Developing a Seaweed Species-Selection Index for Successful Culture in a Seaweed-Based Integrated Aquaculture System

Yun Hee Kang
Marine Research Institute
Pusan National University
Busan, 609-735, Korea

Ik Kyo Chung
Division of Earth Environment System
Pusan National University
Busan, 609-735, Korea
E-mail Address: ikchung@pusan.ac.kr

Aquaculture has long been supporting human demand for fish products and is an important industry worldwide. However, excess nutrient output from fish aquaculture activities may have negative impacts on coastal and sheltered areas, such as eutrophication. In order to reduce or remove mass nutrient sources, integrated multi-trophic aquaculture (IMTA) has been proposed as a concept that combines the cultivation of fed aquaculture species (e.g. finfish/shrimp) with extractive aquaculture species (e.g. shellfish/seaweed). In seaweed-based integrated aquaculture, seaweeds have the capacity to reduce the environmental impact of nitrogen-rich effluent in coastal ecosystems. Thus, the selection of optimal species for seaweed-based integrated aquaculture is very important.

The present study was based on the work of Short et al. (2002), where a species-selection model was developed to determine optimal species for seaweed-based integrated aquaculture. The model synthesizes available literature-based information, reference data, and physiological seaweed experiments to identify and prioritize species for seaweed-based integrated aquaculture. The model process is divided into three phases: (1) priority species are selected according to a preliminary seaweed-based integrated aquaculture suitability index (PSASI); (2) PSASI-indentified priority species are analyzed by laboratory experimentation for pertinent physiological characteristics of seaweed; and (3) based on the PSASI and experimentation results, a seaweed-based integrated aquaculture suitability index (SASI) score is calculated for each species. Results showed that Porphyra yezoensis and Ulva pertusa received high SASI scores under low- and high-water-temperature (10 and 25°C) conditions, respectively. Most species were found to be suitable for IMTA at 17°C, indicating that results may be correlated with the life

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cycles of seaweeds in Korea. However, Ecklonia cava was found not be suitable for IMTA at any water temperature.

A species-selection model applicable to IMTA was developed in order to improve water quality and to achieve cost-effectiveness for sustainable or environmental-friendly aquaculture. Although this model cannot account for every eventuality, and exhibits some errors, it is considered to be a useful method of selecting species for IMTA based on optimal water temperature for each species. For example, the water temperature in the system must be maintained below 17°C to cultivate Porphyra yezoensis, while Enteromorpha sp. and Ulva pertusa are suitable for IMTA at all water temperatures. However, the species-selection model requires additional parameters and testing to make it applicable to other regions in which seaweed species differ from those in Korea. In spite of this deficit, the model provides information crucial for IMTA species selection.