

Biomass-based diversity index related to water quality and fishery resources

Takeshi Goda and Shunsaku Yagi
Setsunan University, Japan

Major part of the Seto Inland Sea and its watershed is known as a place of scenic beauty and was designated as a national park. Also, it must be emphasized that the water area is a heavily utilized fishing ground. However, as this is a typical enclosed marine area, it may easily be affected by pollutant inflow, development of the surrounding area, and reclamation along the coastline. Moreover, there are still many development plans ongoing. Therefore, to make those plans sustainable, the establishment of a potential management system is required.

In the present study, using data of fishing statistics issued by the Ministry of Agriculture, Forestry and Fisheries, values of the biomass-based diversity index,

$$DI_{mass} = -\sum_{i=1}^n \left(\frac{b_i}{B}\right) \log_2 \left(\frac{b_i}{B}\right),$$

were computed. Here B is the total biomass of fish catch and b_i denotes the biomass of its component fish i . This index was introduced through the modification of Shannon-Margaref's Diversity Index, which is often used for the assessment of ecosystems. Throughout the whole inland sea, seventeen kinds of pelagic and demersal fish have been selected ($n=17$). Generally, the value of DI_{mass} becomes higher when the weights of each kind of fish become equal. The Seto Inland Sea has been divided into eight fishing grounds. For each fishing ground the relation of DI_{mass} to water quality and fishery resources is discussed.

Conclusions: 1) DI_{mass} tends to be low when the grade of water qualities such as COD, T-P, T-N, and transparency, is ranked lower. Here it must be noticed that in Osaka Bay, which is the most eutrophic fishing ground of the Seto Inland Sea, the fish catch of sardine and sand eel is quite dominant, and accordingly the DI_{mass} is relatively low. 2) Osaka Bay is regarded as the poorest area in view of water quality, on the other hand this area maintains the highest fish catch. However comprehensively, the aquatic ecosystem seems quite simple. 3) The average price of fish in each fishing ground has been estimated using prices on the Japanese fish market. The results show that the average fish price is generally high in the area of higher DI_{mass} . It means that the percentages of expensive fish, such as sea bream or flatfish, are relatively higher. 4) The relation between benthos and DI_{mass} has been studied with shrimp catch data of the fishing statistics. When the ratio of prawn to the total shrimp is high, the value of DI_{mass} is also high. Here prawn ("Kuruma-ebi") is regarded as the highest grade shrimp in the Seto Inland Sea. Inclusively, we recognize the DI_{mass} as an important index for the management of an enclosed marine area.