Selection of ecologically or biologically significant marine areas for kelp forest ecosystem in northern Japan through assessment and future prediction of species distribution

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The present study aimed to carry out quantitative estimation of biodiversity in kelp forest ecosystems in Japan, along with future prediction of their changes with different IPCC scenarios of climate change, and selection of the ecologically or biologically significant marine areas (EBSAs), based on the combination of biodiversity database analyses, species distribution and future projection models. We first constructed a database of the distribution of algal species in Japan which contained a total of 28,358 data, and used them to estimate the distribution of each kelp species over the coastline of Japan by species distribution models. Species diversity of kelps was the highest in northern and eastern Hokkaido. Variation in water temperature is the most influential factor responsible for the estimated distribution patterns. Based on the obtained statistical relationship between the distribution and multiple environmental factors, we then forecasted future distribution of major kelp species with different scenarios of climate changes by IPCC. Distribution of kelp species was predicted to move northward and cold-current species would disappear from coasts of Japan by 2100. As a result, kelp species diversity in Japan was predicted to decrease greatly with ongoing climate changes. Finally, we selected EBSAs for kelp forest ecosystems along the whole coastline of Japan, by developing protocols to combine different multiple criteria based on scientific information. EBSAs selected based on current kelp distributions included coastal areas in Hokkaido, Sanriku, Izu Peninsula, eastern Kii Peninsula, and northwestern Kyushu. We also developed an additional EBSA selection method incorporating the future shift of species distribution with climate change, which revealed that kelp forests in eastern and southern Japan would not be selected as EBSAs. We expect that the obtained results would contribute to planning long-term conservation and management strategies, as well as adaptation programs of kelp forests in Japan.

Keywords: Biodiversity, Coastal ecosystem, Water temperature rise, Scenario analyses, EBSAs

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