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Studies on the Drag Net–IV

On the Towing Experiments of the Big sized Drag Net

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Abstract

The measuring of the current velocity and resistance inside and outisde the drag net was carried out in the big sized drag net towed actually in the open sea. In the drag net, the length was 6.1 m; the ratio between the diameter of a twine (d mm) and the mesh size (l mm), namely $d/l=0.021$

The results obtained are as follow:

a) The current velocity inside the net body (v m/sec) was ascertained to be almost invariably higher than that at the net mouth (v_0 m/sec); this tendency was noted to be especially remarkable when the cod end was kept opened. The value of v/v_0 obtained from the theoritical formula on the velocity ratio inside and outside the net, namely $\frac{v}{v_0}=\frac{l_0^2}{x^2 e^{\frac{\varepsilon k}{4}\left(\frac{l_0}{x}-1\right)}}$ was ascertained to be 1.21, in case of the theoritical value, and 1.11 in case of the experimental value: here the difference was noted to be almost zero, considering the possible errors in measurement.

b) The relationship between the net resistance (R kg) and the towing speed (V m/sec) was ascertained to be

In case of the closed cod end: $R=213V^{1.48}$

In case of the oepned cod end: $R=184V^{1.37}$

By this was shown the fact that the variation of the net shape in the net shape in the former net was less than that in the latter one.

Introduction

Concerning the shape of the drag net under towing a lot of studies have been carried out hitherto; and in the previously published reports, namely, in the reports (1964)[1], (1973)[2], (1974)[3], it was ascertained that the shape of the drag net is to be influenced largely by the distribution of the current velocity inside and outside the net.

In the ordinary drag net, especially in case of the trawl net which is made of a comparatively thick twine the current velosity inside the net comes almost constantly to be more decreased than that outside the net. While, in case of the net whose towing speed is comparatively low, for example, in Danish Seine, the current velocity inside the net is apt to be more increased than that outside the net. Accordingly, the fishing efficiency of any trawling net is to be influenced by the current velocity inside the net (1964)[4], (1971)[5]. For example, as mentioned above, in case of Danish Seine which is made of thin twine, the current velocity inside the net is apt to be increased,

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making the shape of the drag net better, causing the fishing efficiency of the net to become higher.

The speed-increasing is to be influenced by the relationship between the diameter of a twine (d mm) and the mesh size (l mm). The experiments done hitherto show that the increasing-tendency is to be noted when $d/l<0.013$[1]; while the decreasing-tendency when $d/l>0.031$[3]. Hence the assumption that the increasing-tendency of the current velocity inside the net is to be noted can be fixed at the middle value where the d/l value varies from 0.013 to 0.031.

The ascertainment of the border line between these two tendencies was aimed by the author, with the use of net which was prepared under the d/l value of 0.021, which is the mean value of 0.013 and 0.031.

Experimental Net and Methods

The experimental net was made of four pieces net; length, 6.1 m; material, pylen; mesh size, 15 mm; twine diameter, 0.032 mm; shrinkage, 30%; and to the seam of each net was attached Polyethene rope of the diameter of 12 mm. The net mouth was fixed by the square shaped frame, 2 m long on each side, made of the iron tube with the diameter of 22 mm; and at the part 4.6 m apart from the net mouth, an intermediary frame, made, likewise, of iron and with the length of 1.2 m apiece, was attached, too, shown in Fig. 1~2. In the both iron frames, at the center of the respective one was attached an electric current meter (Toho Dentan, Co, Ltd, type CM–2).

The experiments were carried out according to the method shown in Fig. 3: namely, on board of the training ship Kagoshima maru (Gross tonnage, 1018 ton) the drag net was towed at the starboard side, the towing speed being kept within 0.3~0.5 knot, the current velocity was measured by the current meter attached to the net mouth and the inside net, respectively. The state of the net was divided into two; namely, the case when the cod end was closed, and another, when the cod end was opened.

The experimental place was situated nearly at the center of Molukshe Sea; the

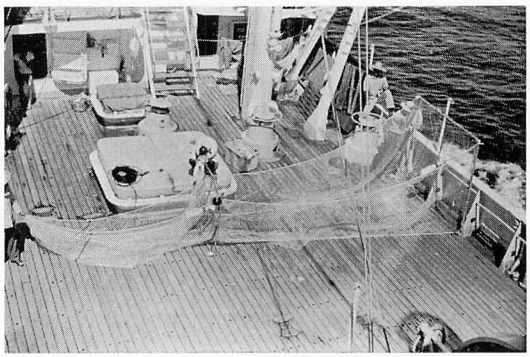


Fig. 1. Setting condition of the current meter and the experimental net.

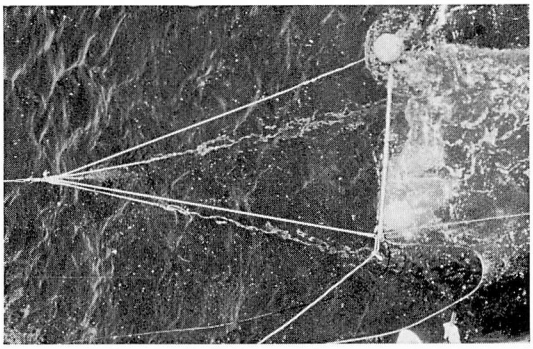


Fig. 2. Current meter installed at the mouth of the experimental net.

Fig. 3. Towing condition of the experimental net.

experimental date was fixed on the 4th December 1974. The sea condition was moderate, with wind direction NE; wind force 1, weather, bc. As an additional experiment, the resistance of the drag net was measured in Kagoshima Bay, on the 8th of January 1975 on board of the Nansei maru (Gross tonnage, 45 ton). In measuring the resistance, load shell for 5 ton and strain meter, were used.

Results and Discussion

As the result of having compared the current velocity observable both at the net mouth and at inside the net, it was ascertained, as shown in Fig. 4, 5, that almost invariably the current velocity was noted inside the net, and that, this was especially remarkable, when the cod end was opened.

In the case when the cod end was closed (under the ordinary net state) it was noted that, given the current velocity at the net mouth the percentage of 100, the speed of the inside net was fixed to be from 96 to 111%. On the measurings of 39 times, 53.9% showed increasing; 25.6%, non-differential; 20.5%, decreasing; in short, increasing tendency was ascertained to be very high. This result seems to be similar to the

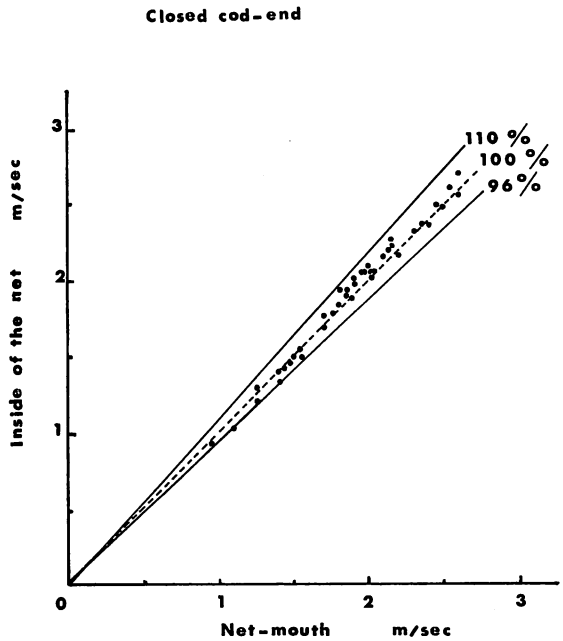


Fig. 4. Comparison of the current velocity at the net mouth with the inside of the experimental net.

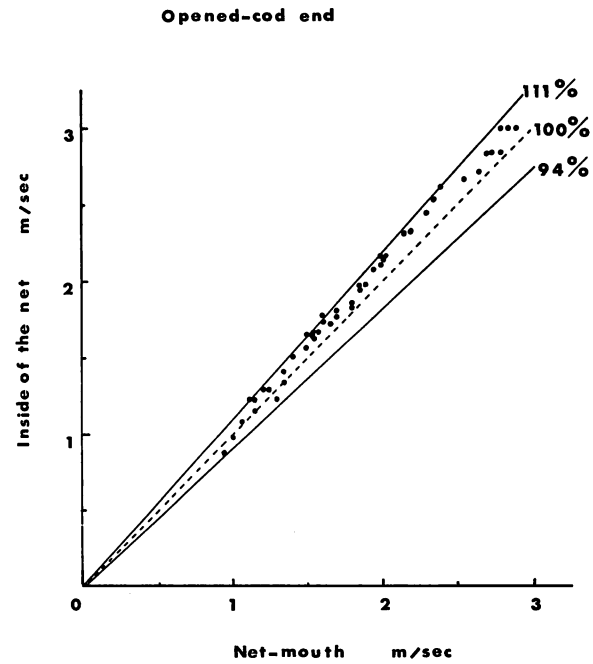


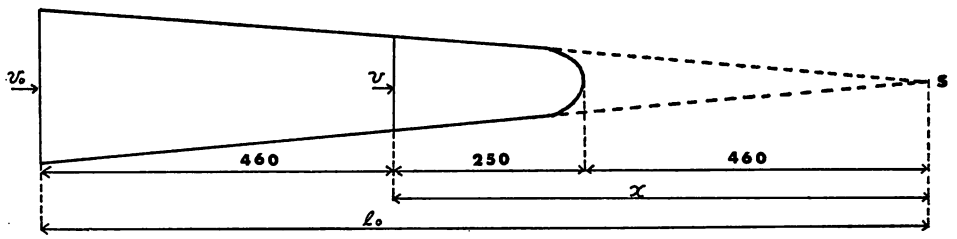
Fig. 5. Comparison of the current velocity at the net mouth with the inside of the experimental net.

result of report (1). In the case when the cod end was opened, the current velocity inside the net showed 94~111%, in contrast to that of the net mouth which was fixed 100%. On the measurings of 47 times, 87.3% showed increasing; 2.1%, non-differential; 10.6%, decreasing; namely, the increasing tendency was exceedingly high, inside the net.

While, in accordance with the theoritical formula obtained in report (3) concerning the current velocity ratio, the theoritical values of the net experimented here, was fixed as in the following:

$$\frac{v}{v_0}=\frac{l_0^2}{x^2 e^{\frac{\varepsilon k}{A}\left(\frac{l_0}{x}-1\right)}}$$

Here, v_0 is the current velocity at the net mouth; v is the current velocity at the intermediary frame; A is the area of the cross section at the net mouth; K is the water flowing length at the intermediary frame; ε is the water filtration ratio. The values of the figures are as follows; $l_0=11.7$ m, $x=7.1$ m, $A=4$ m^2, $K=4.8$ m, $\varepsilon=1.02$. And by substituting these values for the above mentioned formula: we get $v/v_0=1.21$. In Fig. 6, the experimental net under towing was substantialized. In other words, in theoritical value the current velocity inside the net was found to be 121%, in contrast to that at the net mouth, which shows that there is an increasing tendency.



Unit: cm

Fig. 6. Schematic representation of the drag net. Numbers in figure show the length of each part of the net (cm).
v_0: current velocity at the net mouth, v: current velocity at the optional cross section, S: crossing point prolonged two back lines, x: length between the optional cross section and S, l_0: length from net mouth to S.

The highest experimental value was found to be 111%. In this experiment, the spreading of the drag net was good, but, as the drag net was towed at the close side of the vessel, it was swaged under the influence from the wave and the water pressure coming from the rolling of the vessel. And this was assumed to have given some effects on to the correctness of the current meter indication. Yet, the current velocity inside the net was increased obviously, and the value, though it has about 10% of difference, was ascertained to be nearly equal to the theoritical value.

The measuring of the resistance of the drag net was made at the end of the towing

rope, about 50 m in length, and which was let run at the stern of the towing baot. The relationship between the resistance value (R) and the towing speed (V) was as shown in Fig. 7. More than 1 ton of resistance came to be shown when the figure beyond 3 m/sec, and the value was ascertained to be larger when the cod end was opened than when it was closed.

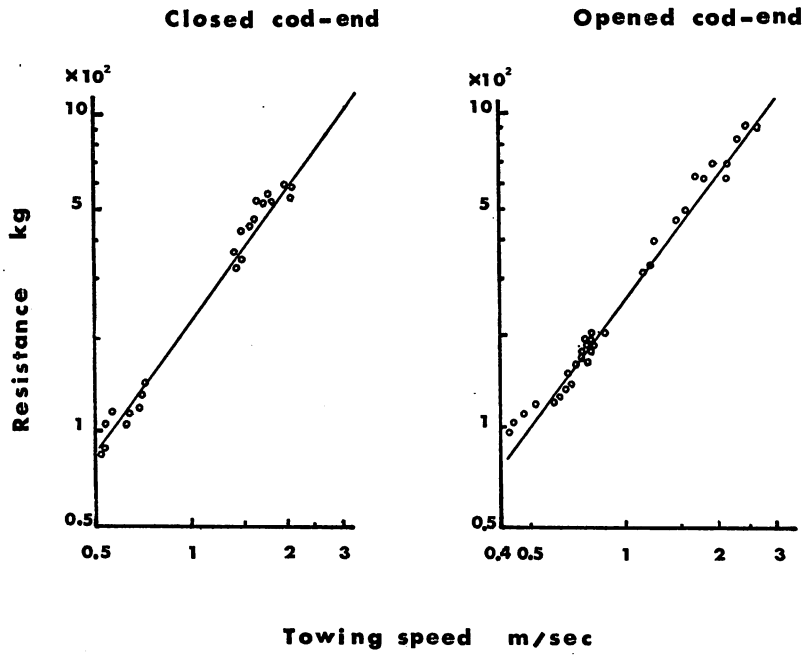


Fig. 7. Relation between the resistance and the towing speed.

The regression line formula was found from the Fig. 5, as in the following:

In case when the cod end was opened: $R=213V^{1.48}$

In case when the cod end was closed : $R=184V^{1.37}$

From these experimental formulas it was ascertained that, provided that the cod end was closed the net shape suffered little influence coming from the increasing tendency of the current velocity. In the next problem of studies is going to prepare a drag net, with a net whose d/l is larger than 0.031; and the experiment shall be carried out with the intention of making some studies concerning the current velocity inside the net.

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