

**Classification of various types of seaweed beds by statistical analysis of acoustic data from a scientific echosounder**

<sup>o</sup>Huamei Shao<sup>1Y\*</sup>, Setuo Kiyomoto<sup>1</sup>, Yohei Kawauchi<sup>2</sup>, Tatsuru Kadoda<sup>1</sup>, Masahiro Nakagawa<sup>1</sup>, and Taku Yoshimura<sup>1</sup>

<sup>1</sup>Stock Enhancement and Aquaculture Department, Seikai National Fisheries Research Institute, FRA, 1551-8, Taira-machi, Nagasaki-shi, Nagasaki, 851-2213, Japan

<sup>2</sup>Fisheries Management and Oceanography Department, Seikai National Fisheries Research Institute, FRA, 1551-8, Taira-machi, Nagasaki-shi, Nagasaki, 851-2213, Japan

\*Corresponding author: hmshao@affrc.go.jp

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In recent years, sparse and low thickness seaweed beds have become to the main type in some areas as the global warming, and they are also known as important food and habitat for the benthic animals. Acoustic method has been used and suggested as an effective, quantitative way for the distribution estimation of some large seaweed meadows based on the backscattering strength (SV) of seaweed and sea bottom, and the challenge is the estimation for low thickness seaweed beds as the acoustic deadzone and resolution. We aimed to classify various types of seaweed beds including the low thickness type based on several more features of SV and shape from acoustic data obtained by a scientific echosounder. Surveys were conducted in five positions of coastal waters off the Kyusyu Island, Japan, from Autumn 2017 to Summer 2018. Firstly, we set 100 m transect lines on the sea bottom in each position, and measured the maximum thickness of seaweed, also took photos for the coverage rate every 1 m<sup>2</sup> along transect lines by diving. Then, we collected the acoustic data along the transect lines by a scientific echosounder with two frequencies of 200 and 400 kHz (DT-X extreme, BioSonic Co.). Five SV and shape features of the first and second echo were extracted from the acoustic data. Then, they were used as the continuous explanatory variables, diving obtained results were used as the response variable for the type classification. Classification was conducted by random forests using “randomForest” package on the statistical software R (ver.3.5.1). Dense and sparse, high and low thickness seaweed beds, and bare ground was observed by the diving. Similar with high thickness seaweed beds,

verification accuracy was around 80% between low thickness seaweed beds and bare ground. In addition, type classification of high or low thickness, dense or sparse seaweed beds were also verified. Further application of acoustic method for the spatial distribution of various types seaweed beds in wide area is expected.