From Cell to Food Web: Plankton Fluxes and Functional Traits in the Mayotte Lagoon

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Context

Tropical island lagoons like that of Mayotte (Comoros archipelago) support high planktonic biodiversity and play key ecological roles, including nutrient cycling, primary production, and energy transfer through marine food webs [1,2]. This reef-lagoon system, composed of mangroves, seagrass beds, and coral reefs, is increasingly impacted by terrigenous inputs, organic pollution, local eutrophication, and climate-related stress [3].

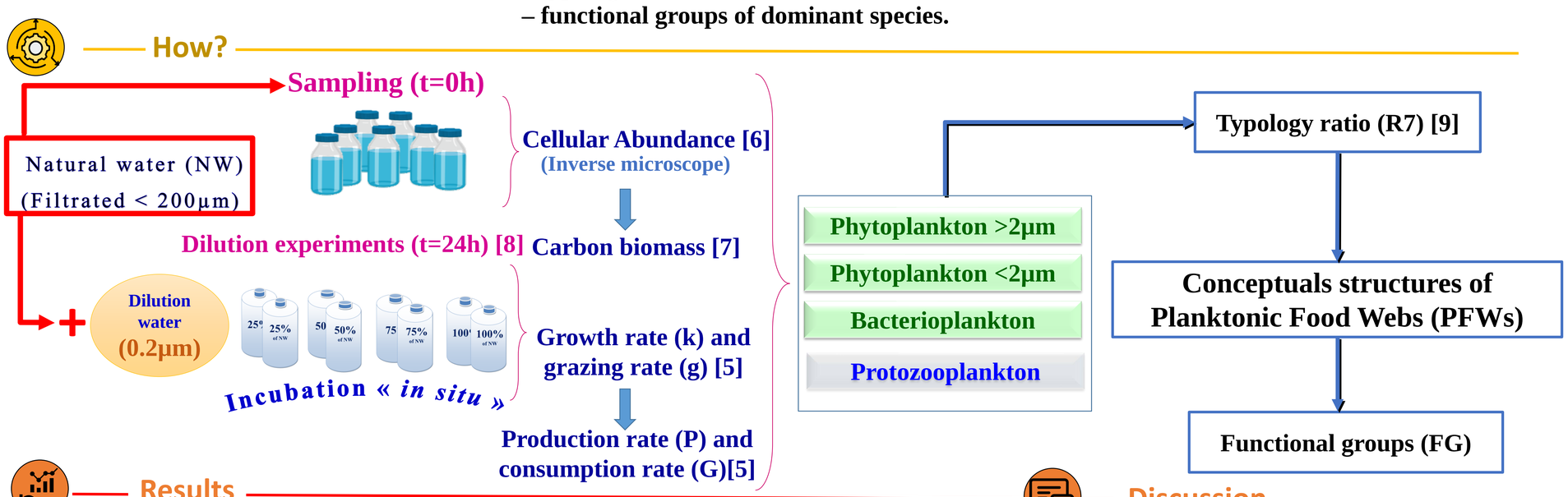
Among its sensitive zones, river mouths—such as the Gouloué river—act as critical interfaces between land and sea, influencing the structure of planktonic food webs (PFWs). These PFWs, driven by interactions among phyto-, protozooplankton and bacterioplankton, determine energy transfer to higher trophic levels such as fish and invertebrates [4,5].

Yet, the structure and functioning of these food webs remain poorly understood in tropical systems like Mayotte, despite their ecological significance.

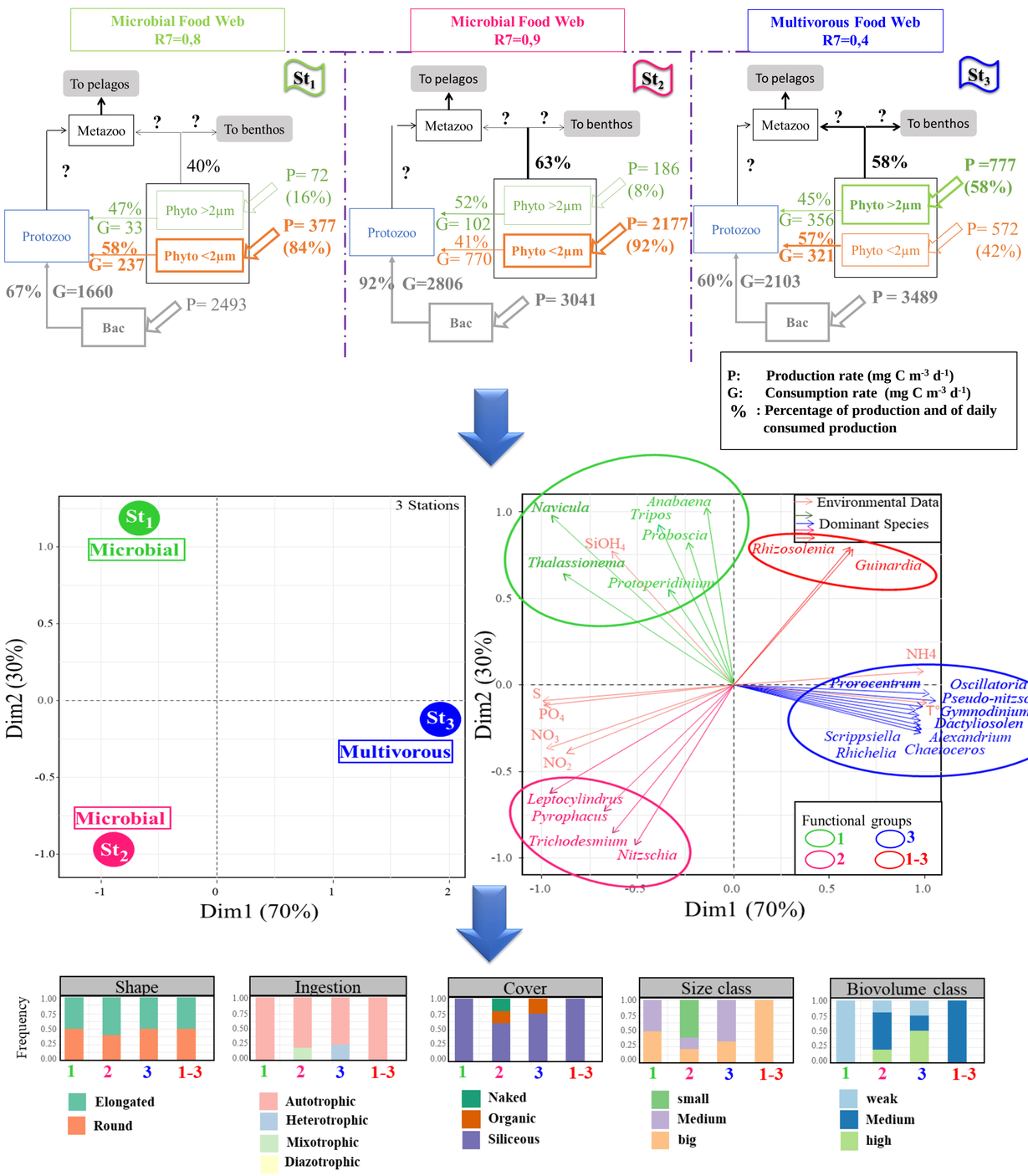
This study aims to:

- **Identify the main planktonic communities (phyto and protozooplankton and bacterioplankton) at three stations along a river-to-reef gradient.**
- **Characterize conceptual food webs based on: – *in situ* fluxes measurements,**
  – typological ratios,
  – functional groups of dominant species.

How?



Results



Discussion

St1

Microbial food web

Less efficient at exporting biogenic carbon to higher trophic levels

- Characterized by intermediate nutrient concentrations (with high $Si(OH)_4$)
- Dominated by mixed-size diatoms and dinoflagellates (*Navicula*, *Anabaena*, *Tripos*, *Proboscia*, *etc.*)
- Functional traits: mostly autotrophic, siliceous, elongated and rounded shapes, with low biovolume
- Production mainly driven by phyto<2µm and bacterioplankton
- High microbivory (dominated by protozooplankton grazing)
- Low energy transfer to higher trophic levels
- Presence of a codominant fonctional group in St_1 and St_3 reflecting a transversal structuring role, able to adapt to different types of PFWs (microbial or multivorous)

St2

Microbial food web

Less efficient at exporting biogenic carbon to higher trophic levels

- Characterized by nutrient-rich waters (high NO_3, NH_4 and PO_4 levels)
- Phytoplankton assemblage includes small diatoms, dinoflagellate and Cyanobacteria (*Leptocylindrus*, *Pyrophacus*, *Trichodesmium*, *Nitzschia*)
- Functional traits: autotrophic with some mixotrophy, mostly small-sized, siliceous or naked, moderate biovolume
- Balanced production between phytoplankton and microbial loop
- Microbivory still dominant but herbivory (proto- and metazooplankton) increasing

St3

Multivorous food web

More efficient at exporting biogenic carbon to higher trophic levels

- Characterized by less nutrients-rich offshore waters with high NH_4
- Dominated by medium-sized diatoms and dinoflagellates (*Chaetoceros*, *Oscillatoria*, *Pseudonitzschia*, *Gymnodinium*, *etc.*)
- Functional traits: autotrophic and some heterotrophic taxa, siliceous or organic coverings, mostly medium-sized cells, moderate biovolume
- Production supported by more efficient phytoplankton communities
- Co-dominance of microbivory and herbivory by zooplankton.

Conclusions & perspectives

- Clear spatial structuring of planktonic food webs in Mayotte lagoon during the rainy season.
- River mouth and intermediate stations (St_1, St_2): microbial webs dominated by bacterioplankton and picophytoplankton, with high protozoan microbivory → fast recycling, low energy transfer.
- Reef station (St_3): multivorous web with medium-sized autotrophs and copepod herbivory → more efficient carbon export.
- Functional differences linked to cell size, trophic mode, and cell covering (siliceous, organic, or naked).
  - → Dry-season study needed to assess the effect of reduced river inputs.
  - → Post-cyclonic monitoring is crucial to assess the functional resilience and reorganization of plankton communities

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