Analysis of influence factor on the catch of Japanese sandfish by Danish seine

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To assess the factor which affect the catch of sandfish by Danish seine trawl, the fishing experiment was conducted at the coastal area of Kushiro. The towing depth and the duration of that the ground line contact with seabed was measured. The GLM analysis was done using catch data and some parameter of fishing condition, to confirm the significant factor on the catch of sandfish *Arctoscopus japonicus*. The model with two variables of towing depth and survey area shows the lowest AIC value. In addition, the results show that the catch of sandfish is insensitive to a slight variation in towing duration. From these, it is thought that the number of haul is valid as the catch effort of sandfish by Danish seine.

1 Introduction

In the survey with Danish seine trawl, the swept area would be used to estimate the fish density [1]. On the other hand, sometimes the number of haul under the same towing duration is often used as catch effort to calculate the CPUE in the stock analysis [2]. However, it is hard to estimate the actual swept area of seine trawl because the shape and the condition of bottom contact would be changed with the process of hauling [3]. Moreover, the tidal condition or other fishing conditions will influence to that. This means, it is uncertain whether the towing duration correspond to the catch effort.

This study aims to assess the factor which affects the catch of sandfish *Arctoscopus japonicus* by seine trawl. A total of 19 haul was conducted at the coastal area of Kushiro, Hokkaido. The towing depth and the duration of that the ground line contact

with seabed was measured. The GLM (Generalized Linier Model) analysis was done using catch data and the parameter of fishing condition, towing duration on seabed, survey area, and its depth, to confirm the significant factor on the catch of sandfish.

2 Materials and Methods

2.1 Fishing experiment

A total of 19 fishing experiment were conducted employing a fishing boat Yutaka (7.9GT) at the coastal area of Kushiro, Hokkaido in November 2005. Two area, (a)Off Shin-Kushiro River and (b)Off Shoro River, were chosen for the location of experiment (Fig. 1). The depths of these areas were ranged from 7 to about 20 m and the bottom material was mad on both.

In the operation, after a barrel with towing rope was thrown into sea, the boat turned round about 600 m (takes 10 min.) with 3 knot paying out the net and another rope. The barrel was recovered to set both ropes on boat and the net was winched up with 100 cm/s speed for 10 minutes. The wake of boat was recorded with GPS (GARMIN 76) at 5 second intervals. Fish captured were sorted and the weight of sandfish was measured on boat.

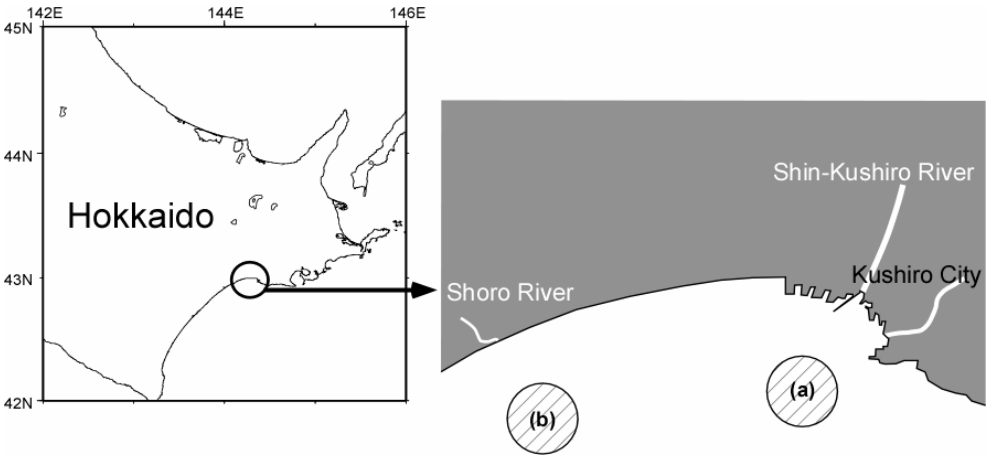

Fig. 1 The location of fishing experiment. (a) shows the area off Shin-Kushiro River and (b) the area off Shoro River.

2.2 Measurement of net condition

Fig. 2 shows the schematic of seine trawl used in the experiment. The depth logger (MDS-V, ALEC Co. Ltd.) was attached to the center of head rope, ground rope, and the tip of port side wing. In addition, the bottom contact recorder[3] developed by NRIFE (National Research Institute of Fisheries Engineering) was attached with the

ground line to measure the available time which means the duration of net contact with seabed. It records the time and self inclination (-90^o - 90^o) by contact with the bottom. The angle is set as 0^o with a bias of $\pm 10^o$ when the device is hanging from the ground line which means the ground line at a distance from seabed, and is increased in inverse relation to the distance after the recorder contact seabed.

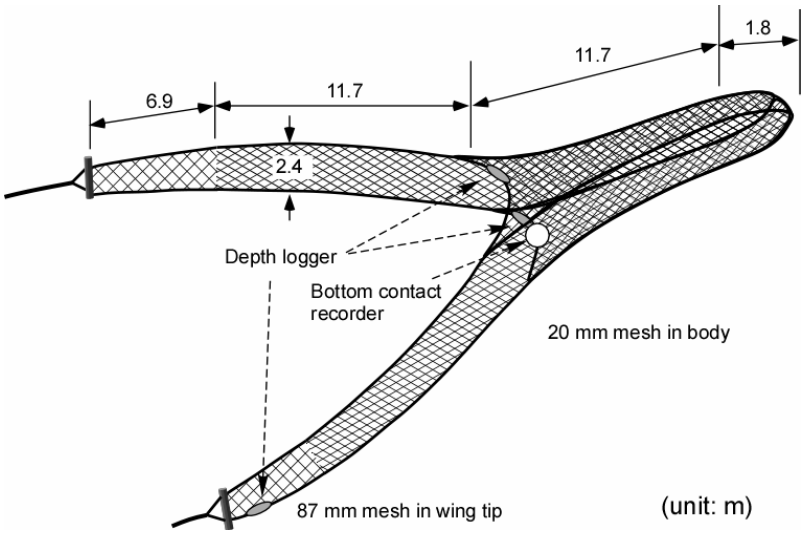

Fig. 2 Schematics of the seine trawl used in the experiment.

2.3 Statistical analysis

The GLM analysis with the normal distribution, which gives the same result as the multi regression, is performed to know the significant factor on catch within the area, depth, and the available time. The linear relationship between the catch weight (Y) and each factor are expressed as follows.

$$Y_i = \beta_0 + depth_i \cdot \beta_1 + effective\ time_i \cdot \beta_2 + area_i \cdot \beta_3 \quad (1)$$

Here, i denote i-th tow and β_3 is the dummy variable which is 0 (Off Shin-Kushiro River) or 1 (Off Shoro River). Several models are compared reducing factor based on the significant level of each factor of the full-model. The model significance is confirmed by ANOVA and the optimal model is determined by comparing the value of AIC (Akaike's Information Criterion), obtained from the maximum log-likelihood, L and the number of parameter, k as:

$$\mathrm{AIC} = -2\ln L + 2k \quad (2)$$

These calculations are performed using statistical software “R” with stats package.

3 Results

3.1 Net condition

Fig. 3 shows the example of the variation of net depth in a haul. The inclination measured from the bottom contact recorder was near 90^{o} at the maximum in any tow which indicate the ground line contacting seabed. The ground line seems to have left the seabed 7 minutes later after winch up started in the depth data. However, the inclination of bottom contact recorder decreases to 0^{o} immediately. We define the duration of contact with seabed disclosed by contact recorder as the available time for capturing sandfish, because this species is generally distributed on seabed.

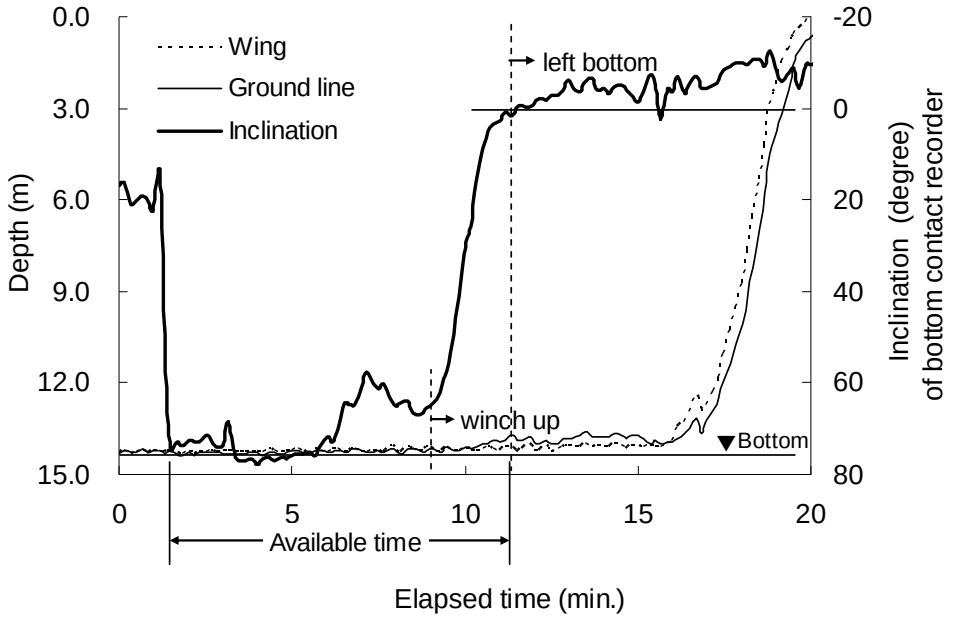

Fig. 3 The variation of net depth and condition of bottom contact in the process of hauling

3.2 Results of GLM analysis

Table 1 shows the data of sandfish used in the analysis which is summarized excluding the hauls with a smaller or zero catch. The available time were varied around 580 sec (S.D.=112 sec), though the towing duration was set as 600 sec.

At first, the analysis was done for full model (Table 2). The variable “depth” was most significant (P < 0.001) than the other variables, though all of variables were

significant ($P < 0.05$) and this model is useful ($P < 0.005$) to represent a catch of sandfish. From this result, the model reduced the “area” or “available time” was compared to the full model with AIC value (Table 3). There are no models failed in ANOVA test ($P < 0.05$). Adjusted r^2 value of the full model was higher than the other model. However, the value of AIC of the model (B), area and depth, was smaller than the other models. This result means that the catch of sandfish is not sensitive to the variation of available time.

Table 1 Summary of data for sandfish used in the analysis

Haul No.	Available time (sec)	Catch weight (kg)	Depth (m)	Area*
1	510	1.7	19.7	a
2	460	1.0	14.1	a
3	580	1.6	21.5	b
4	450	0.1	8.6	b
5	530	0.6	7.9	a
6	590	1.4	14.1	a
7	770	2.0	20.2	a
8	730	1.0	12.2	b
9	640	1.0	13.3	a

*: "a" shows the area off Shin-Kushiro River and "b" the area off Shoro River.

Table 2 The result of GLM for full model

Coefficient	Estimate	P-value		Adjusted r^2	P-value (ANOVA)
Intersept	-0.92087	0.01404	*	0.947	0.00040
Available time	0.00128	0.02513	*		
Depth	0.09791	0.00020	***		
Area	-0.33652	0.01760	*		

*: P <0.05, ***: P <0.001

Table 3 Comparison of the reduced models to the full model

	Model		
	Full	(A) available time and depth	(B) area and depth
Intersept	-0.92087	-0.98876	-0.30540
Available time	0.00128	0.00111	-
Depth	0.09791	0.10177	0.10670
Area	-0.33652	-	-0.29970
Adjusted r^2	0.947	0.849	0.868
P-value (ANOVA)	0.00040	0.001457	0.00097
AIC	-5.8	3.3	2.1

4 Discussion

Generally, the catch of trawl net is increased with towing duration that is representative sweeping time. However, the model without the available time was the best among the models compared in this study, though the full model shows the validity. It is thought that sandfish is concentrated patchily above seabed to migrate for spawning in this season [2, 4]. Naturally, their school size would be varied with area and depth. This is also suggested in our result that the model with “area” and “depth” was chosen. Therefore, the size of school encircled with net might have been more important factor than the available time in the catch of sandfish. Form this result, the number of haul is thought to be valid effort to analyze a stock of sandfish in this season if the towing duration is set as constant, because the catch of sandfish would not be influenced by fluctuation of available time. Hereafter, we intend to analyze other fishes caught and compare each other.

References

[1] M. Morrison, G. Carbines: Estimating the abundance and size structure of an estuarine population of the sparid *Pagrus auratus*, using a towed camera during nocturnal periods of inactivity, and comparisons with conventional sampling techniques, *Fish. Res.*, 82 (2006), 150-161.

[2] K. Watanabe, H. Sugiyama, S. Sugishita, N. Suzuki, K. Sakuramoto: Estimating and monitoring the stock size of sandfish *Arctoscopus japonicus* in the northern Sea of Japan, *Fish. Sci.*, 71 (2005), 776-783.

[3] R. Matsuhira, T. Watanabe, H. Inada: Preliminary experiment to estimate sweep line behavior of Danish seine with a SSBL acoustic positioning system. *Tech. Rept. Nat. Res. Inst. Fish. Eng.*, 27 (2005), 105-112.

[4] A. Nihira: New records of Longsnout flounder, Korean flounder and Japanese sandfish in the coastal waters off Ibaraki Prefecture, Eastern, Japan, Bull. Ibaraki Pref. Fish. Exp. Stat., 40 (2006), 71-75.

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