Marine Biology

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Research

Our main research topics involve the ecology of shallow water ecosystems, both benthic and pelagic, with an emphasis on the exchange processes between water column and seabottom and their importance in coastal seas.

Benthic-pelagic coupling mediated by benthic macrofauna

Subtidal bottoms in 20-30 m depth in the North Adriatic Sea are characterized by high-biomass epibenthic communities consisting of diverse suspension-feeder associations in addition to a rich endobenthos. These communities are believed to play a major role in stabilizing the ecosystem by cropping and partly controlling pelagic production. Bottom anoxias in recent years have led to catastrophic disturbances of these rich bottoms. Using in-situ and laboratory recording and experi-mental techniques we are studying the fluxes of organic matter and inorganic nutrients across the bottom/water interface and in and out of the nepheloid layer developed close to the bottom. Practically all sampling and experimentation is done using SCUBA. We develop and use surface-independent systems to measure oxygen and nutrient flux on the bottom over extended periods. In a subtidal tunnel we manipulate epifauna density and rate of water flow to be able to estimate the influence of suspension feeders on sedimentation rates. Laboratory work involves studying the reaction of experimental sediment columns to pulses of high sedimentation of organic matter, the behaviour of phytoplankton/suspension-feeder microcosms and the ecophysiology of benthic animals under hypoxic conditions.

Symbioses between chemolithoautotrophic bacteria and invertebrates from sulfide-rich habitats

Sulfur-oxidizing bacteria live in symbiosis with a number of invertebrates in the sea. Spectacular are those symbioses developed in the vicinity of hydrothermal springs in the deep sea. We investigate two ectosymbioses (in free-living nematodes from shallow sands and in sedentary colonial ciliates on mangrove peat) (Fig. 1) in order to unravel the functioning and evolution of these mutualistic relationships. The ectosymbioses offer a unique opportunity to study the genesis of symbioses, because the partners are loosely interconnected and sometimes can be separated and studied alone. Furthermore, in most cases close relatives which are non-symbiotic are available for comparison. We are studying the ecological conditions of the occurrence of the symbioses in the field, applying microelectrode techniques to measure the gradients of oyxgen and sulfide. Microorganisms and host are characterized using SEM and TEM techniques, immuno-histochemistry and molecular techniques (PCR, DNA sequencing).

Marine snow and colloidal organic matter

Marine snow - a gelatinous matrix in which living and dead biomass is embedded - plays an important role in the transfer of organic carbon from the

euphotic zone to the deeper layers of the ocean. The Northern Adriatic Sea offers ideal conditions to study the formation and decay of these aggregates. They are composed of colloidal fibrils produced by microorganisms; currently, the role of microorganisms in producing colloidal matter is investigated by visualizing the structure of the colloidal fibrils during the degradation process and chemical analysis. We have evidence that bacterioplankton transformation of organic matter is responsible for the increasingly refractory nature of organic matter in the deeper layers of the sea. The fate of colloidal matter from the release by organisms via coagulation of colloidal matter by turbulent shear to final degradation is followed in laboratory experiments.

Ultraviolet-B radiation

Ultraviolet-B radiation increased over the last decade not only in polar regions but also in mid-latitude areas as a result of stratospheric ozone reduction. UV-B is potentially harmful to organisms which consequently have developed different strategies to protect themselves or to repair radiation-mediated damage. In an international program the role of UV-B radiation on the carbon- and energy-flux through aquatic systems is investigated. We study the influence on metabolic rates of organisms of different trophic levels and over a wide range of habitats, from Arctic and high Alpine lakes to the Adriatic Sea. An important focus in this project is the role of photolysis in the degradation of dissolved organic matter as compared to microbial degradation. Based on recent advances resulting from collaborative work with US scientists we are now able to quantify UV-B mediated DNA-damages at the cellular level. Currently, we are investigating possible adaptative mechanisms and the role of turbulence in altering the light regime and thereby inducing DNA-repair in aquatic microorganisms.

Teaching

Introduction to Ecology (L,2); - Introduction to Marine Science (L,3); - Biogeochemical Cycles in the Sea (L,2); - Introduction to the Marine Fauna and Flora (2-week field course taught in collaboration with the Anatomy and Morphology section) (P,10); - Marine Ecology (2-semester course for advanced students doing research projects (S+P,10)

International Cooperations

Center for Marine Research, Rovinj, Croatia; - Smithsonian Institution, Washington D.C., USA; - Scripps Institution of Oceanography, La Jolla, CA, USA; - Plymouth Marine Laboratory, Plymouth, England; - Station Zoologique Villefranche sur Mer, France; - Universidad del Pais Vasco, Bilbao, Spain; - Microbiologie Marine, CNRS Marseille, France

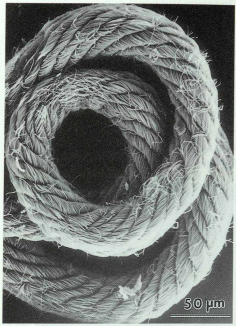

Fig. The nematode *Eubostrichus* sp. is covered by a layer of crescent shaped symbiotic bacteria. SEM, scale bar 100 µm

Selected References

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