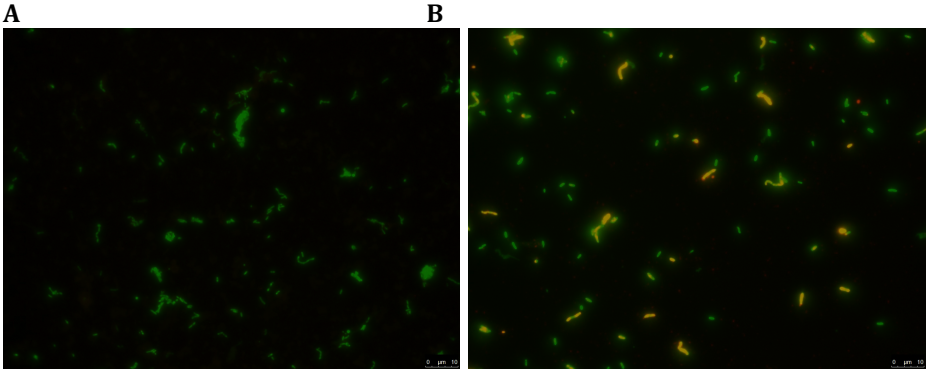
VIRIOBACLINK

Despite the intensive development of microbial ecology methods in the last decades and the recognition of the importance of the linkage between viral and bacterial community dynamics, the two groups are rarely studied together. The present project aimed to increase our understanding of the linkage between viral and bacterial communities in aquatic environments and initiate a framework were the two are studied together in a multidisciplinary way with special focus on the factors determining the nature and strength of the connections between them. To achieve the goals of VIRIOBACLINK a multidisciplinary microbial ecologist, Dr. Anna J. Székely has been trained through the implementations of diverse research objectives.

The main research objectives and results of the project are the following:

- **Evaluation of the methodology** of current cutting-edge viral ecology methods in regard of the study of phages (i.e. viruses that infect bacteria) with special focus on the understudied but ubiquitous non-tailed, single-stranded DNA (ssDNA) phages. The results of this objective revealed various significant distortive biases in the current methodology that require special attention from viral ecologists and the development of new and improvement of old methods. The results of this objective have been published in **review/meta-analysis paper** (Székely & Breitbart, 2016, FEMS Letters), while the experimental evaluation of various viral concentration methods has been presented at the 14th Symposium of Aquatic Microbial Ecology in Uppsala, Sweden (2015).
- **Development of novel method able to visualize and quantify bacteria infected with ssDNA phages**. Through this objective a fluorescent *in situ* hybridization (FISH) technique has been developed that makes possible the for the first time the quantification of bacteria infected with a broader group of phages in environmental sample.



Visualization of phage infection by FISH. A: uninfected cells. B: infected cells in yellow.

- **Assessment of the role of viral communities in determining the faith of bacterial communities.** To achieve this goal Dr Székely performed an extensive microcosm experiment using water from three Swedish boreal lakes. Briefly, in the experiment bacteria were transplanted to water containing the phages of their original source lake or phages from the other lakes to measure the effect of known and unknown phages. The results presented at the 8th Aquatic Virus Workshop in Plymouth, UK (2016) indicate that the unknown phages are less specialized to infect the transplanted bacteria and therefore have a lesser effect than the known ones.

- **Joint viral and bacterial diversity survey of waters differing in organic matter composition**. To fulfill this objective 30 lakes and peats across Sweden differing in water retention time and consequently organic matter composition have been sampled and processed for bacterial and viral diversity as well as detailed chemical analysis such as dissolved organic matter profiling with mass-spectrometry, flocculation, etc. The biological samples are currently being processed for sequencing and the results will be available in 2017.

Finally, the results and the knowledge gained through the VIRIOBACLINK project have allowed Dr. Székely to become a multidisciplinary scientist who has already submitted various research proposals to both American and Swedish funding agencies about topics relevant to the project. One of them (NSF) has already been accepted for funding, which will allow the continuation of the project. In addition, Dr Székely, will continue her career exploring the molecular evolution aspects of the effect of viral and microbial communities on the faith of carbon in freshwater ecosystems.