1Pa6-2

Development of mussel-distribution estimation using high-resolution sonar image
高解像度ソナー画像を用いたカラス貝の分布調査手法の開発

Zhao Fan[1‡], Katsunori Mizuno[1], Shigeru Tabeta[1], Takato Asayama[2], Hiroki Hayami[2], Yasufumi Fujimoto[2], and Tetsuo Shimada[2] ([1] Grad. School Frontier Sciences., Tokyo Univ.; [2] The Miyagi Prefectural Izunuma-Uchinuma Environmental Foundation)
趙 帆 [1†], 水野 勝紀 [1], 多部田 茂 [1], 麻山 賢人 [2], 速水 裕樹 [2], 藤本 泰文 [2], 嶋田 哲郎 [2] ([1] 東大新領域, [2] 伊豆沼財団)

1. Introduction

The mussel (*Cristaria plicata.*) is an aquatic bivalve mollusk that inhabits in the sediment of freshwater lakes or wetlands. In Japan, the mussel is widely used to remove impurities and improve water quality. Conventional survey methods (e.g., surface surveys using optical video cameras and divers) are affected by the transparency of the water and the observation abilities of the divers and usually require a significant amount of time.

To overcome these limitations, a new observation method of mussel distribution by using an acoustic video camera (ARIS) at 3.0 MHz center frequency was developed for getting high-quality acoustic images of mussels. Some large and high-resolution mosaic images, generated from the continuous acoustic images by Image Mosaic operation, can be useful for assessing the status of the mussels.

2. Materials and Methods

For this study, 3 sample mussels (Fig. 1) were prepared and different mussel postures according to their actual underwater habitat were set for teaching data in sample experiments in Lake Izunuma on 8 November 2019. These mussels were put into three brackets, and then brackets were put into the pond and scan by ARIS acoustic video camera. A series of high-resolution acoustic images were obtained by the operator changing the pitch and roll of the ARIS.

Fig. 1 Sample mussels(left), ARIS with a buoy (middle) and sample experiment survey site (right)

The field experiment was conducted in Lake Izunuma on November 9, 2019. Six survey lines were recorded by GPS receivers to map the underwater topography. Continuous acoustic images, taken by ARIS which fixed on a survey boat (Fig.2). Approximately 20000 frames in total were captured during this survey. We applied one method called Scale-Invariant Feature Transform (SIFT) into image processing based on the contiguous frames matching method. The next step is Image Mosaic operation which depends on the output of SIFT.

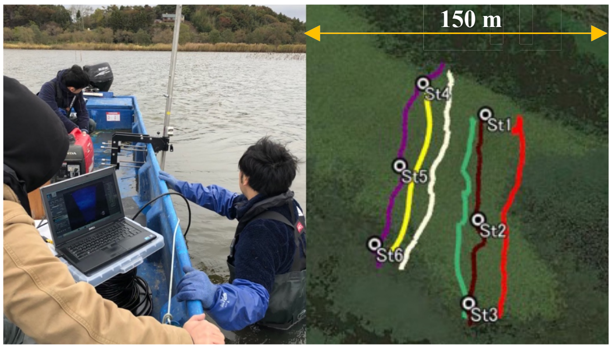

Fig. 2 Field experimental set up: The survey boat was equipped with an ARIS unit and GPS track lines.

3. Results and Discussion

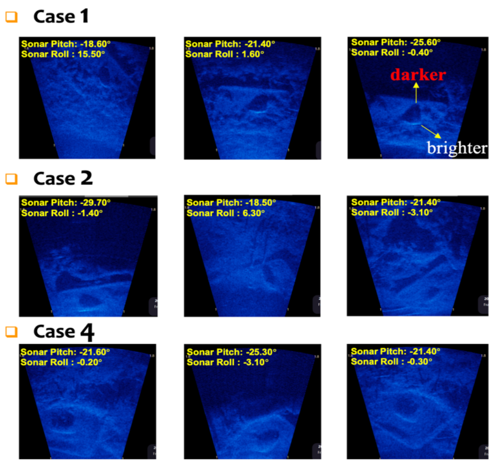

Fig. 3 Acoustic images of mussel sample.

zhao.fan@s.otpe.k.u-tokyo.ac.jp

As Fig.1 shows, sample mussels were set to 5 different cases in sample preparation. These cases were proposed, and different mussel postures were developed for teaching data in sample experiments. Case 1 and Case 2 (the giant mussel) represent the alive mussel in the sediment, a small part of their body (about 5-6 cm) were exposed away from the sediment. The whole body of the dead mussel will lie on the mud, as shown in case 4. No mussels are visible in cases 3 and 5, because the mussels were buried under the sediment or not placed. Acoustic images of very high quality were obtained by the proposed method (Fig. 3).

Because of computer memory limitations, the data for each line were split into approximately 10 blocks for processing. Finally, 6 acoustic survey track lines were generated by connecting the mosaic images and imported into the Google Earth map (Fig.4). The acoustic map was constructed from a total of 15405 still images, and the coverage area was about 450 m^2 at the bottom depth of 0.8 m-1.5 m. Also, the image quality was good with high resolution of about 2.9 mm/pixel. Therefore, we can use this acoustic map at various scales. Fig. 4 shows acoustic maps with different scales at the same location. Some mussels are visible in a small prat mosaic image cut from line#1(L1), in which pixels marked by the green arrow are alive mussels, the dead mussels were marked by the red arrow. Other darker or larger pixels represent the bottom holes. The mosaic image is slightly different from the previous GPS track line because ARIS only recorded part of that survey routes.

4. Discussion

The current survey system can gather the distribution information of mussels efficiently from the high-resolution mosaic images, generated from the continuous acoustic images by Image Mosaic operation. The high-resolution acoustic images obtained allowed us to identify the different status of mussel with high accuracy, and we quantified the number of alive mussels and the dead. These quantification methods could be applied to the various surveys of other aquatic species after code modification. In the future, this fine acoustic map will be used for the automated classification of alive mussel and dead mussel by using the deep-learning technique.

Fig. 4 Survey lines at various scales

Acknowledges

This study was supported in part by a grant from the Miyagi Prefectural Izunuma-Uchinuma Environmental Foundation，JSPS KAKENHI Grant Number 17H04974 and KAKENHI Grant Number 20H02362.

References

1. K. Mizuno, et al: J. Aquatic botany. **110** (2013) 48.
2. D. G. Lowe: Proc. IEEE International Conference on Computer Vision (ICCV). (1999) 1150.
3. Fan ZHAO, et al: Proc. Marine Acoust. Soc. Jpn. (2020) in press.
4. Mizuno, K., Terayama, K., Hagino, S. et al: Sci Rep. **10** (2020) 12416.
5. Mizuno, K.et al: Ecol. Inform. **38** (2017) 89.