Notice on Plankton Seminar

#16001

9:30-11:30, 18 Apr. (Mon.) 2016 at room #W103

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Biological control of harmful algal blooms using competitors and killers

There is an urgent need for bloom mitigation strategies in aquaculture areas due to huge fishery damages by harmful algal blooms (HABs). Many kinds of countermeasures have been proposed but there are few methods actually feasible to the field such except for clay spraying in Kyushu area in Japan and south coast of Korea. Microorganisms such as bacteria appear to be promising control agents against red tides. Algicidal bacteria have actually been isolated from the coastal waters. Several studies on temporal fluctuations of algicidal bacteria and HAB species demonstrated that algicidal bacteria specifically associated with the occurrence and crash of red tides, and also contributed to the rapid termination of red tides in the coastal waters such as the Seto Inland Sea.

New research indicates large numbers of algicidal bacteria attached onto the surface of seaweeds (maximum, million of killers per gram wet weight) such as *Ulva* sp. (Chlorophyta) and *Gelidium* sp. (Rhodophyta) without occurrences of any microalgal blooms. And further we discovered comparatively abundant existence of algicidal bacteria (ten times or more) including killers for *Chattonella antiqua* (Raphidophyceae) on the surface of leaves of seagrass (*Zostera marina*) and in seawater in *Zostera* bed with seaweed beds. The presence of the large number of algicidal bacteria indicates the potential for preventing red tide occurrences. We here propose new prevention strategies for red tides by cultivation of seaweeds in aquaculture areas. When we develop and restore the natural seaweed- and seagrass-bed as a part of Sato-Umi concept, these presumably function to prevent the occurrences of HABs. Further, restored seaweed and seagrass beds also serve as nursery grounds for important fisheries resources.

The harmful raphidophytes *Chattonella* spp. (*C. antiqua*, *C. marina* and *C. ovata*) have a cyst stage in their life cycle. The cysts settle to the sea bottom to overwinter and thereby ensure the persistent existence in the same area, and the germination of cysts provides the inoculum for red tides to overlying waters.

It is empirically known that *Chattonella* blooms have been observed when diatoms are scarce in water columns. Diatoms form resting stage cells under nutrient-deficient conditions, and rapidly sink to bottom and disappear from the water columns. *Chattonella* cysts can germinate in the dark, whereas diatom resting stage cells require light for germination. Thus the predominance of *Chattonella* spp. might be attributed to the disappearance of diatoms and subsequent failure of germination of their resting stage cells under low light conditions at the sea bottom. The selective germination of cysts at the sea bottom is presumably a significant factor for the initiation and success in *Chattonella* red tides in coastal seas such as the Yatsushiro Sea and the Seto Inland Sea.

Giving enough light to the abundant diatom resting stage cells at sea bottom was considered to enhance the germination of diatom resting stage cells and resultant vegetative cells are expected to proliferate in the surface water and to overwhelm *Chattonella* populations by exhaustion of inorganic nutrients (N and P). We here propose bottom sediment perturbation using submarine tractors as a practical strategy for suspending and lifting diatom resting stage cells in sea bottom to euphotic layer in coastal areas. Bottom sediment perturbation is a common technique for improving environmental conditions of sea bottom of aquaculture areas and for enhancing the production of clams in shallow coastal seas. This technique is inexpensive and environment friendly. Practical trials are highly needed in red tide occurring areas such as the Yatsushiro Sea with mass mortalities of cultured fish. Further studies are needed on improvement of gears, operation timing and scale for effective prevention of harmful *Chattonella* red tides by enhancing diatoms in coastal areas.

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