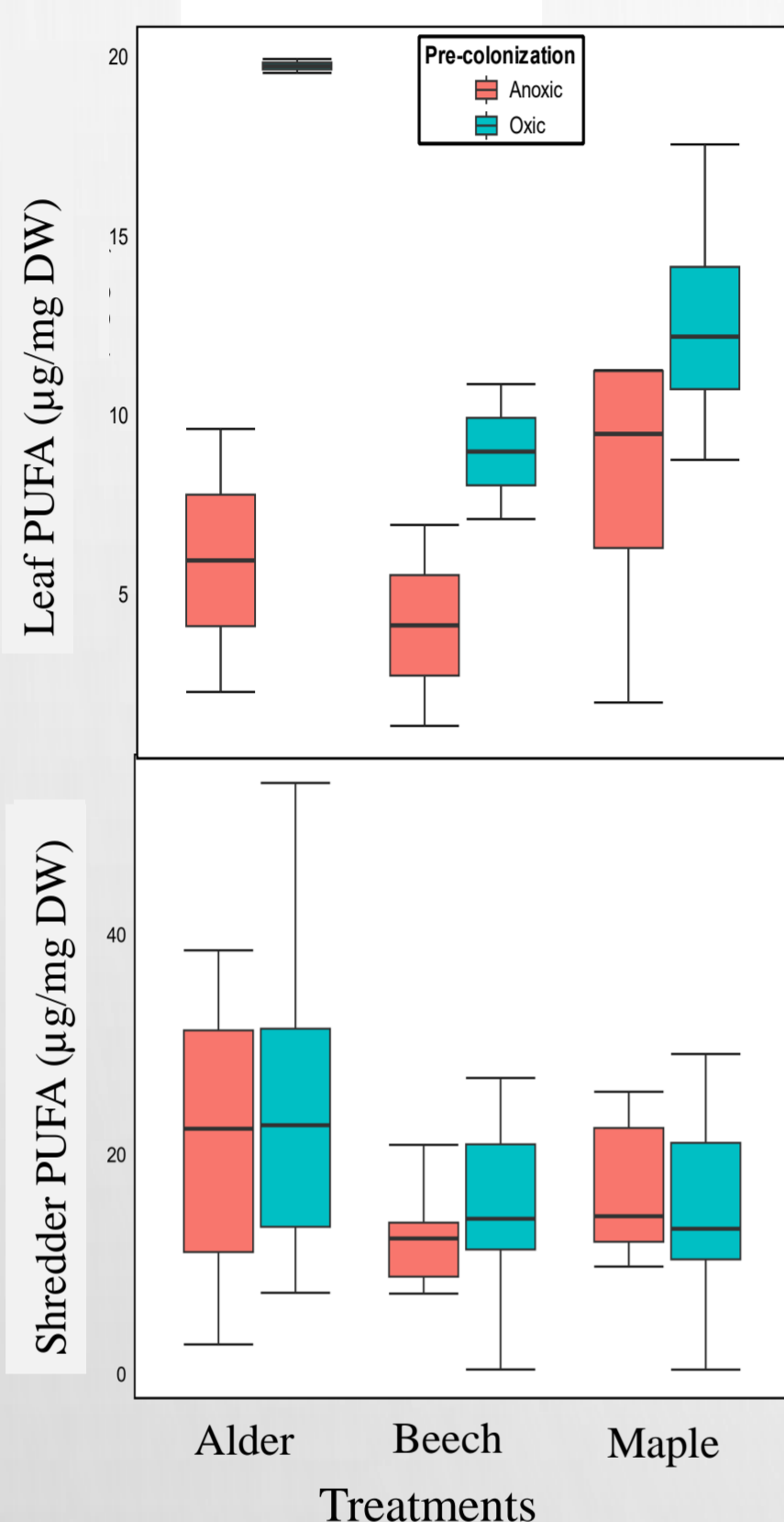


Fig 2: Quantities of leaf PUFA (upper) and shredder PUFA (lower) under different leaf and pre-colonization conditions

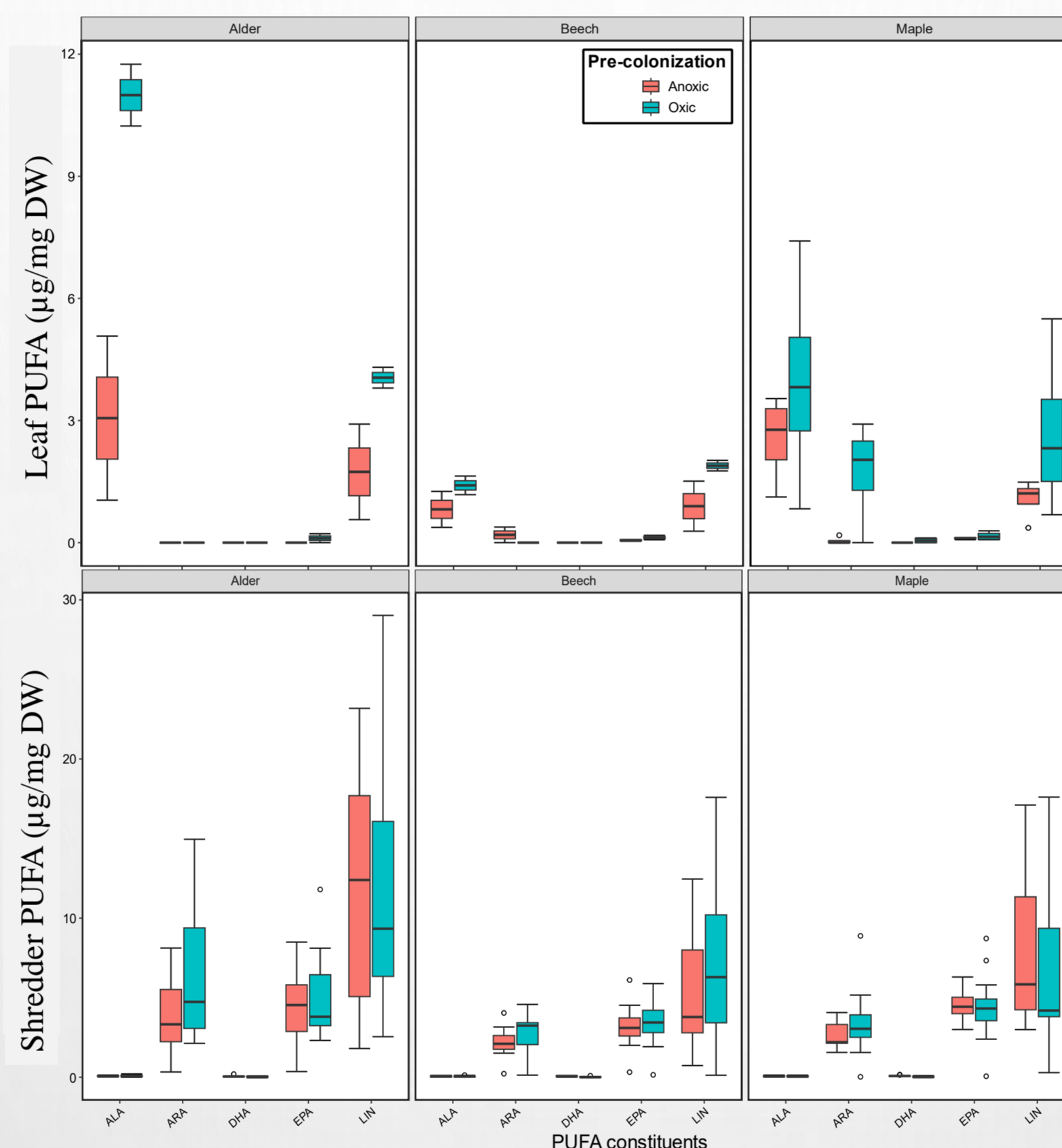


Fig 3: PUFA constituents in leaf diets (top) and shredder consumers (bottom) under different leaf and pre-colonization conditions. ALA - α -Linolenic acid. ARA - Arachidonic acid. DHA - Docosahexaenoic acid. EPA - Eicosapentaenoic acid. LIN - Linoleic acid

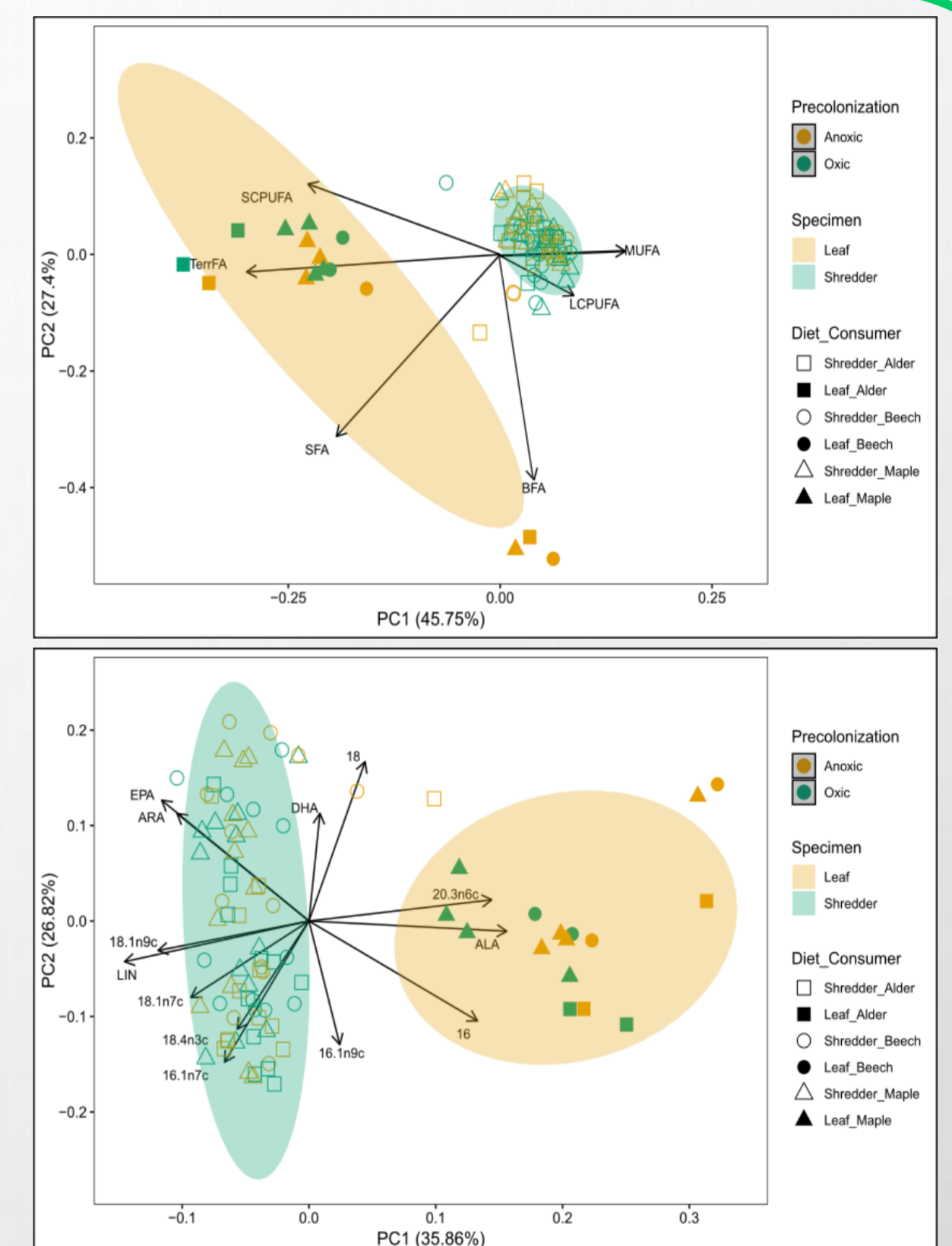


Fig 4: PCA biplots displaying the separation of grouped FAs (upper) and single FAs (lower) between leaf diets and shredder consumers. LC-PUFA – Long chain PUFA. SC-PUFA – Short chain PUFA. MUFA – Monounsaturated FA. BFA- Bacterial FA. SFA – Saturated FA. TerrFA – Terrestrial FA

Findings and conclusion

- **Oxic** microbial pre-colonization significantly improved the FA composition of **leaf diets** by increasing PUFAs content (Fig 2).
- Shredder **consumers FA composition** was significantly influenced by the **type of tOM**. Alder leaf resources had higher FA composition in comparison to maple and beech (Fig 2).
- Terrestrial organic matter quality and microbial colonization on terrestrial organic matter shape resource quality and PUFA availability in headwaters.
- Shredder **consumers** had high levels of **LC-PUFA** (EPA, ARA) and MUFA (Fig 3; Fig 4), while the leaf **diets** had high amounts of **SC-PUFA** (LIN, ALA), BFA, SFA and terrestrial FA (Fig 4).
- *Sericostoma* shredder consumers likely bio-converted the dietary fatty acid precursors from the leaf diets to LC-PUFA.

Materials and Methods

- Alder, beech and maple, pre-colonized under anoxic and oxic conditions were fed to caddisfly larvae (*Sericostoma* sp.) for 25 days under controlled conditions (Fig 5).
- Fatty acid composition of leaf diets and shredder consumers was analyzed after lipid extraction and derivatization to fatty acid methyl esters (FAMES) using gas chromatography (Guo et al. 2016).

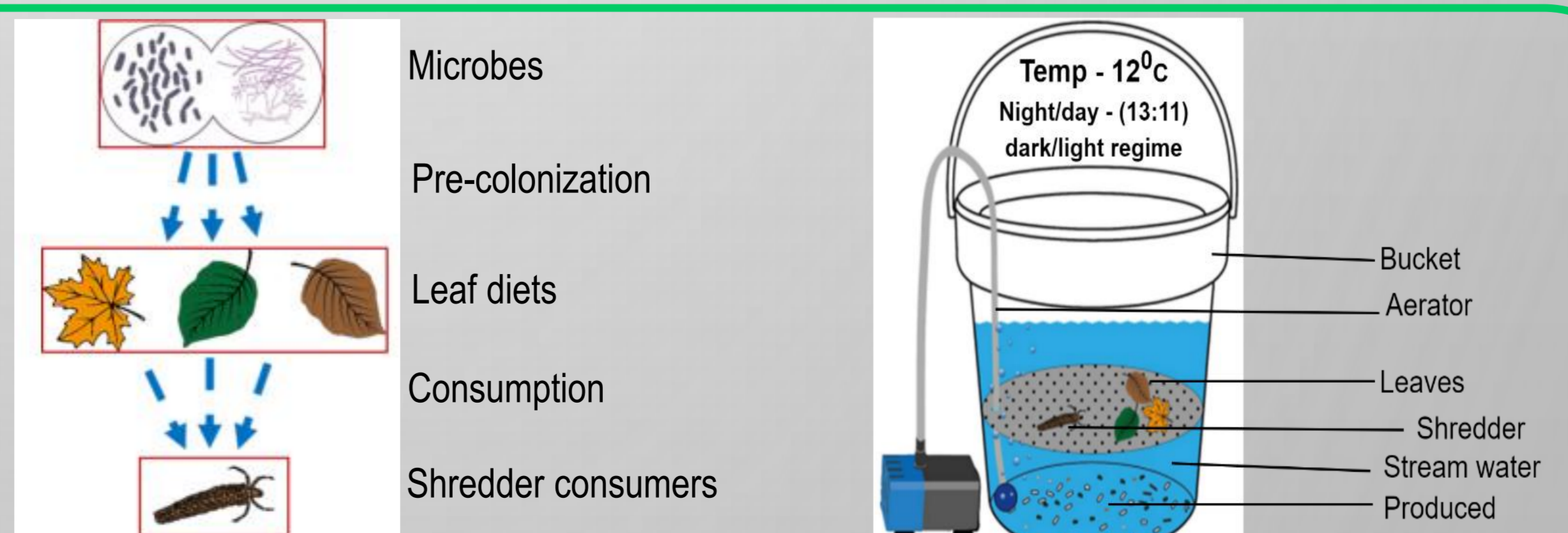


Fig 5: Experimental approach and set-up showing shredder consumption of various leaf diets following oxic and anoxic microbial pre-colonization

References

1. Bernabé et al. 2018. Warming weakens facilitative interactions between decomposers and detritivores, and modifies freshwater ecosystem functioning. *Glob. Change Biol.*, 24(7), 3170-3186.
2. Guo et al. 2016. High-quality algae attached to leaf litter boost invertebrate shredder growth. *Freshw. Sci.*, 35(4), 1213-1221.