Bull. Fac. Fish. Hokkaido Univ.
32(2), 169-175. 1981.

Field Experiments to Test a Method of Measuring Fishing Gear Motion

Takeshi YAMANE*, Katsuaki NASHIMOTO**,
Katsutaro YAMAMOTO** and Osamu SATO**

Abstract

A series of experiments were performed to test the possibility of using a wire installation method for measuring the motion of fishing gear in trains of waves and under various sea conditions. A commercial type drift gill net, 115 mm mesh, 50 m long by 5 m deep was used in the experiments. Pressure gauges were attached to the float and sinker lines to record the motion and an acceleration meter set in a buoy was used to measure the variations in the water surface. Data were simultaneously recorded on an oscillograph on the vessel and displacements were continuously evaluated. Wind scale during the experiments was 5 and 3 measured by the eye.

Introduction

The motion of a drift gill net in trains of surface waves has been studied by Hamuro[1)] under various conditions in the Bering Sea off the Kamuchatka Peninsula but, in his experiments, the sea conditions which directly affect the configuration of the gear in the water were only measured by eye. When the data which was obtained concerning sea conditions were applied to the motion of actual fishing gear in trains of waves, the results were not satisfactory. It has therefore been necessary to obtain data from actual wave measurements to determine the motion of the net more accurately. One of the possible methods is the use of a recording device coupled to a float.

In order to test such a method for the measurement of variations of water surface, an acceleration meter was installed in a buoy. Pressure gauges were also attached to the float line and sinker line to test the possibility of using a pressure gauge to measure the motion of the fishing gear. In the experiments, the variation in acceleration due to elevation of water surface and change in pressure were measured simultaneously. These records were transmitted continuously to the oscillograph on the vessel by means of a wire. The purpose of this paper is to describe the practical procedure used in working on the problem and to show some results of the fishing gear experiment.

* *Laboratory of Fishing Gear Technology, Faculty of Agriculture, Kinki University.*
(近畿大学農学部漁撈学研究室)
** *Laboratory of Fishing Gear Engineering, Faculty of Fisheries, Hokkaido University.*
(北海道大学水産学部漁具設計学講座)

Methods

In the experiments, a commercial type drift gill net, 115 mm mesh, 50 m long by 5 m deep was used. Attention was focused on the changes in pressure due to the change in water depth for the purpose of measuring the vertical motion of the gear. Two disk type gauges were used, attached to the center of the float line and sinker line. To measure the amount of the water surface fluctuation, an acceleration meter was attached to a buoy. The fluctuation of water surface and the change of the pressure were recorded simultaneously by the recorder on the vessel.

Fig. 1 shows the wave-measuring buoy, a cylindrical tube of vinyl chloride, 20 cm diameter by 30 cm in height, attached to a pneumatic tire of 70 cm diameter. An acceleration meter is set on the gyrohorizon as shown in Fig. 2 to maintain horizontality against the water surface. Fig. 3 and 4 show the pressure gauges attached to the float line and sinker line respectively. As shown in Fig. 5, the pressure gauge here is a disk type gauge 6 mm in diameter and 0.6 mm thick with 2 kg/cm^2 capacity. A schematic diagram of these devices and out-line of their arrangement is shown in Fig. 6. The records obtained from each device were transmitted continuously through shielded cables 4 mm in diameter by 25 m long and 8 mm in diameter by 100 mg long. The pressure gauges attached to the center of the float line and sinker line were connected with 4 mm shielded cable and joined with 8 mm shielded cable connected to the recorder on the vessel. The

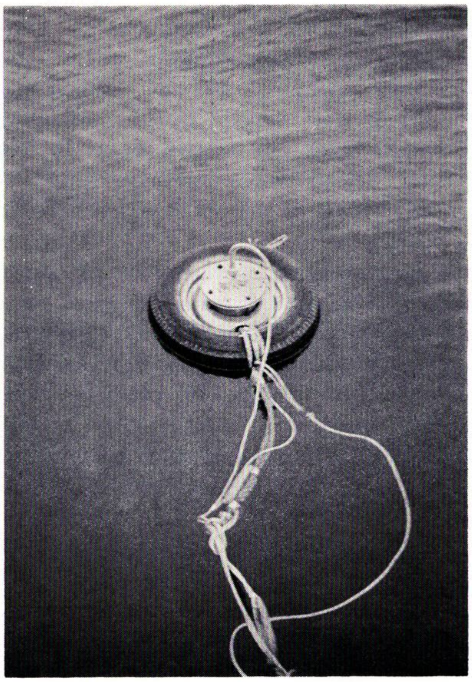

Fig. 1. Wave measuring buoy.

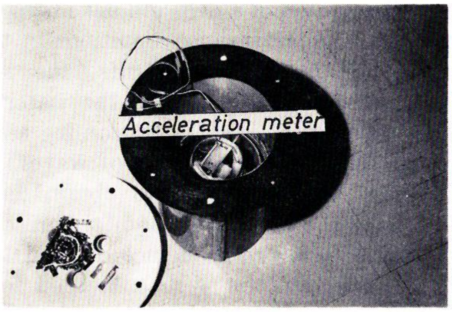

Fig. 2. An acceleration meter.

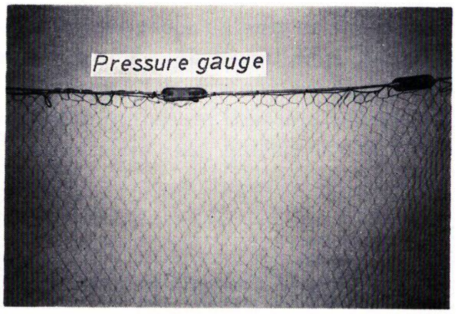

Fig. 3. The pressure gauge attached to the float line.

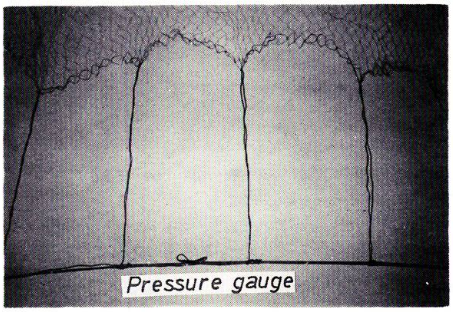

Fig. 4. The pressure gauge attached to the sinker line.

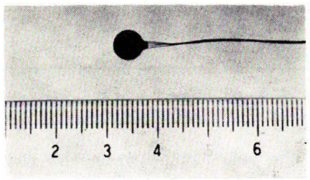

Fig. 5. A disk type pressure gauge.

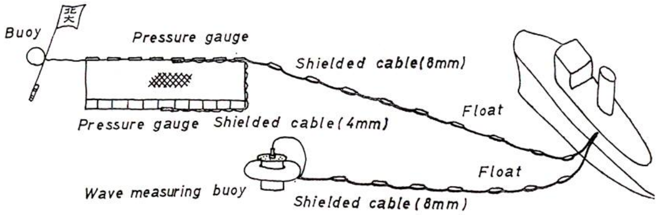

Fig. 6. A schematic diagram of experimental arrangment.

records of the variation of acceleration were also continuously transmitted to the recorder through 8 mm shielded cable. Both of the 8 mm shielded cables were connected to the ropes with 400 gw buoyant floats at one meter intervals.

Preliminary tests were made in an experimental tank to check the response of the pressure gauges. These results are given in Figs. 7, 8 and 9. In addition to the above, pre-tests were also made with the experimental devices in the sea.

After the pre-test experiments were carried out in the Okhotsk Sea in 1976: July 21–23 using the trainning ship Hokusei-maru of the Hokkaido University Department of Fisheries.

Results

Pre-test results

At first, the response of the pressure gauges was examined in the laboratory under various conditions. Fig. 7 shows the effect of temperature on the indicated values against a constant water depth (30 cm). The response abilities of the gauges alter slightly with an increase in the temperatures. However, as is obvious from the figure, the change in response abilities for respective gauges with temperature is almost rectilinear. Here, the different marks represent the different positions of gauges in the experiments; the open circle for the sinker line and the closed circle for the float line.

Next, the relation between the shift of the O-point adjusted on the recorder and temperature was investigated under constant water depth. As shown in

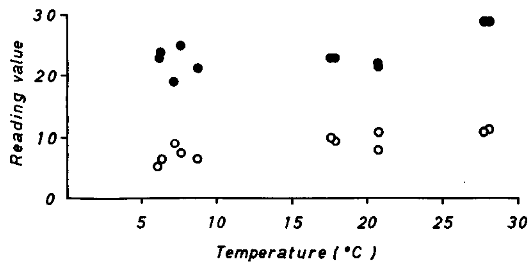

Fig. 7. The relation between the reading values and the temperature in constant water depth (30 cm).

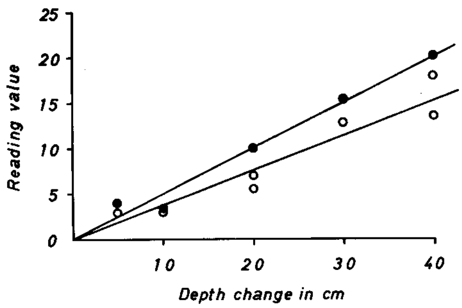

Fig. 9. The calibration curves for 15.7°C.

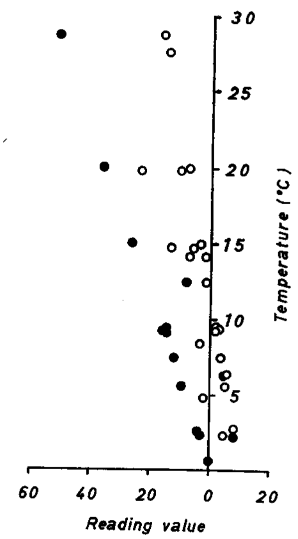

Fig. 8. The relation between the shift of the O-point and the temperature in constant water depth.

Fig. 8, the O-point shifted regularly with an increase in temperature. In this case, the O-point was set for 0.6°C.

The reaction of the gauges to a change in the water depth was then examined. The results are shown in Fig. 9. In this case, the O-point was set for 15.7°C. As shown in the figure, the response of gauges changed uniformly with the increase in the water depth.

As will be obvious from the figures, the pressure gauges used were very sensitive to any change in temperature. Therefore, in the field tests, response characteristics of the gauges were very carefully observed.

Field test results

The field experiments were performed in the Okhotsk Sea (N.52°, E. 153°) in 1976: July 21–23 using a commercial size drift gill net under various sea conditions. When the field experiments were made, we paid special attention to the operation of vessel so as not strain the cables connected to the experimental apparatus. Fig. 10 shows the buoy in the Okhotsk Sea. During these experiments, the wind scales measured by eye were 5 and 3; the experimental devices performed well under these conditions. The results are shown in figures 11, 12, 13 and 14.

Since the pressure gauges were sensitive to temperature, calibration curves were made in advance of the experiments. Fig. 11 shows the calibration curve for 9.6°C. The results in the case of a wind scale 3 are given in Fig. 12. In this figure, the closed circles indicate the float line and the open circles indicate the sinker

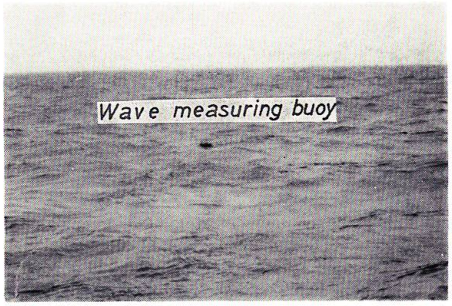

Fig. 10. The buoy in the sea.

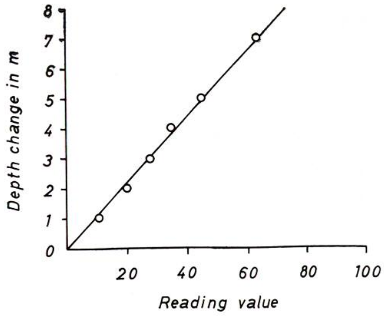

Fig. 11. A calibration curve for 9.6°C.

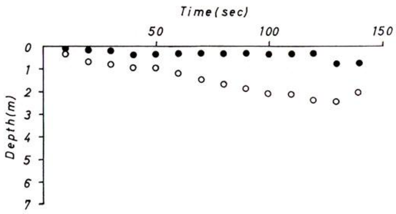

Fig. 12. Motion of the drift gill net under a wind scale 3.

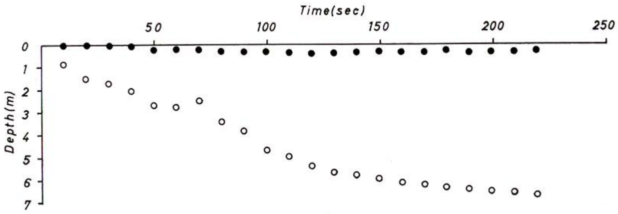

Fig. 13. Motion of the drift gill net under a wind scale 5.

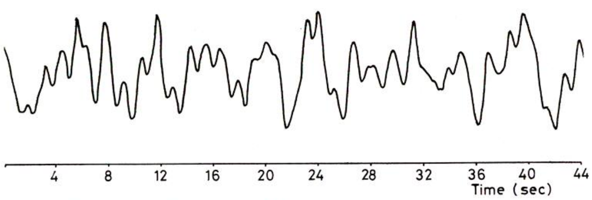

Fig. 14. Original field data on accelerations.

line. In Fig. 12 it can be seen that the float line is clearly reacting to the wave action. In this sea condition, it appears that the float line submerged approximately 30 cm to 70 cm under the water surface. On the other hand, from Fig. 12, it is observed that the sinker line does not descend so much. This interesting phenomena is believed to have arisen from mis-handling of the net; perhaps the net tangled or the sinker line was caught in it. The results obtained during a wind scale 5 are given in Fig. 13. The float line again appears to be reacting to the

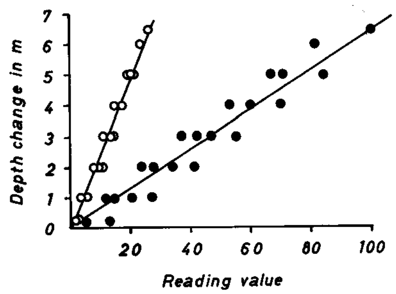

Fig. 15. The calibration curves for 18.6°C

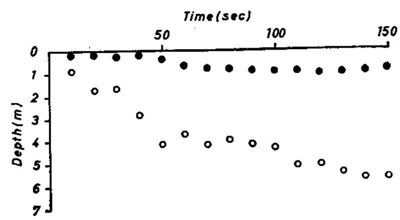

Fig. 16. Motion of the drift gill net under a 5 m/sec wind velocity.

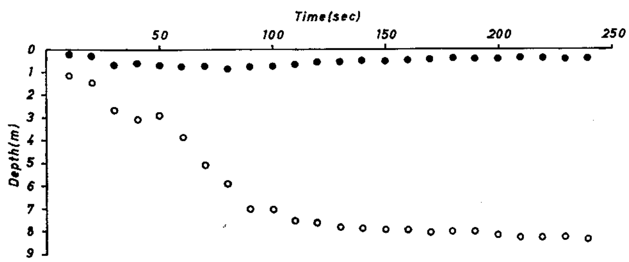

Fig. 17. Motion of the drift gill net under a 6 m/sec wind velocity.

wave action. In Fig. 13, there is almost no periodic motion present in the sinker line for the trains of waves, but the development of net against the vertical direction is mostly good compared with Fig. 12. Here, as mentioned before, an acceleration meter was used to measure the vertical displacement of the water surface. Some examples are given for the above sea conditions in Fig. 14.

After field experiments, supplementary tests were carried out in Funka bay (Usujiri) in 1976: September 9–21. Fig. 15 shows the calibration curves for 18.9°C. Figs. 16 and 17 demonstrate the motion of float line and sinker line in trains of waves. Fig. 16 represents with a wind velocity of 5 m/sec and Fig. 17 those at 6 m/sec. In Fig. 16, the movements of float line are clearly due to the wave action. In this case, the float line sank to a depth of about 1 m below the water surface. In Fig. 17, it will also be noted that the results concerning the float line show a close resemblance to those of Fig. 16. As shown in the figure, the development of net against vertical direction is good in this case as it developed completely 150 seconds after immersion in the sea. On the other hand, it is not obvious that the periodic motion of the sinker line was caused by the wave action.

Comments

In the ocean, it would be rare that such a constant series of waves would be travelling past an installation. Thus, to study the motion of fishing gear, it would become necessary to obtain continuous and detailed records of the sea conditions and the motion of fishing gear. An attempt was made here to test the continuous measuring method using wire under various sea conditions with the purpose of applying this method to a study of the motion of fishing gear in waves.

As shown in the figures, the pressure gauges used in the experiments were very sensitive to temperature and correction of the response involved considerable work. It is therefore considered necessary to improve the stability of the gauges against changes in temperature even though they performed well in the field tests. More detailed data on the pressure gauges would be useful in the interpretation of the vertical motion of the float and sinker line.

Consequently, it is considered that the method used here would be effective in obtaining continuous records of the sea conditions and fishing gear motion.

Acknowledgements

This series of field experiments was carried out with the cooperation of Capt. S. Yamamoto and the crew of the training ship Hokusei-maru. The authors express their sincere thanks.

Reference

1) T. Hamuro (1959). Gyogusokutei-ron. p. 229–312. Makisyoten, Tokyo.