Influence of Nori aquaculture-induced change in light environment on phytoplankton dynamics

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In the Ariake Sea in winter, Nori aquaculture is conducted actively, and its production is the largest in Japan. On the other hand, color bleaching of Nori due to red tide occurrence has become a big problem. From previous research, it is known that the red tide occurrence involves the improvement of the light environment. At the time of Nori aquaculture season, Nori aquaculture net is set densely in the coastal area, and leaf blade is attached to the net and it grows. It can be easily imagined that such net and leaf blade have great influence on the light environment in water, but there are no examples studied so far. In this study, by continuous on-site observation of the photon quantum amount in the Nori aquaculture area and the non-Nori aquaculture area, the influence of Nori aquaculture on the light environment is evaluated, and the influence is evaluated by dynamic growth of leaf blade as a function. We investigated how phytoplankton dynamics by incorporating these results into numerical simulation changes.
We installed a photon meter (DEFI2-L by JFE Advantech Co., Ltd.) and pressure gauge (DEFI2-D10 by JFE Advantech Co., Ltd.) respectively in the sea area just under the Nori aquaculture and in the non-Nori aquaculture area possessed by the Saga Prefecture Fisheries Experiment from January 15 to 25 in 2019. This continuous observation was carried out at 5 second intervals. As a result of the observation, it was revealed that the photon quantum amount decreased by about 75% on average just under Nori aquaculture area. The reduction of this photon (light shielding factor y) was expressed as a function of the leaf length (x unit: cm), and the following equation was obtained.

$y=0.86e^{-0.1\times x}$

Next, we developed a numerical ecosystem model that takes this light shielding factor into consideration and examined how it affects phytoplankton dynamics. Calculation was carried out separately into two patterns with and without light shielding factor in Nori aquaculture area. In consideration of the light shielding factor, the phytoplankton biomass was reduced in the vicinity of the Nori aquaculture area in the inner part of Ariake sea, compared to the case without consideration. This indicates that Nori aquaculture suppresses the growth of phytoplankton by deteriorating the light environment in water.

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