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主論文の要約

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学 位 論 文 題 目

An integrated approach of habitat suitability model for management of Japanese scallop (*Mizuhopecten yessoensis*) aquaculture: a comparative study in Funka Bay and Mutsu Bay, Japan
(ホタテガイ養殖管理のための好適生息域モデルの統合的アプローチ：噴火湾と陸奥湾との比較研究)

The determination of the causes for the changes in marine environment in areas with similar oceanic climate forcing on most suitable sites for scallop aquaculture can help to ensure long-term sustainability of the coastal ecosystem. The present study assessed aquaculture suitability sites using dominant indicators of marine ecological dynamics on Japanese scallop culture in Funka Bay and Mutsu Bay, Japan as comparative examples. Thus the study (i) developed a suitability aquaculture site selection model using geographical information system (GIS)-based multi-criteria evaluation (MCE) to assess coastal sites suitable for Japanese scallop culture based on temporal and potential effects of currents, (ii) assessed the impact of marine environment and suitability score differences in Funka Bay and Mutsu Bay, Japan, (iii) assessed dominant indicators of marine environment change on Japanese scallop in Funka Bay and Mutsu Bay, Japan, and finally (iv) projected the impacts of climate change on scallop aquaculture in both bays. Data sources for possible ecosystem indicators in Funka and Mutsu Bays comprised Moderate Resolution Imaging Spectroradiometer (MODIS), Advanced Land Observing Satellite (ALOS), four dimensional-variational (4D-VAR) data assimilation system, *in situ* and buoy measurements. Water volume and heat fluxes were estimated using standard existing formula. The indicators in both bays delineated the coastal area, limited by bottom depths of ≤ 60 m, using a ranking scale of 1 (least suitable) to 8 (most suitable). Spatio-temporal variability of suitability scores and concentration of indicators occurred within and between the bays. In the most suitable sites in aquaculture operational areas, Funka Bay had a high proportion (51.1%) than Mutsu Bay (13.7%) for the best performed model. Peaks of aquaculture suitability scores were attributed to potential effects of currents. Tsugaru (in both bays) and Oyashio (Funka Bay only) currents influence water mixing, exchange, heat regime and nutrient influx in both bays which affect the magnitude of indicators for scallop growth and survival. Extreme SST (> 24ºC) in summer 2010 was associated with low performance of the 2010 model in Mutsu Bay and mortality of scallops based on daily sea temperature-depth visualizations, water volume and heat fluxes. Only seawater temperature emerged as the main factor for scallop growth and survival that is susceptible to only Mutsu Bay's water volume and heat fluxes fluctuations. Future global warming effects are likely to shrink the most suitable sites for scallop farming in Funka Bay and render the most suitable sites in Mutsu Bay ecologically unreliable. Thus differences in marine environment change influence coastal (scallop) aquaculture in areas with similar climate forcing. Such concepts could be a scientific basis for aquaculture planning on proper designated system of larval distribution and stock management of cultured species to minimize mortality and economic losses.