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Published in:
Frontiers in Microbiology

DOI:
10.3389/fmicb.2013.00059

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Molecular and functional ecology of aquatic microbial symbionts

Hans-Peter Grossart1,2*, Lasse Riemann3 and Kam W. Tang4

1 Department of Experimental Limnology, IGB-Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany
2 Institute of Biochemistry and Biology, Potsdam University, Potsdam, Germany
3 Department of Biology, University of Copenhagen, Copenhagen, Denmark
4 Department of Biological Sciences, Virginia Institute of Marine Science, Gloucester Point, VA, USA

*Correspondence: hgrossart@igb-berlin.de

Edited by:
Jonathan P. Zehr, University of California, Santa Cruz, USA
Reviewed by:
Jonathan P. Zehr, University of California, Santa Cruz, USA

Recent advances in methodology such as profiling using microsensors allow researchers to characterize microhabitats within the higher organisms in unprecedented detail. Rapid development of single-cell and molecular techniques for phylogenetic and physiological analyses also offers enormous opportunities to study these symbionts at scales from a single gene to the whole community, and even their evolutionary history. New experimental approaches using genetically accessible model systems and individual-based modeling can also provide a mechanistic understanding of host-symbiont relationships.

This special issue brings together 11 articles that highlight new findings on biodiversity and functions of aquatic microbial symbionts, including microbial assemblages in close association with higher organisms.

The article by Wahl et al. (2012) presents a conceptual framework for studying the role of bacteria on the outer body of marine organisms, which represents a highly active interface between host and biofilm microbes. The authors show that biodiversity and functions of the attached microflora are largely dependent on environmental parameters, and how the microflora influences the host's ecology and health. The article by Bickel et al. (2012) focuses on ciliate epibionts of crustacean zooplankton in lakes. The authors show that ciliate epibiont abundance varies greatly between lakes and zooplankton species, respectively. Although the ciliate epibionts exhibited high grazing rates on free-living bacteria, their effects on the total bacterial abundance seemed to be rather low. Also, effects of epibionts on the physiology and development of their host require further study.

A cluster of three articles (Dziallas et al., 2012; Garciabonet et al., 2012; McManus et al., 2012) addresses endosymbiotic relationships between microbes and higher organisms. The article by Dziallas et al. (2012) addresses endosymbiotic relationships between microbes and higher organisms. The article by Bickel et al. (2012) focuses on ciliate epibionts of crustacean zooplankton in lakes. The authors show that ciliate epibiont abundance varies greatly between lakes and zooplankton species, respectively. Although the ciliate epibionts exhibited high grazing rates on free-living bacteria, their effects on the total bacterial abundance seemed to be rather low. Also, effects of epibionts on the physiology and development of their host require further study.

The next two articles evaluate the role of symbionts of an ascidian (Kühl et al., 2012) and a coral (Wangpraseurt et al., 2012) in photosynthetic activities in relation to environmental parameters such as irradiation, periods of anoxia, and physiology of the host. Kühl et al. (2012) focus on a chlorophyll b-containing...
symbiotic cyanobacterium and its photosynthetic activity, whereas Wangpraseurt et al. (2012) examine optical microniches in corals and provide evidence for the importance of such microniches for photobiology and stress response of the corals, as well as for the phenotypic and genotypic plasticity of the coral symbionts.

Finally, the articles by Dinasquet et al. (2012) and Rivera et al. (2013) report on the contributions of organism-associated bacteria to spatial heterogeneity of bacterioplankton activity and community composition in the sea. Dinasquet et al. (2012) show data indicating specific associations between certain bacterioplankton groups and their jellyfish host, whereas Rivera et al. (2013) highlight the role of ballast water for the dispersal of potentially pathogenic vibrio species.

In summary, these articles cover a range of symbiotic relationships in aquatic environments, pinpoint that these relationships are widespread, and that they conceivably play important roles for the health, adaptation, and evolution of the host organisms, and, thereby, for food web structure and ecosystem functioning. We hope that this special issue will stimulate more discussions and research on the fascinating subject of microbial symbiosis, which seems to be the rule rather than the exception in aquatic ecosystems.

REFERENCES


Received: 31 January 2013; accepted: 28 February 2013; published online: 15 March 2013.


This article was submitted to Frontiers in Aquatic Microbiology, a specialty of Frontiers in Microbiology.

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