# Novel Microfluidics for the study of Microeukaryotes

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## We all know Microalgae are important… but why?

- Contribute up to 50% of global photosynthesis.
- Regulators of global carbon and oxygen fluxes.

## What about in their habitat, the Marine Environment?

- Placed at the bottom of the food-web together with bacterioplankton.
- Primary producers per excellence.

**Biogeochemical cycles**

## And what else?

- Oil Industry.
- Agricultural Industry.
- Food Industry.

**More sustainable world**

Retrieved from: NASA/NOAA GOES Project

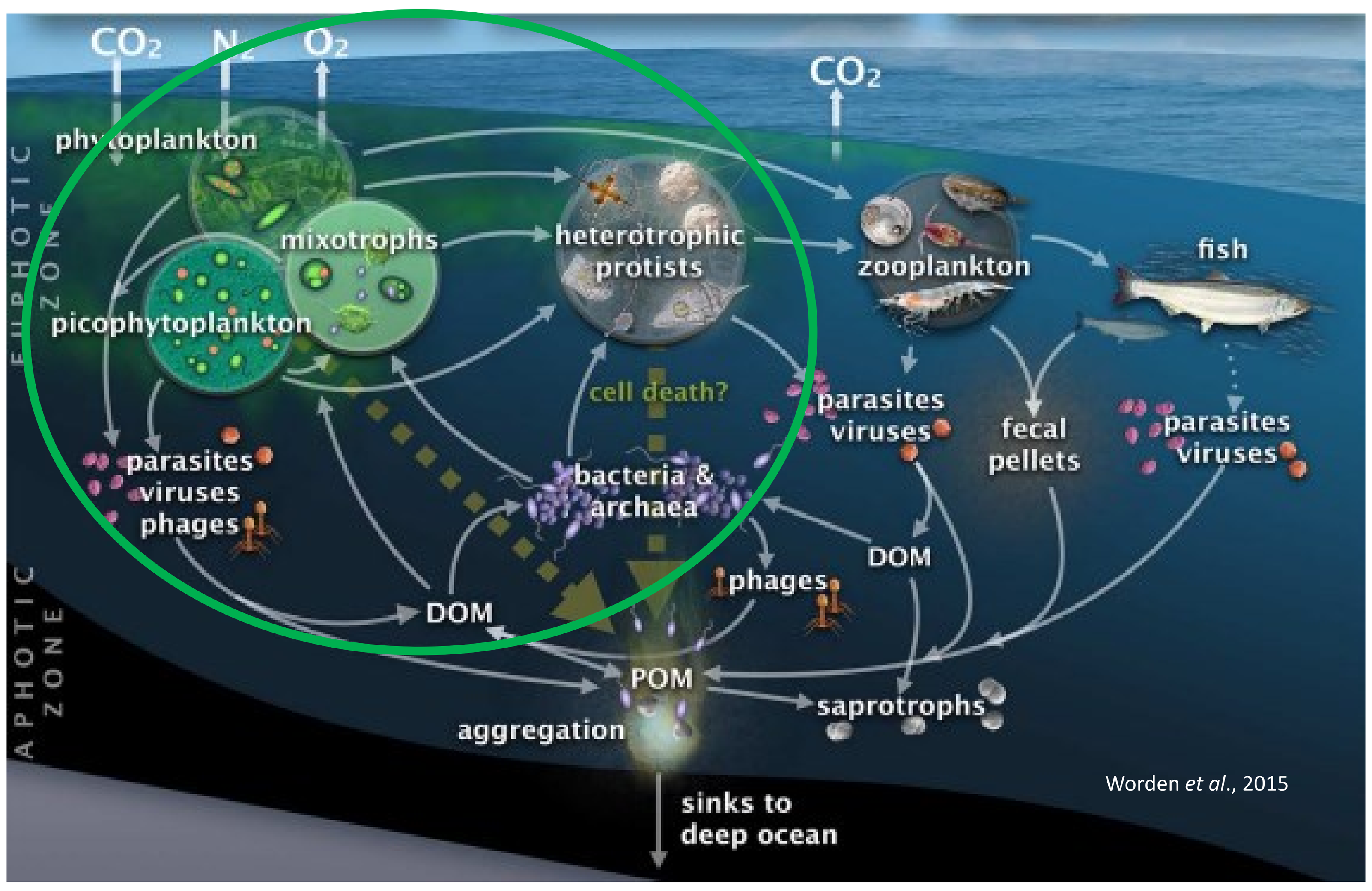


**Figure 1.** Marine food web. Green circle indicates microorganisms and their position in such web.

## MAIN OBJECTIVE

**To develop a microfluidic device for studying algal behaviour and their interactions with bacteria.**

### Specific objectives:

- To observe physiological changes in *O. tauri* under confinement.
- To record an in-vivo division.
- To study the interaction between *O. tauri* and its associated bacteria.

## Why *Ostreococcus tauri*?

*Potentiality as a model system:*

- High environmental adaptability.
- Small cell size (≤1 µm).
- Simple intra and extra-cell structure.
- Simple division strategy.
- Low DNA content.

## Why Microfluidics?

*Main Characteristics:*

- Single-cell approach to observe in-situ cells.
- Total control over the environment surrounding the study system.
- Cheap and biodegradable.

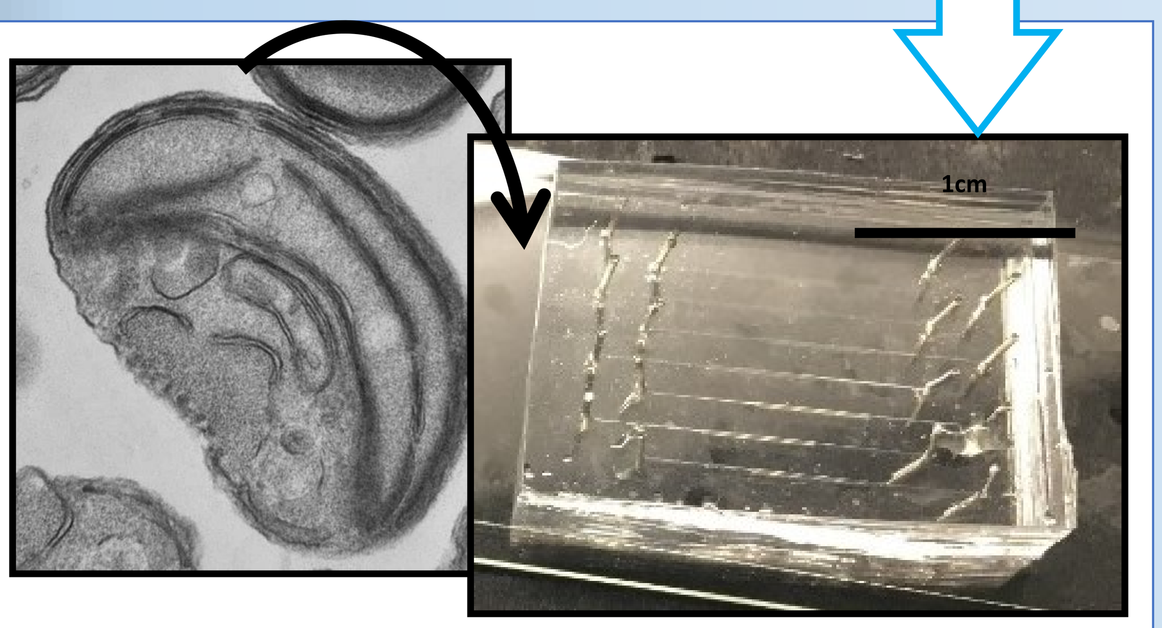


**Figure 2.** Left: *O. tauri RCC143*, right: PDMS device used in the current project. ©Wenche Eikrem and Jahn Throndsen, University of Oslo.

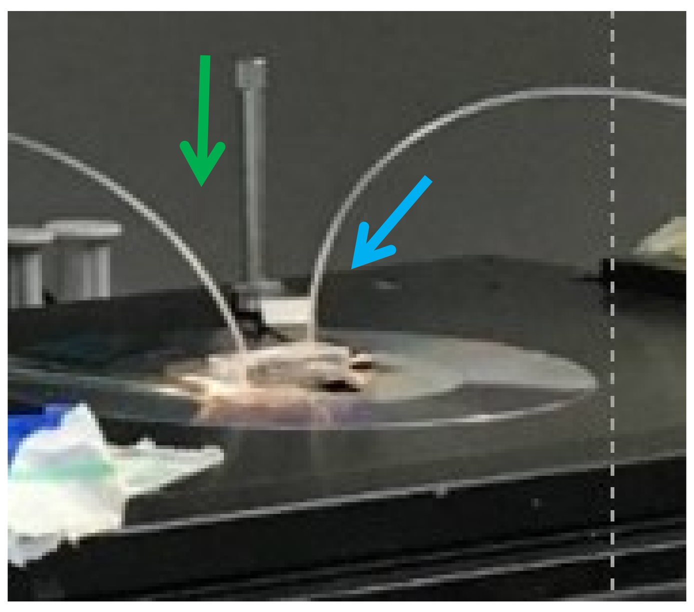

**Figure 3**. Zoom into the PDMS device. Arrows are inlet (green) and outlet (blue).

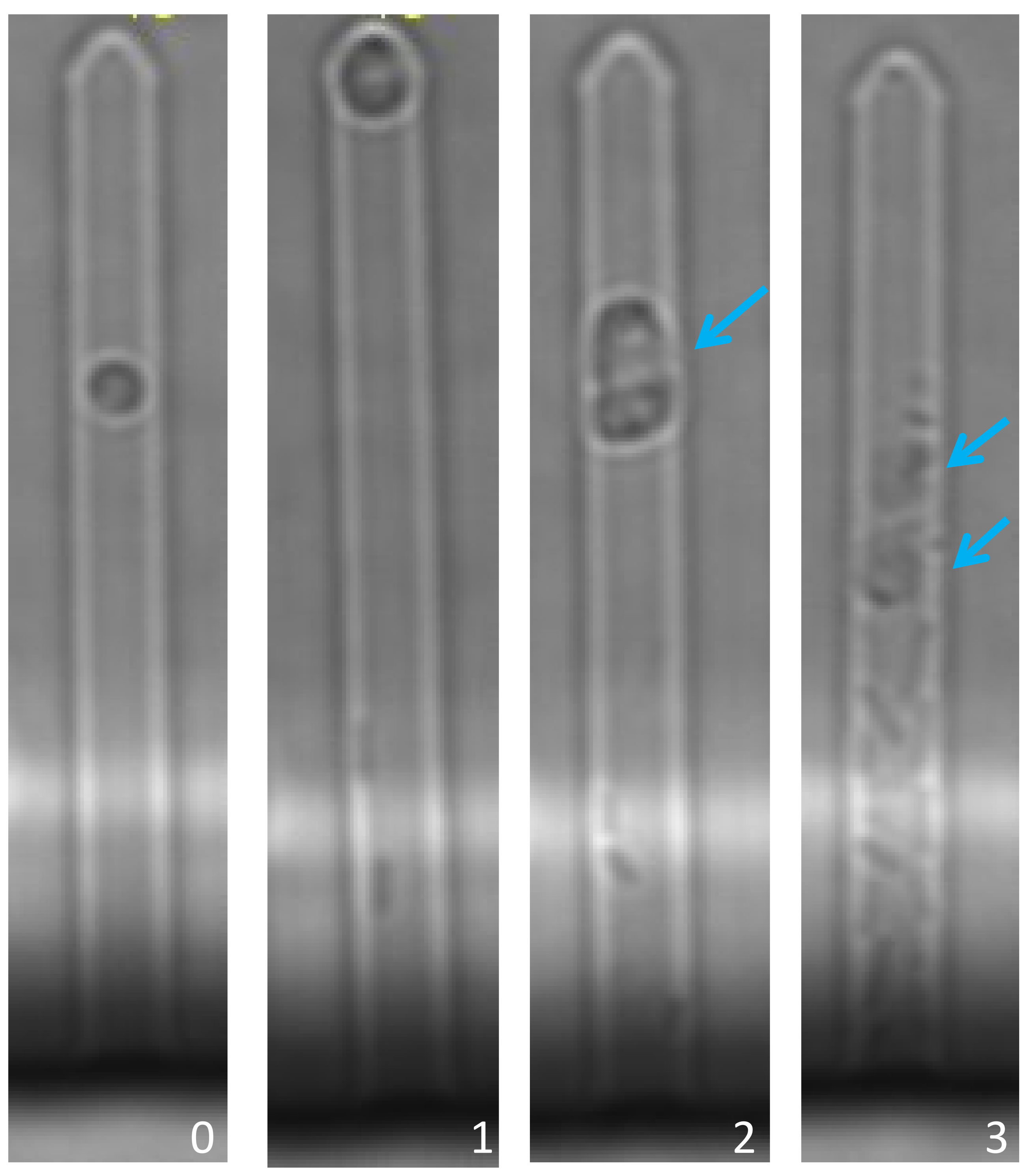


**Fig. 5.** Actual view of the microfluidic device (**Fig. 3**) under an inverted light microscope. Numbers refer to time in days. Arrows indicate the event of a division.

**Figure 4**. Microfluidics-microscope assays. Microalgae are trapped within the microfluidic device (1) (**Fig. 2**) and this is connected to a portable pump (2) that supplies a constant flow into the chip so that the media (marine L1) is renewed uninterruptedly.

## Conclusions

Up to date, there are microfluidics studies using microalgae such as *Chlorella sp* (Luke CS *et al*., 2016), but the biggest use is to test the resistance of bacteria against antibiotics (Cama *et al*., 2015).However, as shown in this project, the barriers are being open to also study other groups of microorganisms. Microfluidics is presented as an interesting and useful tool to finally uncover some of the mysteries found in this big but at once, tiny world.


### References

R. J. Clarke, 2017. *Modelling of Microscale Transport in Biological Processes*, Pages 171-206, Chapter 7 - Microorganisms and Their Response to Stimuli: Worden *et al*., 2015. *Rethinking the marine carbon cycle: Factoring in the multifarious lifestyles of microbes.:* Luke CS, *et al*., 2016. *A Microfluidic Platform for Long-Term Monitoring of Algae in a Dynamic Environment*. ACS Synth Biol. 5(1):8–14.: *Cama et al., 2015. Quantification of fluoroquinolone uptake through the outer membrane channel* OmpF *of* Escherichia coli. Journal of the American Chemical Society.



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