Working Time of Danish Seiners During Alaska Pollack Fishery—VI.* The Relation of Working Time to Wind Wave After Elimination of the Influence of Different Amount of Catch

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The relation of working time to wind wave had been examined in the preceding report¹⁾. And the following results were obtained: The time expended on the laying and on the sinking-pulling steps of works had no relation to catch²⁾, but increased with the wind wave, although slightly in the former and negligibly in the latter. The hauling-brailing step was the least resistive to the wind wave, and was retarded with it. And this step, occupying the largest part of the time expended to complete a haul, was retarded by catch too³⁾. As the consequence, the time expended to complete a haul was suffered from both of the wind wave and the catch. The similar could be said to the length of interval between hauls. These facts emphasized the necessity to clear up the discrepancy in the relation of these times and of the length of interval due to the different amount of catch according to the grade of wind wave. The results will be shown in the present report.

Material and Method

The detailed descriptions of the materials used in the present series of reports were given in the first report¹⁾; and they were not illustrated here again. It is one of the most usual ways to examine the relation of the working time to the height of wave observable among the hauls yielding the same amount of catch. But the regression lines of the working time on catch were estimated in the present report, after stratification of the records into 7 wave-grade groups. Then the change of them with the grade of wind wave was examined. This was because of the following reasons: The height of wind wave was recorded in the grade through the aspect of sea surface. The grade number has a relation to the wave height, but the range differs with grade number, being narrow in the lower grades and wide in the higher grades.

There remained a doubt to estimate the regressive relation of the length of intervals on catch, because the frequency distributions of the length of intervals tailed in the direction of long interval. Instead of the regression lines, the lines passing through the averages at respective catch grades were estimated, taking the difference in the sample size into

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consideration. And these lines were used here for convenience. The intervals longer than 80 min. were excluded from the present examination, because it was highly probable that the boats engaged in different works during these intervals.

Results

The time expended to complete a haul and the hauling-brailing time showed very significant regression on catch in all the grades of wind wave. Figure 1 shows the regressive relation of the hauling-brailing time on catch under the wind wave of the grade 4, as an example. The coefficients and constants of the regression lines were plotted against the grade of wind wave in Fig. 2. In this figure, the intervals between the grades are scaled in proportional to the height of wave. The coefficients and constants of the lines passing through the average lengthes of the intervals were added to this figure for convenience.

To assist the understanding on the general feature of the difference in the hauling-brailing time according to the catch and to the wind wave, the regression lines are illustrated in Fig. 3. This figure shows that the influence of wind wave was far smaller than that of the

Fig. 1. The regressive relation of the hauling-brailing time on catch, observable under the wind wave of the grade 4.

Note: Filled spindle... frequency distribution; Filled circle... average time; Scale... the frequency.

Fig. 2. The influence of wind wave on the regressive relation of working time or length of interval on catch.

Note: $t = ax + b$ where t is the working time and length of the interval between hauls in minutes and x is catch in tons.

Filled circle, The time expended to complete a haul

Open circle The hauling-brailing time

Circle with dot The length of interval between hauls

For the length of interval, the lines passing through the average lengthes at respective catch grades are used instead of the regression lines.

catch, being as small as to modify the time-catch relation slightly. To examine the significance of the difference of the working time due to the wind wave, accordingly, the records were stratified according to the catch, and the difference of the average time between the grades of wind wave was examined (Table 1). As shown by n_2 of this table and the next one, the sample size of the present report was very large. But the variation of the working time was also large. The records were chosen by calendar days. And the catch grades and the grades of wind wave were not the same in the sample size. Most of the hauls yielded a catch of 1 to 7 tons, especially 2 and 3 tons. And most of the days chosen were in the grades 2,3,5, and 6 of wind wave. To give discussion on the results of the tests, the influence of these facts should be kept in mind. In the catch grades of 1 to 7

Fig. 3. Regression lines of the hauling-brailing time on catch observable under respective grades of wind wave.

Note: The numbers at the end of lines denote the grade of wind wave.

Line T represents the relation before stratification into the wave-grade groups.

Table 1. Comparison of the averages of the hauling-brailing time under respective grades of wind wave.

Catch grade (tons)	Range of wind wave					
	1 to 5		1 to 6		1 to 7	
	F_0	n_2	F_0	n_2	F_0	n_1
0	0.42	23	0.37	28	0.37	5
1	1.01	535	2.97*	653	2.64*	6
2	0.49	825	1.89	1018	2.91**	6
3	3.30*	908	18.59**	1127	16.71**	6
4	1.43	575	5.14**	718	4.81**	6
5	0.50	364	3.85**	468	9.93**	6
6	1.03	192	4.11**	244	4.64**	6
7	3.11*	141	2.67*	199	2.29*	6
8	1.32	79	1.55	104	1.51	6
9	1.34	22	1.59	32	1.29	6
10	1.28	79	2.01	98	1.45	6
	$n_1 = 4$		$n_1 = 5$			

* significant at 0.05 level

** significant at 0.01 level

tons, the difference of the wind wave in the range from the grade 1 to 5 did not cause significant difference in the average of the hauling-brailing time, but the wind wave over the grade 6—namely, in the nearest two grades to the fishable limit—retarded this step of work. This result of the test coincided with such a fact that in Fig. 3 the regression lines for the wind wave of the grades 6 and 7 were located upside of those for other grades. But the differences in the average times between the grades of wind wave were insignificant in other catch grades because of large variation of the time expended on this step of work. The similar results could be found in the time expended to complete a haul.

A possibility of the difference of the wind wave in respect of the influence of catch on working time was suggested by the difference in the regression coefficients in Fig. 2 and in the inclination of the lines in Fig. 3, although the difference in the working time for

Table 2. Comparison of the regression coefficients of the working time on catch.

Grade of wind wave		t_h		t_c	
		F_0	n_2	F_0	n_2
1	2	12.02**	1134	1.86	1132
	3	5.91*	1337	0.39	1339
	4	1.90	691	0.07	693
	5	2.58	953	1.06	954
	6	4.44*	1054	1.61	1054
	7	0.31	226	2.63	223
2	3	3.89*	2291	1.79	2291
	4	14.73**	1645	3.46	1645
	5	15.48**	1907	0.11	1906
	6	5.09*	2008	0.03	2006
	7	6.35*	1180	2.29	1175
3	4	5.08*	1848	0.51	1852
	5	4.91*	2110	1.33	2113
	6	0.21	2211	2.58	2213
	7	2.37	1383	4.31*	1382
4	5	0.35	1464	2.50	1467
	6	3.09	1565	3.82	1567
	7	0.07	737	5.53*	736
5	6	2.46	1827	0.29	1828
	7	0.36	999	2.24	997
6	7	1.52	1100	1.60	1097

t_h : Hauling-brailing time

t_c : Time expended to complete a haul

$n_2 = 1$

* significant at 0.05 level

** significant at 0.01 level

this reason was not so large as modifying the above-mentioned general trend. This suggestion was examined through the significance test on the difference between the regression coefficients. As shown in Table 2, the coefficient of the hauling-brailing time for the wind wave of the grade 2 was larger than that of other grade; the coefficient for the grade 3 was smaller than that for the grade 2 but larger than that for either the grade 1, 4, or 5. These facts meant that the increase in the hauling-brailing time due to catch was the largest in the grade 2 and the second in the grade 3. Most of the differences between the regression coefficients were insignificant in the time expended to complete a haul because of large variation of the time.

For the same purpose as Fig. 3, the lines showing the change of the length of interval are illustrated in Fig. 4. This figure shows the following trends: The wind wave elongated the interval but the catch cut down it; and the former was less influential than the latter. The intervals in the grade 1 seemed to be too long. The coefficient for the grade 4 seemed to be smaller than those for other grades. But it was hard to examine the significance of these suggestions, because of the tailing of the frequency distributions in the direction of long interval.

Discussion

The influence of wind wave on the hauling-brailing time was far smaller than that of the catch, and was as small as to modify the time-catch relation slightly. The wind wave in the range from the grade 1 to 5 did not cause significant difference in the hauling-brailing time, but the wind wave over the grade 6 retarded this step of work. It is natural that it takes longer time to haul up and to brail out better catch. The work of fishermen was very heavy under the wind wave of the grades 6 and 7, but the retardation found here was not so large as the impression from the difficulty of work on deck. The equipment is more resistive to the wind wave than the fishermen in respect of the working pace. Under heavy conditions, the fishermen paid very much effort to keep up themselves with the fishing work progressing chiefly at the pace of equipment. Our impression was derived

Fig. 4. Relation between length of intervals between hauls and catch under respective grades of wind wave.
Note: The numbers at the end of lines denote the grade of wind wave.

from the difficulty to work at the same pace, but the result indicated here may be the retardation not covered by the fishermen's effort and that of the working pace of the equipment. Accordingly, it is natural that the result was far smaller than our impression.

In contrast with the above-mentioned general trend, the examination on the difference of the regression coefficient showed that the increase in the hauling-brailing time with catch was the largest in the grade 2 and the second in the grade 3. This fact and the retardation of work under rough sea were not contradictory to each other, but were because of the different reasons. The rough sea was influential chiefly by disturbing the smooth work of the fishermen; but increase in the hauling-brailing time due to catch under calm water was because of insufficient assistance of wind wave to this step of work. Namely, the net is hauled up with assistance of a good use of the rolling of the boat, and different wind drift of the boat from the net makes it easy to handle the net.

Figure 3 showed that it took shorter time to haul up the net and brail out the catch under the wind wave of the grade 1 than under the grades 2 and 3. This may be due to the following reason: After the main part of the net being taken on deck, the cod end was hauled to board side. Then the cod end was kept open and the catch was scooped up. It is easier to do so under calm water than under little rough water. When the boat yielded a good catch, the proportion of the time needed to brail up the catch was large and shortening of the time due to this reason covered up the retardation of the work to haul up the main part of the net.

The detailed discussion on the trends of the time expended to complete a haul was omitted because of the following reason: The time expended to complete a haul and the hauling-brailing time had similar inclination on the catch and the grade of wind wave to each other, as shown in Fig. 2, in the general trend of the change of the constant with the grade of wind wave and in the values of the coefficient at respective grades of wind wave except at the grade 7. The tailing of the frequency distributions in the direction of long interval prevented us from giving discussion on the trend of the length of interval between hauls.

Summary

The regressive relations of the hauling-brailing time and the time expended to complete a haul on catch were examined after stratification of the records into the wave-grade groups, for the purpose of finding out the influence of wind wave after elimination of the influence of different amount of catch. And the results obtained are summarized as follows:

1. The time expended to complete a haul and the hauling-brailing time showed very significant regressive relation on catch in all the grades of wind wave.

2. These times had similar inclination on the catch and the grade of wind wave to each other, as shown in Fig. 2, in the general trend of the change of the constant with the grade of wind wave and in the values of coefficient at respective grades of wind wave except at the grade 7.

3. The influence of wind wave on the hauling-brailing time was far smaller than that of the catch, and was as small as to modify the time-catch relation slightly.

4. The wind wave in the range from the grade 1 to 5 did not cause significant difference in the hauling-brailing time, but the wind wave over the grade 6 retarded this step of work.

5. The increase in the hauling-brailing time with catch was the largest in the grade 2 and the second in the grade 3, although the difference due to this fact was not so large as modifying the above-mentioned general trend.

References

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