

Interactions of microbes in aquatic systems

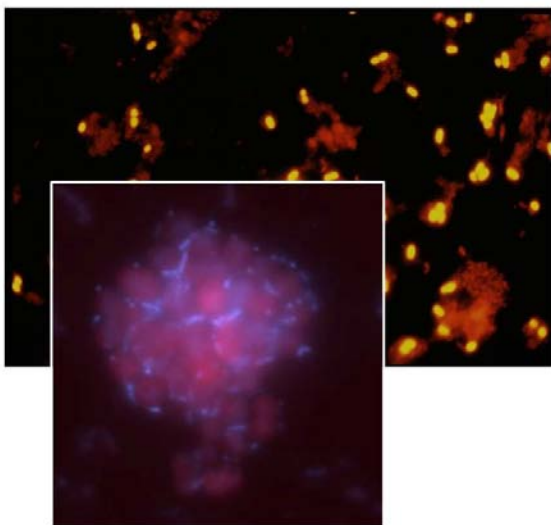
Uncultured populations of bacteria were analyzed in aquatic systems and populations related to environmental characteristics for many years. Initially, these studies dealt with the qualitative and quantitative analysis of Archaea in anaerobic sediments of Lake Rotsee (Lucerne, Switzerland), and were subsequently expanded to studies on the interaction of aggregate-forming phototrophic sulfur and sulfate-reducing bacteria in the chemocline of the meromictic Lake Cadagno, Switzerland. In the first study two major groups were identified with different distribution patterns in the environment. The latter topic (in a long-lasting collaboration with Dr. Mauro Tonolla and co-workers, Cantonal Institute of Microbiology, Bellinzona, Switzerland) revealed four major populations of purple sulfur bacteria in the observed aggregates related to the genus *Lamprocystis* that



were identified to form non-obligate, but numerically prominent associations with sulfate-reducing bacteria related to *Desulfocapsa thiozymogenes* suggesting an ecological advantage to both groups of organisms under appropriate environmental conditions. Mixed cultures of two isolates resembling a new strain of *D. thiozymogenes* and a new species of *Lamprocystis* resulted in their association in aggregates similar to those observed in the chemocline of Lake Cadagno. Concomitant growth

enhancement of both isolates in mixed culture suggested synergistic inter-actions that presumably resemble a source-sink relationship for sulfide between the sulfate-reducing bacterium growing by sulfur disproportionation and the purple sulfur bacteria acting as biotic scavenger.

These studies demonstrated (and visualized) close interactions of aggregate-forming phototrophic sulfur and sulfate-reducing bacteria, and suggested alternative metabolic activities with respect to sulfur cycle transformations of the sulfate-reducing bacteria (i.e. sulfur disproportionation). The development of molecular tools also allowed us to follow populations dynamics in time (i.e. during a decade) and detect shifts in populations as a consequence of environmental disturbance. Finally, the methods allowed us to enrich and isolate representative strains of the key functional groups in the chemocline, i.e. a strain resembling



Desulfocapsa thiozymogenes as well as several isolates representing different populations of purple sulfur bacteria.

Two isolates were proposed and described as novel species within the genus *Thiocystis*, *Thiocystis chemoclinalis* sp. nov., and *Thiocystis cadagnonensis* sp. nov., respectively. Another isolate, previously assigned to the genus *Lamprocystis*, was reclassified and described as novel species within the genus *Thiodictyon*, *Thiodictyon syntrophica* sp. nov. Other isolates are currently under investigation at the Cantonal Institute of Microbiology, Bellinzona, Switzerland.

Selected publications

1. Peduzzi, S., Storelli, N., Welsh, A., Peduzzi, R., Hahn, D., Perret, X., Tonolla, M. 2012. *Candidatus „Thiodictyon syntrophicum“*, sp. nov., a new purple sulfur bacterium isolated from the chemocline of Lake Cadagno forming aggregates and specific associations with *Desulfocapsa* sp. *Systematic and Applied Microbiology* 35, 139-144.
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3. Decristophoris, P.M.A., Peduzzi, S., Ruggeri-Bernardi, N., Hahn, D., Tonolla, M. 2009. Fine scale analysis of shifts in community structure in the chemocline of meromictic Lake Cadagno, Switzerland. *Journal of Limnology* 68, 16-24.
4. Tonolla, M., Peduzzi, R., Hahn, D. 2005. Long-term population dynamics of phototrophic sulfur bacteria in the chemocline of Lake Cadagno, Switzerland. *Applied and Environmental Microbiology* 71, 3544-3550.
5. Tonolla, M., Botinelli, M., Demarta, A., Peduzzi, R., Hahn, D. 2005. Molecular identification of an uncultured bacterium (“morphotype R”) in meromictic Lake Cadagno, Switzerland. *FEMS Microbiology Ecology* 53, 235-244.
6. Tonolla, M., Peduzzi, S., Demarta, A., Peduzzi, R., Hahn, D. 2004. Phototrophic sulfur and sulfate-reducing bacteria in the chemocline of meromictic Lake Cadagno, Switzerland. *Journal of Limnology* 63, 157-166.

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9. **Peduzzi, S., Tonolla, M., Hahn, D.** 2003. Vertical distribution of sulfate-reducing bacteria in the chemocline of Lake Cadagno, Switzerland, over an annual cycle. *Aquatic Microbial Ecology* 30, 295-302.
10. **Tonolla, M., Demarta, A., Peduzzi, S., Hahn, D., Peduzzi, R.** 2000. *In situ* analysis of sulfate-reducing bacteria related to *Desulfocapsa thiozymogenes* in the chemocline of meromictic Lake Cadagno (Switzerland). *Applied and Environmental Microbiology* 66, 820-824.
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13. **Tonolla, M., Demarta, A., Hahn, D., Peduzzi, R.** 1998. Microscopic and molecular *in situ* characterization of bacterial populations in the meromictic Lake Cadagno. *Documenta Istituto italiano Idrobiologia* 63, 31-44.