MODELLING OF COMPETITION AMONG MUSSELS

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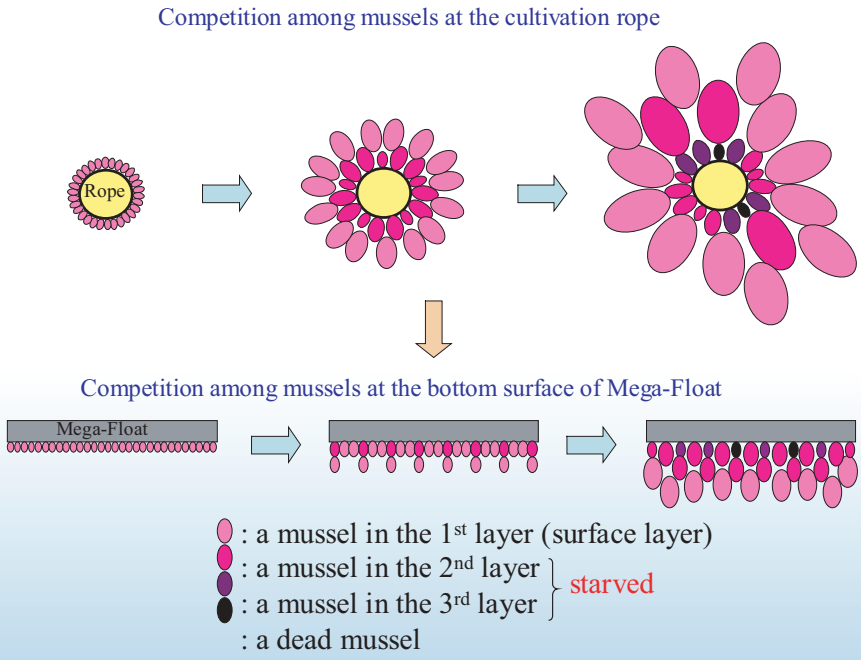
An artificial structure built in the sea provides space for settlement of sessile organisms in banks. Mussels are the dominant species and their activities may change the water quality around them. In order to assess the environmental impact of the mussel bank, a mathematical model was constructed which describes the dynamics controlled by competition for space and food. The competition model can predict the food ingestion, the oxygen consumption, and the growth of the mussels as controlled by competition for space and food.

A new runway will be built in Tokyo Bay of Japan as an international airport. A mega-floating platform is one of the three possibilities proposed as the method of construction. To realize this Mega-Float, a prototype model has been anchored in the southern area of Tokyo Bay. In this project, the resulting changes in water current, water quality and benthic ecosystem were examined to assess the environmental impacts. It appeared that the water quality just below the under-surface of the prototype model changed due to activities of the sessile organisms, about 80 percent of which were blue mussels (*Mytilus galloprovincialis*). For the quantitative environmental impact assessment a mathematical model was developed to describe the dynamics of mussels on an artificial structure as con-

A prototype model of the Mega-Float



The competition model was developed for mussels on the cultivation rope, and applied to mussels at the under-surface of the Mega-Float.

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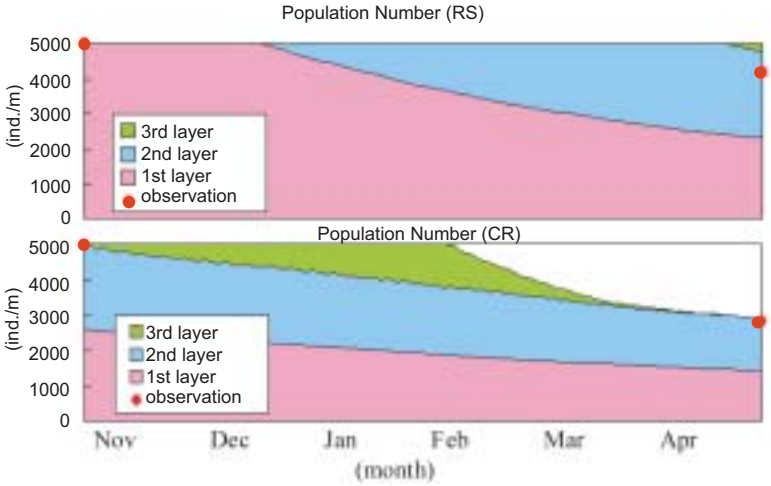
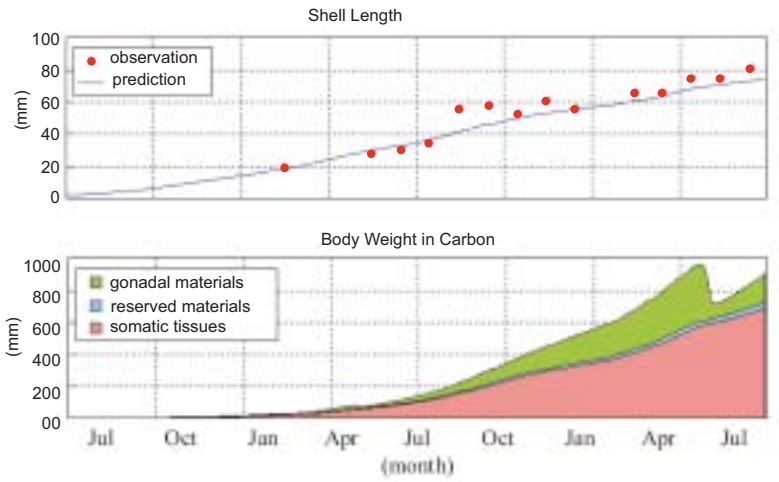


Time variations in population number of mussels, the seeds of which are collected from rocky shores (RS) and collector ropes (CR).

calibrated with data of growth experiments on a cultivation rope. On such a rope the population number starts with 5000 individuals per meter, which are collected from rocky shores and collector ropes. As mussels grow, the population number decreases due to death of starved mussels, and about half of the living mussels are inactive in the inner layer of the mussel bank.

The competition model will be trolled by competition for space and food availability. With the model the impact of the dynamics of the mussels on the environment such as changes in the suspended matter and oxygen concentration can be estimated. The model consists of a physiological growth model based on the Dynamic Energy Budget model (DEB) of Kooyman and a competition model for space. In the latter the formation of new layers of mussels is described as a function of the mussel density on the artificial structure. In this way a multilayer structure of a mussel bank can be described, in which competition for food between mussels in different layers takes place. For the mussel in the basic layers the formation of new layers will undoubtedly lead to food shortage and starvation due to their unfavorable position. This starvation will depend on the physiological status of the mussel as described with the DEB model.



Time variations in shell length and body weight in carbon in 2 years.

The competition model is developed by using observations of mussels growing on cultivation ropes at the northwest coast of Spain. The parameter values of the physiological submodel are calibrated with observed growth curves. The parameters of the space competition submodel are applied to competition among mussels on the under- surface of the Mega-Float, and is connected to the three dimensional marine ecosystem model. The food ingestion, the oxygen consumption, and the growth of the mussels can be estimated according to temperature and suspended matter in the ambient water, and the impacts of the mussel bank on the surrounding environment are predicted.