Working Time of Danish Seiners during Alaska Pollack Fishery-XII.*

The Difference of Working Speed According to the Boat

By

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The preceding reports[2)-7)] of this series dealt with the difference in the working speed of the Danish seiners due to the difference in the following four factors—the amount of catch, the depth fished, the height of wind wave, and the power of main engine of the boats. With regard to the influence of the power, the following trends were found out: The time for the sinking-pulling step decreased while the time for the hauling-brailing step increased in accordance with the power of the boats, both at a rate of 1.1 min. per 100 Hp[7)]. The time for the hauling-brailing step, consequently the time for completing a haul, was deeply affected by the amount of catch[2)], although it was hard to consider that both the time for the laying step and that for the sinking-pulling step were affected by it. The predominating influence of the different amount of catch relating to the power was eliminated from the influence of the power, and the following trends were found out: The time for the hauling-brailing step and that for completing a haul showed very slight decrease in accordance with the power[9)]. There remained, however, a doubt in these results, because a large between-boat difference was found out among the average times for respective steps of work. This fact necessitated the examination on the difference of the working speed according to the boat. The present report shows the results of the comparison of the boats in the average times for either the laying step or for the sinking-pulling one and the comparison of them in the catch regression of either the time for the hauling-brailing step or that for completing a haul. And it was found out that the between-boat difference was the factor second to the amount of catch in respect of the influence on the working speed.

Material and Method

The present report used the same materials as those used in the preceding reports[1)-11)],

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i.e. the records of all the hauls conducted in the 48 days (3 days × 16 strata of 10-day intervals) chosen randomly from a complete set of the routine telegrams sent from the 22 Danish seiners to the factory ship several times a day throughout the season of 1964. From the telegrams for each haul, the length of the following intervals were timed, and used in the present report after the aggregation of them into the classes of the nearest five-minute intervals:

The laying time (abbreviated to t_l) $= t_2 - t_1$

The sinking-pulling time (abbreviated to t_s) $= t_3 - t_2$

The hauling-brailing time (abbreviated to t_h) $= t_4 - t_3$

The time for completing a haul (abbreviated to t_c) $= t_4 - t_1$,

where t_1 was the time started to lay the warp, t_2 the time finished laying, t_3 the time started to wind up the warp, and t_4 the time finished brailing the catch.

In the preceding reports[2)-7)], the relations of these times to the following factors were examined: The amount of catch (x in tons), the depth fished, the height of wind wave, and the power of main engine of the boat. Among them, the amount of catch was deeply influential in the hauling-brailing time, consequently in the time for completing a haul, while the influences of the other factors on the time lengths for respective steps of work were negligible. The between-boat differences of t_l and t_s were, accordingly, examined through the comparison of their averages. And those of t_h and t_c were examined through the comparison of the regression lines of them on x.

Results

1. The length of the laying time

The maximum between-boat difference of the average of t_l was about two minutes. This was too small to cause any noticeable difference in t_c; but it may be said that this was larger when this was compared with the extremely small variation of t_l shown in Fig. 1 of the first report of this series[1)]. And the extremely small within-boat variation resulted in the significant between-boat difference (0.05 level) of the average of t_l found in the 100 pairs out of 231 ones (22 × 21/2), although its meaning in the practical point of view was highly doubtful. Among them, the 15 pairs were between the boats of the same power (out of the 35 ones); and the other 85 pairs were between the boats of the different power (out of the 196 ones). Namely, the rate of occurrence of the significant difference of t_l between the boats of the same power was the same to that between the boats of the different power ($\chi_0^2 = 0.003$, df = 1). This fact suggested that t_l should be independent of the power. The average of t_l of the following boats was significantly larger (or smaller) (0.05 level) than that of more than 11 boats out of the 21 ones. And all the significant differences were found in the combinations with these boats:

significantly larger .... No. 20 (270 Hp) and No. 22 (275 Hp)

significantly smaller .... No. 11 (220 Hp), No. 13 (270 Hp), No. 16 (270 Hp), No. 2 (290 Hp), and No. 18 (320 Hp)

Table 1. The comparison of the boats either in the average of the laying time (t_l) or in that of the sinking-pulling time (t_s).

Boat Nos. under comparison		Laying time(t_l in min.)								Sinking-pulling time (t_s in min.)							
		F	F_0	n_1	n_2	F_1	n_2'	t_0	t	F	F_0	n_1	n_2	F_1	n_2'	t_0	t
11	21	1.24	1.30*	232	236			3.37*	1.97	1.24	1.07	232	236	2.40	468		
	3	1.24	1.47*	236	248			2.56*	1.97	1.24	1.33*	236	248			1.55	1.97
	5	1.24	1.62*	252	236			3.01*	1.97	1.23	1.42*	236	252			0.32	1.97
	6	1.23	2.44*	236	251			3.32*	1.97	1.23	1.92*	236	251			1.09	1.97
	8	1.24	1.61*	245	236			1.34	1.97	1.24	1.30*	245	236			3.03*	1.97
	9	1.24	1.52*	242	236			2.60*	1.97	1.24	1.93*	236	242			0.07	1.97
	7	1.24	1.16	233	236	3.64	469			1.24	1.13	236	233	11.63*	469		
	12	1.23	2.16*	236	255			2.31*	1.97	1.23	1.94*	236	255			3.96*	1.97
	13	1.24	1.02	245	236	0.90	481			1.24	1.02	236	245	41.08*	481		
	15	1.24	1.54*	236	238			3.63*	1.97	1.24	1.13	238	236	20.62*	474		
	16	1.24	2.47*	242	236			0.60	1.97	1.24	1.33*	236	242			0.98	1.97
	20	1.24	2.49*	244	236			4.73*	1.97	1.24	1.22	244	236	31.96*	480		
	22	1.24	1.83*	230	236			3.92*	1.97	1.24	1.22	236	230	45.15*	446		
	2	1.24	1.67*	243	236			2.12*	1.97	1.24	1.32*	236	243			10.60*	1.97
	4	1.24	1.26*	239	236			1.78	1.97	1.24	1.25*	239	236			2.46*	1.97
	10	1.24	1.80*	236	238			3.31*	1.97	1.24	1.14	236	238	4.18*	474		
	14	1.26	1.51*	162	236			2.68*	1.98	1.26	1.41*	162	236			2.17*	1.98
	17	1.24	1.11	231	236	4.88*	467			1.24	1.72*	231	236			2.95*	1.97
	18	1.30	1.26	109	236	3.56	345			1.32	1.53*	236	109			3.52*	1.98
	19	1.28	1.34*	236	147			3.41*	1.98	1.28	1.41*	236	147			3.89*	1.98
	1	1.24	1.30*	222	236			2.48*	1.97	1.24	1.14	236	222	35.66*	458		
21	3	1.24	1.91*	232	248			1.31	1.97	1.24	1.42*	232	248			0.15	1.97
	5	1.24	1.25*	252	232			0.21	1.97	1.24	1.52*	232	252			2.01*	1.97
	6	1.24	3.16*	232	251			0.93	1.97	1.24	2.06*	232	251			0.72	1.97
	8	1.23_{85}	1.23_{84}	245	232	3.09	477			1.24	1.21	245	232	19.60*	477		
	9	1.24	1.18	242	232	0.38	474			1.24	2.07*	232	242			1.84	1.97
	7	1.24	1.12	232	233	2.14	465			1.24	1.21	232	233	3.05	465		
	12	1.23	2.80*	232	255			1.78	1.97	1.23	2.08*	232	255			2.06*	1.97
	13	1.24	1.28*	232	245			4.26*	1.97	1.24	1.09	232	245	22.12*	477		
	15	1.24	1.99*	232	238			0.33	1.97	1.24	1.06	238	232	8.66*	470		
	16	1.24	1.90*	242	232			3.23*	1.97	1.24	1.43*	232	242			0.70	1.97
	20	1.24	1.92*	244	232			1.87	1.97	1.24	1.14	244	232	16.46*	476		
	22	1.24	1.41*	230	232			0.86	1.97	1.24	1.31*	232	230			4.96*	1.97
	2	1.24	1.29*	243	232			4.99*	1.97	1.24	1.42*	232	243			8.67*	1.97
	4	1.24	1.03	232	239	2.36	471			1.24	1.16	239	232	0.88	471		
	10	1.24	2.34*	232	238			0.73	1.97	1.24	1.22	232	238	0.16	470		
	14	1.27	1.17	162	232	0.03	394			1.27	1.31*	162	232			3.41*	1.98
	17	1.24	1.16	232	231	1.47	463			1.24	1.61*	231	232			4.23*	1.97
	18	1.32	1.03	232	109	18.21*	341			1.32	1.64*	232	109			2.04*	1.98
	19	1.28	1.74*	232	147			0.05	1.98	1.28	1.51*	232	147			2.31*	1.98
	1	1.24	1.01	222	232	0.62	454			1.25	1.22	232	222	18.20*	454		
3	5	1.23	2.39*	252	248			1.01	1.97	1.23	1.07	248	252	4.37*	500		
	6	1.23	1.65*	248	251			0.61	1.97	1.23	1.45*	248	251			0.64	1.97
	8	1.23	2.37*	245	248			0.77	1.97	1.23	1.72*	245	248			4.70*	1.97
	9	1.23	2.25*	242	248			0.55	1.97	1.23	1.45*	248	242			1.92	1.97
	7	1.24	1.71*	233	248			0.35	1.97	1.24	1.17	233	248	4.42*	481		
	12	1.23	1.46*	248	255			0.50	1.97	1.23	1.46*	248	255			2.54*	1.97
	13	1.23	1.50*	245	248			3.63*	1.97	1.23	1.31*	245	248			5.35*	1.97
	15	1.24	1.04	248	238	1.45	486			1.24	1.51*	238	248			3.38*	1.97
	16	1.23	3.64*	242	248			2.52*	1.97	1.23	1.00	248	242	0.38	490		

		Laying time (t_l in min.)								Sinking-pulling time (t_s in min.)							
Boat Nos. under comparison		F	F_0	n_1	n_2	F_1	n_2'	t_0	t	F	F_0	n_1	n_2	F_1	n_2'	t_0	t
3	20	1.23	3.68*	244	248			3.11*	1.97	1.23	1.62*	244	248			4.59*	1.97
	22	1.24	2.70*	230	248			2.12*	1.97	1.24	1.09	230	248	32.39*	478		
	2	1.23	2.47*	243	248			4.47*	1.97	1.23	1.01	243	248	97.90*	491		
	4	1.24	1.85*	239	248			0.45	1.97	1.24	1.66*	239	248			1.17	1.97
	10	1.24	1.22	248	238	0.58	486			1.24	1.17	238	248	0.36	486		
	14	1.26	2.23*	162	248			0.89	1.98	1.26	1.87*	162	248			3.51*	1.98
	17	1.24	1.64*	231	248			0.05	1.97	1.24	2.29*	231	248			4.41*	1.97
	18	1.30	1.85*	109	248			3.70*	1.98	1.32	1.15	248	109	5.25*	357		
	19	1.27	1.10	147	248	1.73	395			1.28	1.06	248	147	7.09*	359		
	1	1.24	1.92*	222	248			0.38	1.97	1.24	1.17	222	248	24.14*	470		
5	6	1.23	3.95*	252	251			0.63	1.97	1.23	1.36*	252	251			1.64	1.97
	8	1.23	1.01	252	245	2.26	497			1.23	1.84*	245	252			2.99*	1.97
	9	1.23	1.06	252	242	0.15	494			1.23	1.36*	252	242			0.31	1.97
	7	1.24	1.39*	252	233			1.20	1.97	1.24	1.25*	233	252			4.10*	1.97
	12	1.23	3.49*	252	255			1.44	1.97	1.23	1.37*	252	255			4.90*	1.97
	13	1.23	1.59*	252	245			3.87*	1.97	1.23	1.39*	245	252			7.38*	1.97
	15	1.24	2.49*	252	238			0.08	1.97	1.23	1.61*	238	252			5.27*	1.97
	16	1.23	1.53*	242	252			2.97*	1.97	1.23	1.07	242	252	2.10	494		
	20	1.23	1.54*	244	252			2.00*	1.97	1.23	1.73*	244	252			6.47*	1.97
	22	1.24	1.13	230	252	1.05	482			1.24	1.16	230	252	61.10*	482		
	2	1.23	1.03	243	252	21.49*	495			1.23	1.07	243	252	148.18*	495		
	4	1.23	1.29*	252	239			1.27	1.97	1.23	1.77*	239	252			2.97*	1.97
	10	1.24	2.92*	252	238			0.45	1.97	1.23	1.25*	238	252			2.60*	1.97
	14	1.27	1.07	252	162	0.00	414			1.26	2.00*	162	252			2.05*	1.98
	17	1.24	1.45*	252	231			0.95	1.97	1.24	2.44*	231	252			2.88*	1.97
	18	1.32	1.29	252	109	14.63*	361			1.32	1.08	252	109	16.25*	361		
	19	1.28	2.18*	252	147			0.17	1.98	1.27	1.00	147	252	20.78*	399		
	1	1.24$_{04}$	1.24*$_{08}$	252	222			0.55	1.97	1.23$_{8}$	1.24*$_{5}$	222	252			6.92*	1.97
6	8	1.23	3.92*	245	251			1.27	1.97	1.23	2.49*	245	251			4.46*	1.97
	9	1.23	3.72*	242	251			0.14	1.97	1.23	1.00	251	242	2.03	493		
	7	1.24	2.83*	233	251			0.87	1.97	1.24	1.70*	233	251			2.86*	1.97
	12	1.23	1.13	255	251	1.59	506			1.23	1.01	251	255	12.50*	506		
	13	1.23	2.48*	245	251			4.48*	1.97	1.23	1.89*	245	251			6.35*	1.97
	15	1.23	1.59*	238	251			0.74	1.97	1.23	2.18*	238	251			4.16*	1.97
	16	1.23	6.02*	242	251			3.00*	1.97	1.23	1.44*	242	251			0.04	1.97
	20	1.23	6.08*	244	251			2.89*	1.97	1.23	2.34*	244	251			5.44*	1.97
	22	1.24	4.47*	230	251			1.83	1.97	1.24	1.57*	230	251			6.76*	1.97
	2	1.23	4.08*	243	251			5.18*	1.97	1.23	1.45*	243	251			11.40*	1.97
	4	1.23	3.06*	239	251			0.97	1.97	1.23	2.39*	239	251			1.78	1.97
	10	1.23	1.35*	238	251			0.23	1.97	1.23	1.69*	238	251			1.25	1.97
	14	1.26	3.69*	162	251			0.55	1.98	1.26	2.70*	162	251			3.22*	1.98
	17	1.24	2.71*	231	251			0.55	1.97	1.24	3.31*	231	251			4.16*	1.97
	18	1.30	3.06*	109	251			4.20*	1.98	1.30	1.25	109	251	9.84*	360		
	19	1.27	1.81*	147	251			0.91	1.98	1.27	1.36*	147	251			3.41*	1.98
	1	1.24	3.18*	222	251			0.05	1.97	1.24	1.69*	222	251			5.85*	1.97
8	9	1.24	1.05	245	242	1.26	487			1.24	2.50*	245	242			3.37*	1.97
	7	1.24	1.38*	245	233			0.41	1.97	1.24	1.47*	245	233			6.32*	1.97
	12	1.23	3.46*	245	255			0.44	1.97	1.23	2.52*	245	255			7.13*	1.97
	13	1.23	1.58*	245	245	(4.78)*	(245)			1.23	1.32*	245	245	(82.88)*	(245)		

Boat Nos. under comparison		Laying time (t_l in min.)								Sinking-pulling time (t_s in min.)							
		F	F_0	n_1	n_2	F_1	n_2'	t_0	t	F	F_0	n_1	n_2	F_1	n_2'	t_0	t
8	15	1.24	2.47*	245	238			1.70	1.97	1.24	1.14	245	238	52.46*	483		
	16	1.24	1.54*	242	245			1.64	1.97	1.24	1.73*	245	242			4.15*	1.97
	20	1.23	1.55*	244	245			3.31*	1.97	1.23	1.06	245	244	68.60*	489		
	22	1.24	1.14	230	245	5.98*	475			1.24	1.59*	245	230			9.46*	1.97
	2	1.23	1.04	243	245	9.82*	488			1.24	1.72*	245	243			13.14*	1.97
	4	1.24	1.28*	245	239			0.31	1.97	1.24	1.04	245	239	27.23*	484		
	10	1.24	2.90*	245	238			1.37	1.97	1.24	1.48*	245	238			5.04*	1.97
	14	1.27	1.06	245	162	1.86	407			1.26	1.09	162	245	0.18	407		
	17	1.24	1.44*	245	231			0.66	1.97	1.24	1.33*	231	245			0.20	1.97
	18	1.32	1.28	245	109	6.78*	354			1.32	1.99*	245	109			6.15*	1.98
	19	1.28	2.16*	245	147			1.76	1.98	1.28	1.83*	245	147			6.63*	1.98
	1	1.24	1.23	245	222	0.96	467			1.24	1.48*	245	222			8.71*	1.97
9	7	1.24	1.31*	242	233			0.79	1.97	1.24	1.70*	233	242			4.04*	1.97
	12	1.23	3.29*	242	255			0.96	1.97	1.23	1.01	242	255	24.42*	497		
	13	1.24	1.50*	242	245			3.46*	1.97	1.24	1.90*	245	242			7.49*	1.97
	15	1.24	2.34*	242	238			0.38	1.97	1.24	2.19*	238	242			5.25*	1.97
	16	1.24	1.62*	242	242	(6.98)*	(242)			1.24	1.45*	242	242	(1.53)	(242)		
	20	1.24	1.64*	244	242			2.35*	1.97	1.24	2.35*	244	242			6.50*	1.97
	22	1.24	1.20	230	242	1.96	472			1.24	1.57*	230	242			7.94*	1.97
	2	1.24	1.10	243	242	18.24*	485			1.24	1.46*	243	242			12.60*	1.97
	4	1.24	1.21	242	239	0.75	481			1.24	2.40*	239	242			2.85*	1.97
	10	1.24	2.75*	242	238			0.02	1.97	1.24	1.70*	238	242			2.45*	1.97
	14	1.27	1.01	242	162	0.13	404			1.26	2.71*	162	242			2.32*	1.98
	17	1.24	1.37*	242	231			0.54	1.97	1.24	3.32*	231	242			3.20*	1.97
	18	1.32	1.21	242	109	12.74*	351			1.30	1.26	109	242	17.58*	351		
	19	1.28	2.05*	242	147			0.58	1.98	1.27	1.36*	147	242			4.51*	1.98
	1	1.24	1.17	242	222	0.02	464			1.24	1.69*	222	242			7.00*	1.97
7	12	1.24	2.50*	233	255			0.04	1.97	1.23	1.72*	233	255			0.10	1.97
	13	1.24	1.14	233	245	8.00*	478			1.24	1.11	245	233	9.76*	478		
	15	1.24	1.78*	233	238			1.37	1.97	1.24	1.28*	238	233			1.35	1.97
	16	1.24	2.13*	242	233			2.08*	1.97	1.24	1.18	233	242	7.14*	475		
	20	1.24	2.15*	244	233			3.13*	1.97	1.24	1.38*	244	233			2.54*	1.97
	22	1.24	1.58*	230	233			2.20*	1.97	1.24	1.08	233	230	11.29*	463		
	2	1.24	1.44*	243	233			3.74*	1.97	1.24	1.17	233	243	52.76*	476		
	4	1.24	1.08	239	233	0.01	472			1.24	1.41*	239	233			0.71	1.97
	10	1.24	2.09*	233	238			1.00	1.97	1.24	1.00	233	238	2.05	471		
	14	1.27	1.30*	162	233			1.08	1.98	1.27	1.59*	162	233			4.95*	1.98
	17	1.24	1.04	233	231	0.07	464			1.24	1.95*	231	233			5.89*	1.97
	18	1.30	1.08	109	233	10.51*	342			1.32	1.35*	233	109			0.51	1.98
	19	1.28	1.56*	233	147			1.46	1.98	1.28	1.25	233	147	0.46	380		
	1	1.24	1.12	222	233	0.41	455			1.24	1.01	233	222	7.18*	455		
12	13	1.23	2.19*	245	255			3.45*	1.97	1.23	1.91*	245	255			3.46*	1.97
	15	1.23	1.41*	238	255			1.82	1.97	1.23	2.20*	238	255			1.43	1.97
	16	1.23	5.33*	242	255			2.31*	1.97	1.23	1.46*	242	255			3.20*	1.97
	20	1.23	5.38*	244	255			3.54*	1.97	1.23	2.37*	244	255			2.76*	1.97
	22	1.24	3.95*	230	255			2.56*	1.97	1.24	1.59*	230	255			3.76*	1.97
	2	1.23	3.61*	243	255			4.33*	1.97	1.23	1.47*	243	255			8.31*	1.97
	4	1.23	2.71*	239	255			0.08	1.97	1.23	2.42*	239	255			0.87	1.97
	10	1.23	1.20	238	255	1.90	493			1.23	1.71*	238	255			1.74	1.97

Boat Nos. under comparison		Laying time (t_l in min.)								Sinking-pulling time (t_s in min.)							
		F	F_0	n_1	n_2	F_1	n'_2	t_0	t	F	F_0	n_1	n_2	F_1	n'_2	t_0	t
	14	1.26	3.27*	162	255			1.25	1.98	1.26	2.74*	162	255			5.42*	1.98
	17	1.24	2.40*	231	255			0.37	1.97	1.24	3.35*	231	255			6.50*	1.97
12	18	1.30	2.71*	109	255			3.53*	1.98	1.30	1.27	109	255	0.25	364		
	19	1.27	1.61*	147	255			1.80	1.98	1.27	1.38*	147	255			0.69	1.98
	1	1.24	2.81*	222	255			0.79	1.97	1.24	1.71*	222	255			2.96*	1.97
	15	1.24	1.56*	245	238			4.70*	1.97	1.24	1.15	238	245	2.61	483		
	16	1.24	2.43*	242	245			0.12	1.97	1.24	1.31*	245	242			5.90*	1.97
	20	1.23	2.46*	244	245			5.47*	1.97	1.23	1.24*	244	245			0.40	1.97
	22	1.24	1.80*	230	245			4.73*	1.97	1.24	1.20	245	230	0.02	475		
	2	1.23	1.65*	243	245			1.31	1.97	1.24	1.30*	245	243			3.86*	1.97
13	4	1.23_6	1.23^*_7	239	245			2.69*	1.97	1.24	1.27*	239	245			3.57*	1.97
	10	1.24	1.83*	245	238			4.42*	1.97	1.24	1.12	245	238	20.73*	483		
	14	1.26	1.49*	162	245			3.44*	1.98	1.26	1.43*	162	245			7.36*	1.98
	17	1.24	1.10	231	245	9.85*	476			1.24	1.75*	231	245			8.41*	1.97
	18	1.30	1.24	109	245	1.36	354			1.32	1.51*	245	109			2.26*	1.98
	19	1.28	1.36*	245	147			4.33*	1.98	1.28	1.39*	245	147			2.26*	1.98
	1	1.24	1.28*	222	245			3.36*	1.97	1.24	1.12	245	222	0.21	467		
	16	1.24	3.79*	242	238			3.30*	1.97	1.24	1.51*	238	242			3.91*	1.97
	20	1.24	3.83*	244	238			2.33*	1.97	1.24	1.08	244	238	1.32	482		
	22	1.24	2.81*	230	238			1.26	1.97	1.24	1.39*	238	230			1.79	1.97
	2	1.24	2.57*	243	238			5.37*	1.97	1.24	1.50*	238	243			5.38*	1.97
	4	1.24	1.93*	239	238			1.45	1.97	1.24	1.10	239	238	3.70	477		
15	10	1.24	1.18	238	238	0.23	476			1.24	1.29*	238	238	(7.32)*	(238)		
	14	1.26	2.32*	162	238			0.08	1.98	1.26	1.24	162	238	35.63*	400		
	17	1.24	1.71*	231	238			1.07	1.97	1.24	1.52*	231	238			6.78*	1.97
	18	1.29	1.93*	109	238			4.45*	1.98	1.32	1.74*	238	109			0.72	1.98
	19	1.27	1.14	147	238	0.09	385			1.28	1.60*	238	147			0.62	1.98
	1	1.24	2.00*	222	238			0.58	1.97	1.24	1.29*	238	222			1.19	1.97
	20	1.24	1.01	244	242	20.13*	486			1.24	1.62*	244	242			5.11*	1.97
	22	1.24	1.35*	242	230			3.75*	1.97	1.24	1.09	230	242	39.07*	472		
	2	1.24	1.48*	242	243			1.16	1.97	1.24	1.01	243	242	109.18*	485		
	4	1.24	1.97*	242	239			1.98*	1.97	1.24	1.66*	239	242			1.69	1.97
16	10	1.24	4.45*	242	238			3.05*	1.97	1.24	1.17	238	242	1.41	480		
	14	1.27	1.63*	242	162			2.75*	1.97	1.26	1.87*	162	242			3.05*	1.98
	17	1.24	2.22*	242	231			2.31*	1.97	1.24	2.29*	231	242			3.92*	1.97
	18	1.32	1.97*	242	109			1.05	1.98	1.32	1.15	242	109	7.72*	351		
	19	1.28	3.32*	242	147			3.25*	1.97	1.28	1.06	242	147	10.18*	389		
	1	1.24	1.89*	242	222			2.54*	1.97	1.24	1.17	222	242	29.81*	464		
	22	1.24	1.36*	244	230			1.00	1.97	1.24	1.49*	244	230			0.53	1.97
	2	1.24	1.49*	244	243			6.06*	1.97	1.24	1.61*	244	243			4.04*	1.97
	4	1.24	1.98*	244	239			3.17*	1.97	1.24	1.02	239	244	9.13*	483		
	10	1.24	4.50*	244	238			2.68*	1.97	1.24	1.39*	244	238			3.88*	1.97
20	14	1.27	1.65*	244	162			1.83	1.97	1.26	1.15	162	244	47.12*	406		
	17	1.24	2.24*	244	231			2.92*	1.97	1.24	1.41*	231	244			7.73*	1.97
	18	1.32	1.98*	244	109			5.40*	1.98	1.32	1.87*	244	109			1.80	1.98
	19	1.28	3.35*	244	147			1.94	1.97	1.28	1.72*	244	147			1.76	1.98
	1	1.24	1.91*	244	222			2.51*	1.97	1.24	1.39*	244	222			0.03	1.97

Boat Nos. under comparison		Laying time (t_l in min.)								Sinking-pulling time (t_s in min.)							
		F	F_0	n_1	n_2	F_1	n_2'	t_0	t	F	F_0	n_1	n_2	F_1	n_2'	t_0	t
22	2	1.24	1.10	230	243	29.17*	473			1.24	1.08	230	243	14.89*	473		
	4	1.24	1.46*	230	239			2.26*	1.97	1.24	1.53*	239	230			3.79*	1.97
	10	1.24	3.30*	230	238			1.62	1.97	1.24	1.08	238	230	23.36*	468		
	14	1.27	1.21	230	162	0.82	392			1.27	1.72*	162	230			7.60*	1.98
	17	1.24	1.65*	230	231			1.98*	1.97	1.24	2.11*	231	230			8.70*	1.97
	18	1.32	1.46*	230	109			4.74*	1.98	1.32	1.25	230	109	5.49*	339		
	19	1.28	2.46*	230	147			0.92	1.98	1.28	1.15	230	147	5.80*	377		
	1	1.25	1.40*	230	222			1.56	1.97	1.25	1.08	222	230	0.36	452		
2	4	1.24	1.33*	243	239			3.61*	1.97	1.24	1.65*	239	243			7.34*	1.97
	10	1.24	3.02*	243	238			5.13*	1.97	1.24	1.16	238	243	77.61*	481		
	14	1.27	1.10	243	162	17.38*	405			1.26	1.86*	162	243			10.64*	1.97
	17	1.24	1.50*	243	231			4.01*	1.97	1.24	2.28*	231	243			11.94*	1.97
	18	1.32	1.33*	243	109			0.02	1.98	1.32	1.16	243	109	31.80*	352		
	19	1.28	2.25*	243	147			5.06*	1.98	1.28	1.07	243	147	36.01*	390		
	1	1.24	1.28*	243	222			4.19*	1.97	1.24	1.16	222	243	19.16*	465		
4	10	1.24	2.27*	239	238			1.09	1.97	1.24	1.42*	239	238			0.60	1.97
	14	1.26	1.21	162	239	1.37	401			1.26	1.13	162	239	17.40*	401		
	17	1.24	1.13	239	231	0.13	470			1.24	1.38*	231	239			4.96*	1.97
	18	1.32	1.00	239	109	9.59*	348			1.32	1.91*	239	109			1.11	1.98
	19	1.28	1.69*	239	147			1.53	1.98	1.28	1.76*	239	147			1.31	1.98
	1	1.24	1.04	222	239	0.52	461			1.24	1.42*	239	222			3.16*	1.97
10	14	1.26	2.73*	162	238			0.40	1.98	1.26	1.60*	162	238			3.86*	1.98
	17	1.24	2.01*	231	238			0.69	1.97	1.24	1.87*	231	238			4.74*	1.97
	18	1.30	2.27*	109	238			4.22*	1.98	1.32	1.35*	238	109			1.77	1.98
	19	1.27	1.34*	147	238			0.70	1.98	1.28	1.24	238	147	3.96*	385		
	1	1.24	2.35*	222	238			0.21	1.97	1.24	1.00	238	222	16.90*	460		
14	17	1.27	1.36*	162	231			0.86	1.98	1.27	1.22	231	162	0.31	393		
	18	1.34	1.21	162	109	13.48*	271			1.34	2.16*	162	109			4.98*	1.98
	19	1.31	2.03*	162	147			0.14	1.98	1.31	1.99*	162	147			5.32*	1.98
	1	1.27	1.16	162	222	0.26	384			1.27	1.60*	162	222			7.02*	1.98
17	18	1.30	1.13	109	231	12.24*	340			1.32	2.64*	231	109			5.83*	1.98
	19	1.28	1.50*	231	147			1.20	1.98	1.28	2.44*	231	147			6.22*	1.98
	1	1.24	1.17	222	231	0.15	453			1.25	1.96*	231	222			8.06*	1.97
18	19	1.34	1.69*	109	147			4.32*	1.98	1.35	1.08	147	109	0.02	256		
	1	1.32	1.04	222	109	12.92*	331			1.32	1.34*	222	109			1.86	1.98
19	1	1.29	1.75*	222	147			0.76	1.98	1.29	1.24	222	147	3.21	369		

Note: $F=F^{n_1}_{n_2}$ (0.05)

F_0...... The Snedecor's F for the comparison of the unbiased estimates of variance with n_1 and n_2 degrees of freedom

F_1..... The Snedecor's F for the comparison of the average times, when the difference between the unbiased estimates of variance was insignificant

$$\frac{(\bar{x}_1-\bar{x}_2)^2}{w^2\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}$$ with 1 and n_2' degrees of freedom $$w^2=\frac{S_{x_1}+S_{x_2}}{N_1+N_2-2}$$

F_1 in parenthesis. . . The Snedecor's F for the comparison of the average times, when the difference between the unbiased estimates variance was significant and $n_1 = n_2$

$$\frac{(\bar{x}_1 - \bar{x}_2)^2}{w^2\left(\frac{1}{N_1} + \frac{1}{N_2}\right)} \quad \text{with 1 and } n_2' \text{ degrees of freedom} \qquad w^2 = \frac{S_{x_1} + S_{x_2}}{N_1 + N_2 - 2}$$

t_0.......The Student's t for the comparison of the average times when the difference between the unbiased estimates of variance was signigicant and $n_1 \neq n_2$

$$t_0 = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{u_1^2}{N_1} + \frac{u_2^2}{N_2}}} \qquad t = \frac{u_1^2 t_1/N_1 + u_2^2 t_2/N_2}{\frac{u_1^2}{N_1} + \frac{u_2^2}{N_2}} \qquad t_i^2 = F_{n_i}^1(0.05)$$

* significant at 0.05 level

These facts meant that the significant between-boat difference in t_l was due to the different value of some of the boats, and whether a boat took a larger value, or a smaller one, or an ordinary one, was independent of its power. Namely, the speed of the laying work depended on some other factors than the power—most probable one may be the individuality of the skipper or the boat.

The uniformity of the working speed is one of the other important characteristics of the work pattern. This is examined through the comparison of the unbiased estimates of variance. The significant difference between the unbiased estimates of variance was found in the 174 pairs of the boats. Among them, the 28 pairs were between the boats of the same power, and the other 146 pairs were between the boats of the different power. Namely, it was hard to find any significant difference between these groups in respect of the rate of occurrence of the significant difference of the unbiased estimates of variance of t_l ($\chi_0^2 = 0.485$, df = 1). The unbiased estimate of variance of t_l of the following boats was significantly larger (or smaller) (0.05 level) than that of more than 11 boats out of the 21 ones:

significantly larger .... No. 5 (250 Hp), No. 8 (250 Hp), No. 16 (270 Hp), No. 20 (270 Hp), No. 22 (275 Hp), and No. 2 (290 Hp)

significantly smaller .... No. 11 (220 Hp), No. 3 (250 Hp), No. 6 (250 Hp), No. 12 (270 Hp), No. 13 (270 Hp), No. 15 (270 Hp), No. 10 (320 Hp), and No. 19 (320 Hp)

It was, however, hard to find any clear relation between this classification of the boats and either the power or the average of t_l.

2. The length of the sinking-pulling time

The maximum between-boat difference of t_s was about 6.5 minutes, i.e. about 25%. And the significant between-boat difference of t_s was found in the 167 pairs of the boats out of the 231 ones. Among them, the 21 pairs were between the boats of the same power, and the other 146 pairs were between the boats of the different power. The χ_0^2 value of the homogeneity test of these groups in respect of the rate of occurrence of the significant difference was 3.11 with one degree of freedom. The average of t_s of the following boats took significantly larger (or smaller) value than that of more than 11 boats out of the 21 ones:

Table 2. The summarized results of the comparison of the average of the laying time.

Engine (Hp)	220	230	250					270						275	290	310	320					340
Boat No. (*i*) / Boat No. (*j*)	11	21	3	5	6	8	9	7	12	13	15	16	20	22	2	4	10	14	17	18	19	1
11		+	−	+	−	+	+		−		−	+	+	+	+	+	−	+			−	+
21	−		−	+	−				−	−	−	+	+	+	+		−				−	
3	−			+	−	+	+	+	−	+		+	+	+	+	+		+	+	+		+
5	−				−			−	−	−	−	+	+			−	−		−		−	−
6	−					+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
8								−	−	−	−	+	+			−	−		−		−	
9	−							−	−	−	−	+	+				−		−		−	
7									−		−	+	+	+	+		−	+			−	
12	−									+	+	+	+	+	+	+		+	+	+	+	+
13		+	+	+	+	+	+	+	+		−	+	+	+	+	+	−	+			−	+
15	−									−		+	+	+	+	+		+	+	+		+
16		+	+	+	+		+	+	+		+			−	−	−	−	−	−	−	−	−
20	−		−	−	−	−	−	−	−	−	−	−		−	−	−	−	−	−	−	−	−
22	−		−			−		−	−	−		−				−	−		−	−	−	−
2	+	+	+	+	+	+	+	+	+		+		+	+		−	−		−	−	−	−
4										−		−	+	+	−		−				−	
10	−									−		−	+		−			+	+	+	+	+
14	−									−		−			−				−		−	
17	−									−		−	+	+	−						−	
18		+	+	+	+	+	+	+	+		+		+	+		+	+	+	+		−	
19	−									−		−			−					−		−
1	−									−		−	+		−					−		

The number of the boats showing the significant difference of either the unbiased estimate of variance or the average

Boat No. (*i*)	11	21	3	5	6	8	9	7	12	13	15	16	20	22	2	4	10	14	17	18	19	1
	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −
Unbiased estimate of variance	6 11	8 5	2 16	13 2	0 20	11 2	10 2	6 8	0 19	6 11	2 16	20 0	20 0	14 2	14 2	8 6	1 17	10 2	6 8	6 4	4 15	7 6
Average	1 14	5 0	5 2	5 1	5 1	3 2	5 1	4 2	5 2	0 17	5 1	0 16	17 0	11 0	0 18	4 2	5 1	5 0	5 2	0 17	5 0	5 1

Note: The right-upper half is for the comparison of the unbiased estimate of variance; and the left-lower half is for the comparison of the average.
+…… The value of the boat *i* was significantly (0.05 level) larger than that of the boat *j*.
−…… significantly smaller

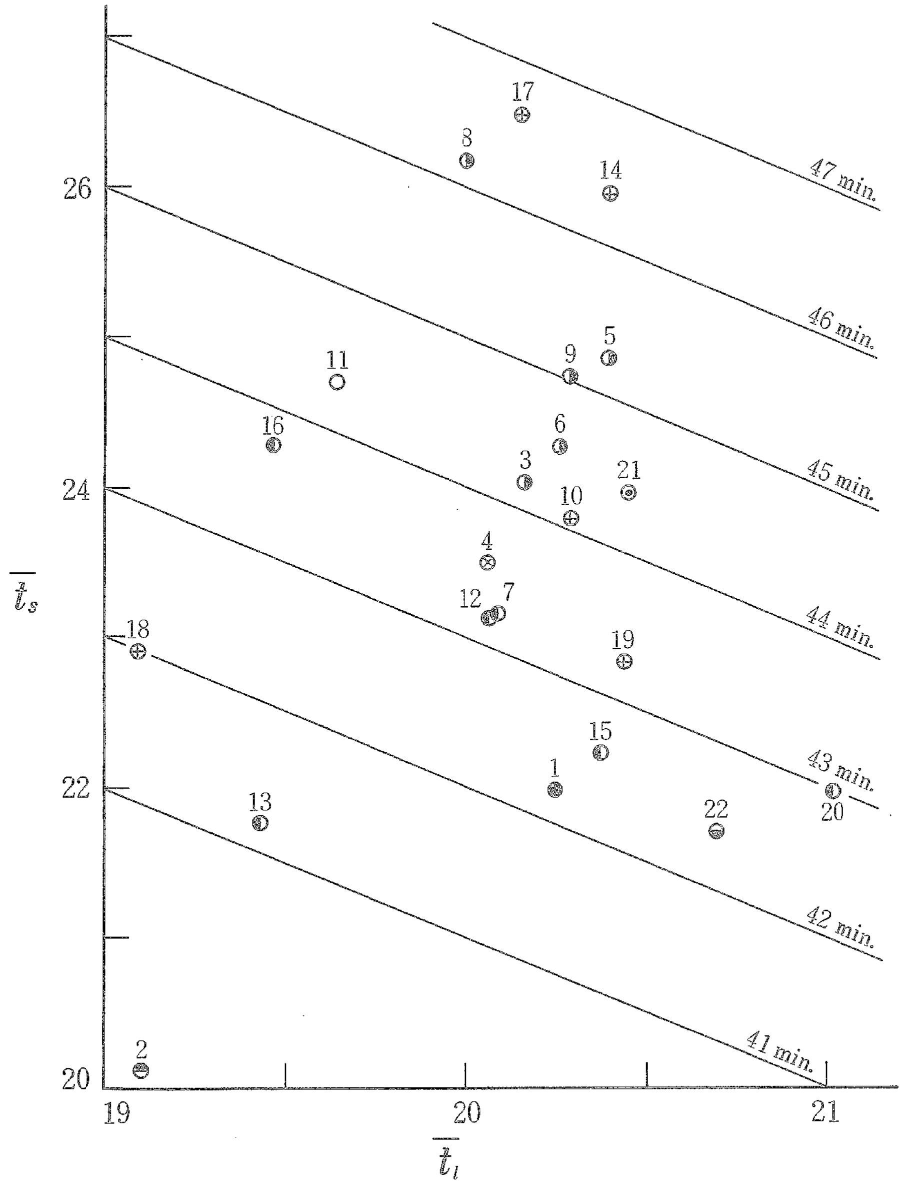

Fig. 1. The distribution of the boats in respect of the average of t_l and t_s.
Note: The numeral attached to the mark is the boat number. The line shows the sum of t_l and t_s.
The open circle 220Hp
The circle with center dot 230Hp
The circle with right half filled 250Hp
The circle with left half filled 270Hp
The circle with lower half filled 275Hp
The circle with upper half filled 290Hp
The circle with × 310Hp
The circle with + ... 320Hp
The soild circle 340Hp

significantly larger .... No. 11 (220 Hp), No. 5 (250 Hp), No. 8 (250 Hp), No. 9 (250 Hp), No. 14 (320 Hp), and No. 17 (320 Hp)

significantly smaller .... No. 13 (270 Hp), No. 15 (270 Hp), No. 20 (270 Hp), No. 22 (275 Hp), No. 2 (290 Hp), No. 19 (320 Hp), and No. 1 (340 Hp)

More than 90% of the significant differences were found in the combinations with these boats. And a rough trend of the decrease of t_s in accordance with the power was found in the distribution of the points in Fig. 1, although there were the two boats taking small

Table 3. The summarized results of the comparison of the average of the sinking-pulling time.

Engine (Hp)	220	230	250					270						275	290	310	320					340
Boat No. (*i*) / Boat No. (*j*)	11	21	3	5	6	8	9	7	12	13	15	16	20	22	2	4	10	14	17	18	19	1
11			—	—	—	+	—		—			—			—	+		+	+	—	—	
21			—	—	—		—		—			—		—	—			+	+	—	—	
3					—	+	—		—	+	+		+			+		+	+			
5		—	—		—	+	—	+	—	+	+		+			+	+	+	+			+
6						+		+		+	+	+	+	+	+	+	+	+	+		+	+
8	—	—	—	—	—		—	—	—	—		—		—	—		—		+	—	—	—
9						+		+		+	+	+	+	+	+	+	+	+	+		+	+
7	+		+	+	+	+	+		—		+		+			+		+	+	—		
12	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+		+	+
13	+	+	+	+	+	+	+	+	+			—	+		—	+		+	+	—	—	
15	+	+	+	+	+	+	+					—		—	—		—		+	—	—	—
16						+		—	—	—	—		+			+		+	+			
20	+	+	+	+	+	+	+	+	+			+		—	—		—		+	—	—	—
22	+	+	+	+	+	+	+	+	+			+				+		+	+			
2	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+			
4	+			+		+	+			—			—	—	—		—		+	—	—	—
10	+			+		+	+			—	—		—	—	—			+	+	—		
14	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—			—	—	—
17	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—			—	—	—
18	+	+	+	+	+	+	+			—		+		—	—			+	+			+
19	+	+	+	+	+	+	+			—		+		—	—		+	+	+			
1	+	+	+	+	+	+	+	+	+			+			—	+	+	+	+			

The number of the boats showing the significant difference of either the unbiased estimate of variance or the average

Boat No. (*i*)	11	21	3	5	6	8	9	7	12	13	15	16	20	22	2	4	10	14	17	18	19	1
	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—	+—
Unbiased estimate of variance	9 4	10 2	3 9	3 12	0 18	15 1	0 18	5 6	0 18	9 5	13 1	3 9	14 1	3 7	3 9	15 1	5 6	16 0	20 0	0 12	3 9	5 6
Average	12 3	9 4	10 4	14 3	10 3	19 0	12 3	5 9	5 10	1 16	1 11	10 3	1 14	1 16	0 21	5 6	7 6	19 0	19 0	3 10	3 11	1 14

Note: The right-upper half is for the comparison of the unbiased estimate of variance; and the left-lower half is for the comparison of the average.
+……The value of the boat *i* was significantly (0.05 level) larger than that of the boat *j*.
—……significantly smaller

t_s. This fact meant that the speed of this step of work depended on the power and the more powerful boats inclined to finish the sinking-pulling work in a shorter time.

With regard to the uniformity of t_s, the significant between-boat difference of the unbiased estimate of variance of t_s was found in the 154 pairs. The 26 pairs were between the boats of the same power and the other 128 pairs were between the boats of the different power. The χ_0^2 value of the homogeneity test was 1.078 with one degree of freedom. The following boats took the significantly larger (or smaller) value of the unbiased estimate of variance of t_s than that of more than 11 boats out of the 21 ones:

significantly larger .... No. 8 (250 Hp), No. 15 (270 Hp), No. 20 (270 Hp), No. 4 (310 Hp), No. 14 (320 Hp), and No. 17 (320 Hp)

significantly smaller .... No. 5 (250 Hp), No. 6 (250 Hp), No. 9 (250 Hp), No. 12 (270 Hp), and No. 18 (320 Hp)

It was, however, hard to find any clear relation between this classification and the power.

It is probable that it requires a longer time to wait for the sinking down of the gear, when the net is laid within a shorter time. The distribution of the points in Fig. 1 did not, however, provide us with any fact in support of the possibility like this. And the time interval between the start of laying the gear to the finish of pulling work ($t_l + t_s$) depended mainly on t_s; in consequence, ($t_l + t_s$) showed a rough dependence on the power.

3. The linear regression of t_h on x

The length of the hauling-brailing time, consequently that of the time for completing a haul, was seriously affected by the amount of catch[2]. The between-boat differences of the speed of these steps of work were examined through the comparison of their linear regression equations on the amount of catch, for the purpose of not only finding out the between-boat difference after the elimination of the predominating influence of the different amount of catch relating to the boat but also dividing the difference of the time length into the part relating to the amount of catch and that not relating to it. As shown in Tables 4 to 6 and Fig. 2, the boats were classified into the two groups in respect of the value of b_{0n}. In one of the groups, b_{0n} was larger than 50, and that of the other group was from 45 to 48. The former group consisted of the four boats—No. 11 (220 Hp) No. 20 (270 Hp), No. 2 (290 Hp), and No. 14 (320 Hp). And the other group consisted of the other boats. These two groups were rather clearly separated from each other. It was, however, hard to find any clear relation between this classification and either the power or the classification in respect of t_l or t_s.

The value of b_{1n} means the increase of t_h due to unit increase of the catch. In the present case, b_{1n} differed according to the boats, ranging from 2.5 to 4. Among the 231 pairs of the boats, the difference between b_{1n} was significant in the 103 pairs. The 14 pairs were between the boats of the same power, and the other 89 pairs were between the boats of the different power. The χ_0^2 value of the homogeneity test was 0.352 with one degree of freedom. About 85% of the significant differences were due to either the larger value or the smaller one of b_{1n} (than that of more than 11 boats out of the 21 ones) of the following eight boats:

significantly larger .... No.6 (250 Hp), No.10 (320 Hp), and No.17 (320 Hp) significantly smaller .... No. 11 (220 Hp), No. 3 (250 Hp), No. 2 (290 Hp), No. 18 (320 Hp), and No. 1 (340 Hp)

It was hard to find any clear relation between this classification and either that of b_{0n} or that of t_l or t_s. The length of t_h depends on the relation between b_{0n} and b_{1n}, and differs according to the amount of catch. The catch by a haul varied from 0 to 21 tons; about 80% of the hauls yielded a catch of less than five tons, and about 95% yielded less than 10 tons[2]. With the assistance from the lines in Fig. 2, t_h of the hauls yielding the same amount of catch by a boat was compared with that of the other boats. And the following trends were found out:

1) The maximum between-boat difference of t_h of the hauls yielding a catch of five tons was about seven minutes, i.e. about 10% of t_h.

2) That of the hauls yielding a catch of 10 tons was about 15 minutes, i.e. 20% of t_h.

3) Even within the boats of the same power groups, t_h of the hauls yielding the same amount of catch showed a large between-boat difference. And the ranges of their dis-

Table 4. The estimated linear regression equations of the hauling-brailing time (t_h in min.) on the amount of the catch (x in tons) by boats.

Engine (Hp)	Boat No.	b_{0n}	b_{1n}	F_0	n_2
220	11	52.767	2.625	331.42**	232
230	21	46.396	3.390	403.95**	231
250	3	47.720	2.745	259.75**	246
	5	45.496	3.464	341.46**	250
	6	46.087	3.866	548.66**	250
	8	45.745	3.418	698.11**	241
	9	47.722	3.642	411.95**	239
270	7	46.771	2.964	327.18**	231
	12	47.163	3.335	707.02**	250
	13	47.328	3.618	720.11**	243
	15	48.069	3.182	742.60**	235
	16	46.337	3.019	355.67**	239
	20	51.029	2.992	173.20**	240
275	22	46.414	3.236	136.59**	225
290	2	50.646	2.331	176.53**	239
310	4	46.709	3.519	523.57**	236
320	10	47.475	3.792	703.39**	235
	14	51.104	2.960	217.23**	161
	17	46.980	3.959	241.28**	226
	18	45.399	2.745	336.33**	106
	19	46.750	3.443	210.43**	143
340	1	45.019	2.766	442.75**	214

Note: $t_h = b_{0n} + b_{1n}\,x$

F_0 ····· The Snedecor's F for the regression coefficient with 1 and n_2 degrees of freedom

** significant at 0.01 level

Table 5. The comparison of the boats in the linear regression coefficients of t_h on x.

Engine (Hp)	230		250										270							
Boat No.	21		3		5		6		8		9		7		12		13		15	
	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n
11	−3.456**	463	−0.541	478	−3.550**	482	−5.665**	482	−4.096**	473	−4.413**	471	−1.552	463	−3.722**	482	−5.012**	475	−3.021**	467
21			2.683**	477	−0.289	481	−2.018*	481	−0.134	472	−1.020	470	1.802	462	0.265	481	−1.060	474	1.029	466
3					−2.831**	496	−4.715**	496	−3.161**	487	−3.590**	485	−0.923	477	−2.809**	496	−4.012**	489	−2.148*	481
5							−1.595	500	0.200	491	−0.670	489	2.010*	481	0.572	500	−0.660	493	1.301	485
6									2.149*	491	0.919	489	3.856**	481	2.584**	500	1.171	493	3.416**	485
8											1.023	480	2.177*	472	0.461	491	−1.066	484	1.351	476
9													2.748**	470	1.424	489	0.110	482	2.173*	474
7															−1.804	481	−3.060**	474	−1.101	466
12																	−1.534	493	0.889	485
13																			2.429*	478
15																				
16																				
20																				
22																				
2																				
4																				
10																				
14																				
17																				
18																				
19																				
1																				

Engine (Hp)	270				275		290		310		320										340	
Boat No.	16		20		22		2		4		10		14		17		18		19		1	
	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n
11	−1.825	471	−1.361	472	−2.043*	457	1.294	471	−4.242**	468	−5.746**	467	−1.398	393	−4.705**	458	−0.552	338	−3.126**	375	−0.720	446
21	1.589	470	1.367	471	0.845	456	4.313**	470	−0.563	467	−1.823	466	1.664	392	−1.876	457	2.743**	337	−0.190	374	2.935**	445
3	−1.169	485	−0.861	486	−1.553	471	1.691	485	−3.373**	482	−4.714**	481	−0.827	407	−4.038**	472	0.001	352	−2.472*	389	−0.095	460
5	1.810	489	1.597	490	0.699	475	4.413**	489	−0.226	486	1.389	485	1.823	411	−1.590	476	2.717**	356	0.069	393	3.027**	464
6	3.662**	489	3.039**	490	2.006*	475	6.322**	489	1.538	486	0.341	485	3.559**	411	−0.310	476	4.845**	356	1.535	393	5.227**	464
8	1.937	480	1.623	481	0.631	466	4.990**	480	−0.501	477	−1.939	476	2.015*	402	−1.970	467	3.369**	347	−0.101	384	3.541**	455
9	2.554*	478	2.131*	479	1.231	464	5.118**	478	0.519	475	−0.654	474	2.559*	400	−1.007	465	3.742**	345	0.692	382	3.969**	453
7	−0.240	470	−0.102	471	−0.873	456	2.636**	470	−2.468*	467	−3.803**	466	0.013	392	−3.362**	457	0.909	337	−1.711	374	0.936	445
12	1.556	489	1.322	490	0.349	475	4.670**	489	−0.928	486	−2.405*	485	1.678	411	−2.300*	476	3.022**	356	−0.444	393	3.141**	464
13	2.836**	482	2.326*	483	1.295	468	5.773**	482	0.481	479	−0.885	478	2.840**	404	−1.221	469	4.305**	349	0.693	386	4.525**	457
15	0.835	474	0.7645	475	−0.192	460	4.108**	474	−1.759	471	−3.315**	470	1.013	396	−2.955**	461	2.242*	341	−1.086	378	2.364*	449
16			0.095	479	−0.704	464	2.898**	478	−2.250*	475	−3.593**	474	0.229	400	−3.212**	465	1.154	345	−1.535	382	1.211	453
20					−0.679	465	2.298*	479	−1.907	476	−2.958**	475	0.101	401	−2.821**	466	0.780	346	−1.307	383	0.848	454
22							2.837**	464	−0.928	461	−1.863	460	0.793	386	1.925	451	1.423	331	0.555	368	1.592	439
2									−5.086**	475	−6.446**	474	−2.362*	400	−5.362**	465	−1.639	345	−3.834*	382	−1.969	453
4											−1.300	471	2.258*	397	−1.519	462	3.416**	342	0.280	379	3.713**	450
10													3.486**	396	−0.591	461	4.878**	341	1.341	378	5.276**	449
14															−3.024**	387	0.824	267	−1.562	304	0.843	375
17																	3.724**	332	1.444	369	4.272**	440
18																			−2.441*	249	−0.103	320
19																					2.687**	357

* significant at 0.05 level
** significant at 0.01 level

Table 6. The summarized results of the comparison of the linear regression coefficients of t_h on x.

Engine (Hp)	220	230	250					270						275	290	310	320					340
Boat No. (i)	11	21	3	5	6	8	9	7	12	13	15	16	20	22	2	4	10	14	17	18	19	1
Boat No. (j) 11		+		+	+	+	+		+	+	+			+		+	+		+		+	
21	−		−		+										−					−		−
3		+		+	+	+	+		+	+	+					+	+		+		+	
5	−		−					−							−					−		−
6	−	−	−			−		−	−		−	−	−	−	−			−		−		−
8	−		−		+			−							−			−		−		−
9	−		−					−			−	−	−		−			−		−		−
7				+	+	+	+			+					−	+	+		+			
12	−		−		+										−		+		+	−		−
13	−		−					−			−	−	−		−			−		−		−
15	−		−		+		+			+					−		+		+	−		−
16					+		+			+					−	+	+		+			
20					+		+			+					−		+		+			
22	−				+										−							
2		+		+	+	+	+	+	+	+	+	+	+	+		+	+	+	+		+	
4	−		−					−				−			−			−		−		−
10	−		−					−	−		−	−	−		−			−		−		−
14					+	+	+			+					−	+	+		+			
17	−		−					−	−		−	−	−		−			−		−		−
18		+		+	+	+	+		+	+	+					+	+		+		+	
19	−		−												−					−		−
1		+		+	+	+	+		+	+	+					+	+		+		+	

The number of the boats showing the significant difference

	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−
	0 13	5 1	0 12	6 0	14 0	7 1	10 0	1 8	5 3	10 0	5 5	1 6	1 5	2 1	0 17	8 0	11 0	1 7	11 0	0 12	5 0	0 12

Note: +……The value of the boat i was significantly (0.05 level) larger than that of the boat j.
−……significantly smaller

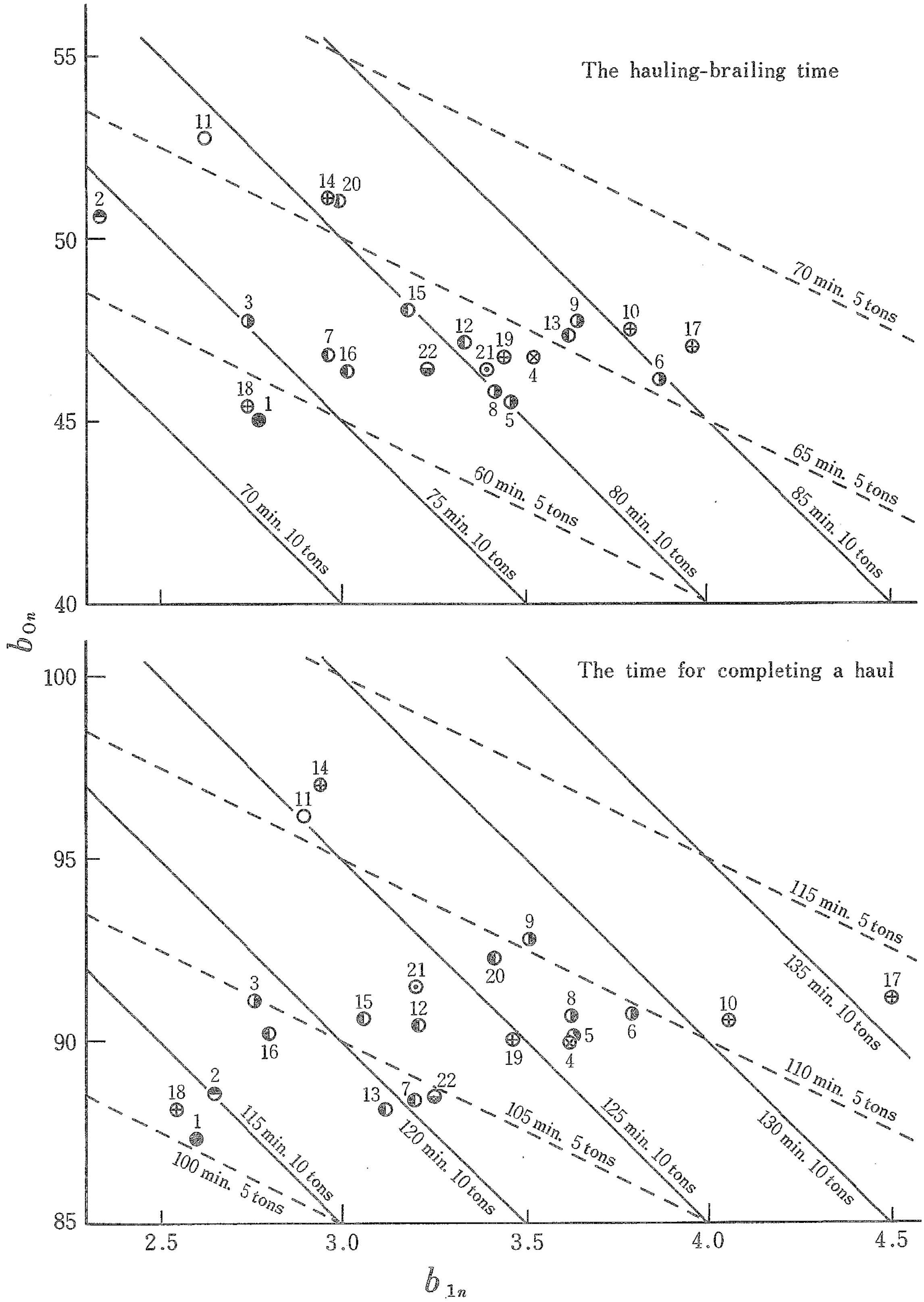

Fig. 2. The distribution of the boats in respect of the constant (b_{0n}) and the coefficient (b_{1n}) of the linear regression equation of the working speed on the amount of catch.

tribution of the different power groups were widely overlapping, although some of the boats taking the larger b_{1n} than the others inclined to take larger t_h and some of those taking smaller b_{1n} inclined to take smaller t_h than the others. Namely, a larger between-boat difference of t_h of the hauls yielding the same amount of catch was found out, but it was hard to find any clear relation between t_h and the power.

4. The linear regression of t_c on x

The boats were classified into the two groups according to the value of the constant, b_{0n}, of the linear regression equation of t_c. One of the groups took large b_{0n}, and

Table 7. The estimated linear regression equations of the time for completing a haul (t_c in min.) on the amount of catch (x in tons) by boats.

Engine (Hp)	Boat No.	b_{0n}	b_{1n}	F_0	n_2
220	11	96.151	2.896	256.86**	231
230	21	91.481	3.208	190.53**	231
250	3	91.086	2.763	229.40**	245
	5	90.139	3.631	337.49**	250
	6	90.745	3.791	417.88**	250
	8	90.636	3.627	374.92**	251
	9	92.844	3.510	273.12**	240
270	7	88.298	3.198	200.66**	231
	12	90.464	3.212	396.99**	251
	13	88.168	3.617	307.59**	243
	15	90.626	3.066	352.77**	235
	16	90.227	2.799	142.09**	239
	20	92.209	3.414	192.87**	240
275	22	88.494	3.251	126.73**	222
290	2	88.534	2.650	181.90**	241
310	4	89.943	3.616	313.52**	236
320	10	90.568	4.060	402.95**	236
	14	97.009	2.943	176.50**	160
	17	91.160	4.497	325.28**	227
	18	88.121	2.546	139.20**	106
	19	90.077	3.466	122.95**	145
340	1	87.304	2.595	225.00**	215

Note: $t_c = b_{0n} + b_{1n}x$

consisted of the boat Nos. 11 (220 Hp) and 14 (320 Hp). The other group consisted of the other 20 boats. This group took smaller b_{0n} than the former, and a rough trend of a slight increase of b_{0n} in accordance with b_{1n} was found out. The regression coefficient, b_{1n}, varied from 2.5 to 4.5. Among the 231 pairs of the boats, the difference between b_{1n} was significant in the 96 ones. The 14 pairs were between the boats of the same

Table 8. The comparison of the boats in the linear regression coefficients of t_c on x.

Engine (Hp)	230		250										270							
Boat No.	21		3		5		6		8		9		7		12		13		15	
	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n
Boat No. 11	−1.067	462	0.519	476	−2.744**	481	−3.440**	481	−2.806**	482	−2.186*	471	−1.044	462	−1.307	482	−2.631**	474	−0.698	466
21			1.518	476	−1.394	481	−1.969	481	−1.414	482	−0.952	471	0.029	462	−0.014	482	−1.319	474	0.505	466
3					−3.221**	495	−3.950**	495	−3.298**	496	−2.669**	485	−1.489	476	−1.848	496	−3.101**	488	−1.230	480
5							−0.587	500	0.017	501	0.412	490	1.441	481	1.651	501	0.051	493	2.206*	485
6									0.622	501	1.000	490	1.997*	481	2.357*	501	0.628	493	2.890**	485
8											0.408	491	1.460	482	1.682	502	0.036	494	2.251*	486
9													0.974	471	1.123	491	−0.356	483	1.630	475
7															−0.049	482	−1.362	474	0.479	466
12																	−1.559	494	0.631	486
13																			2.098*	478
15																				
16																				
20																				
22																				
2																				
4																				
10																				
14																				
17																				
18																				
19																				
1																				

270				275		290		310		320										340	
16		20		22		2		4		10		14		17		18		19		1	
t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n	t	n
0.327	470	−1.694	471	−1.070	453	0.920	472	−2.642**	467	−4.283**	467	−0.165	391	−5.269**	458	1.235	337	−1.690	376	1.202	446
1.225	470	−0.603	471	−0.117	453	1.839	472	−1.322	467	−2.765**	467	0.817	391	−3.786**	458	2.018*	337	−0.682	376	2.130*	446
−0.120	484	−2.105*	485	−1.470	467	0.417	486	−3.109**	481	−4.731**	481	−0.639	405	−5.691**	472	0.774	351	−2.097*	390	0.667	460
2.702**	489	0.685	490	1.112	472	3.518**	491	0.052	486	−1.514	486	2.314*	410	−2.749**	477	3.635**	356	0.475	395	3.936**	465
3.244**	489	1.197	490	1.612	472	4.186**	491	0.629	486	−0.965	486	2.990**	410	−2.294*	477	4.462**	356	0.966	395	4.710**	465
2.748**	490	0.685	491	1.124	473	3.596**	492	0.037	487	−1.569	487	2.371*	411	−2.831**	478	3.753**	357	0.474	396	4.039**	466
2.158*	479	0.282	480	0.725	462	2.928**	481	−0.355	476	−1.833	476	1.861	400	−2.999**	467	3.208**	346	0.123	385	3.336**	455
1.226	470	−0.647	471	−0.144	453	1.830	472	−1.371	467	−2.844**	467	0.780	391	−3.841**	458	1.947	337	−0.706	376	2.106*	446
1.457	490	−0.694	491	−0.124	473	2.218*	492	−1.565	487	−3.290**	487	1.008	411	−4.452**	478	2.530*	357	−0.798	396	2.614*	466
2.596*	482	0.625	483	1.049	465	3.391**	484	0.001	479	−1.530	479	2.217*	403	−2.739**	470	3.509**	349	0.424	388	3.795**	458
0.947	474	−1.198	475	−0.578	457	1.633	476	−2.114*	471	−3.842**	471	0.449	395	−4.898**	462	1.889	341	−1.226	380	1.967	450
		−1.811	479	−1.213	461	0.484	480	−2.617**	475	−4.066**	475	−0.428	399	−4.908**	466	0.728	345	−1.720	384	0.691	454
				0.429	462	2.425*	481	−0.629	476	−2.028*	476	1.359	400	−3.054**	467	2.426*	346	−0.128	385	2.697*	455
						1.757	463	−1.051	458	−2.332*	458	0.834	382	−3.277**	449	1.866	328	−0.508	367	2.000*	437
								−3.409**	477	−4.995**	477	−0.983	401	−5.865**	468	0.347	347	−2.334*	386	0.211	456
										1.542	472	2.212*	396	−2.748**	463	3.485**	342	0.423	381	3.806**	451
												3.663**	396	−1.369	463	4.903**	342	1.667	381	5.470**	451
														−4.607**	387	1.273	266	−1.386	305	1.255	375
																5.702**	333	2.637**	372	6.347**	442
																		−2.377*	251	−0.177	321
																				2.620**	360

*significant at 0.05 level
**significant at 0.01 level

Table 9. The summarized results of the comparison of the linear regression coefficients of t_c on x.

Engine (Hp)	220	230	250					270						275	290	310	320					340
Boat No. (i) / Boat No. (j)	11	21	3	5	6	8	9	7	12	13	15	16	20	22	2	4	10	14	17	18	19	1
11				+	+	+	+			+						+	+		+			
21																	+		+	−		−
3				+	+	+	+			+			+			+	+		+		+	
5	−		−								−	−			−			−	+	−		−
6	−		−					−	−		−	−			−			−	+	−		−
8	−		−								−	−			−			−	+	−		−
9	−		−									−			−				+	−		−
7					+												+		+			−
12					+										−		+		+	−		−
13	−		−								−	−			−			−	+	−		−
15				+	+	+				+						+	+		+			
16				+	+	+	+			+						+	+		+			
20			−												−		+		+	−		−
22																	+		+			−
2				+	+	+	+		+	+			+			+	+		+		+	
4	−		−								−	−			−			−	+	−		−
10	−	−	−					−	−		−	−	−	−	−			−		−		−
14				+	+	+				+						+	+		+			
17	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−		−		−	−	−
18		+		+	+	+	+		+	+			+			+	+		+		+	
19			−												−				+	−		−
1		+		+	+	+	+	+	+	+			+	+		+	+		+		+	

The number of the boats showing the significant difference

	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−	+−
	0 8	2 2	0 10	8 1	10 1	8 1	6 1	1 3	3 3	8 1	0 7	0 8	4 2	1 2	0 11	8 1	13 0	0 7	20 0	0 12	4 1	0 14

Note: +……The value of the boat i was significantly (0.05 level) larger than that of the boat j.
−……significantly smaller

power and the 82 ones were between the boats of the different power. The χ_0^2 value of the homogeneity test was 0.04 with one degree of freedom. And about one third of these significant differences was due to either the large value or the small one of the following five boats:

significantly larger .... No. 10 (320 Hp) and No. 17 (320 Hp)
significantly smaller.........No. 2 (290 Hp), No. 18 (320 Hp), and No. 1 (340 Hp)

Namely, the powerful boats inclined to take the significantly different b_{1n} from that of the other boats, but whether it was larger or smaller differed according to the boat.

For the hauls yielding a catch of five tons, the maximum between-boat difference of t_c was about 14 minutes. The boat Nos. 1 (340 Hp), 2 (290 Hp), and 18 (320 Hp) took smaller t_c than the others because of small b_{0n} and small b_{1n}. The boat Nos. 11 (220 Hp), 14 (320 Hp), and 17 (320 Hp) took large t_c because of the large value of b_{0n} in the former two boats and the large value of b_{1n} in the last one. In accordance with the increase in the catch, the difference in b_{1n} get influential in t_c, as shown in the increasing declivity of the lines in Fig. 2. And the maximum between-boat difference of t_c of the hauls yielding 10 tons of catch was about 23 minutes, i.e. 20% of t_c, because of the large variation of b_{1n}. It was, however, hard to find any clear relation between t_c and the power.

Discussion

The between-boat differences in the times required for respective steps of works (t_i) were examined in the preceding sections. And it was found out that some of the boats needed a shorter time and some others took longer time than the other boats for a step of work; but whether a boat needed a longer time, or a shorter time, or an ordinary length of time, differed according to the steps. In spite of the fact that the main engine of the boat varied from 220 Hp to 340 Hp, it was hard to find the power-depending change of t_i except a rough trend of decrease of t_s. It was hard to find any significant difference between the pairs of the boats of the same power and those of the different power in respect of the rate of occurrence of the significant difference in either of the other five characters examined. These facts suggested that the working speeds of respective steps should not depend on the power. And some considerations were given for the purpose of showing the reason for it.

1. The length of the laying time

The laying time of the two boats was significantly longer and that of the two boats was significantly shorter than that of more than a half of the other boats, in spite of the fact that the laying work was the step showing an extremely small time variation. It was, however, hard to find any clear relation between t_l and the power. The result coinciding with this was found in the preceding report[7]. This may be due to the possibility of the boats running with a reduced power during this step because of the following two reasons: One is that the running speed depends on the speed of the smooth and safe handling of the warp and net. And it is natural that this speed is independent of the power of the boat but depends on the temperament or skillfulness of the crew and on the construction of the working space. The other is the following pattern of the laying work: The fishing ground examined here was shallow. The boats used the warp of the same and minimum length. And they have to reduce the speed four times a laying; twice for the hard turnings, once for laying the net, and once for picking up the buoy at the initial end of the warp. The warp was short; consequently the distances between the points to reduce the speed were short. These facts prevented the boats from running with full power during this step.

2. The length of the sinking-pulling time

The time for the sinking-pulling step of the six boats was significantly longer and that of the seven boats was significantly shorter than that of the more than a half of the other boats. The distribution of the marks in Fig. 1 showed a rough trend of the decrease of t_s in accordance with the power. Attention should be paid to the following facts: The difference of t_s between the boats of the same power was large, and the maximum between-boat difference of t_s (6.5 min.) was four times as large as that due to the regression on the power. The regression on the power was significant in most of the wave grades, while that was significant in not all the wave-depth strata[8]. These facts aroused a doubt as to the boat needing full power during the sinking-pulling step. The time for this step can be divided into that for the sinking sub-step and that for the pulling one. During the former sub-step, the boat waits for the net and warp sink down, and the engine is not in use. It is, accordingly, natural that the length of the time for this sub-step is independent of the power. If the laying time showed a sharp shortening in accordance with the power, it is probable that it requires a longer time to wait for the net sink down, when the net is laid within a shorter time. But, there was little possibility like this, because of the following reason: The net is laid down in water at the half-way of the laying work, and starts to sink down as soon as laid down at a speed of 12 to 15 m per minute. The net was settled down on the sea floor about at the finish of the laying work. In addition, t_l did not show any significant trend of decrease in accordance with the power. The Danish seiners examined here did not use any depth telemetric systems. Accordingly, they had no method of confirming the settling of the net. And the decision of the work pattern—i.e. the estimation of the time of settling of the net and whether the boat starts to pull the warp a little before the settling or a short time after it—depends mainly on the skipper's way of thinking. It is, accordingly, highly probable that the length of the time for this sub-step shows a large between-boat variation due to the different way of thinking among the skippers.

During the pulling work, the warp is pulled at a considerable speed with the assistance of the gypsy drum driven by the main engine. But it is hard to consider that the pulling speed clearly depends on the power because of the following reason: The Danish seine is the fishing method suitable for catching the fish in deep grounds, and the boats are constructed for fishing in these grounds. In spite of these facts, the fishable depth in the present case was legally restricted within 150 m. Accordingly, the boats worked with sufficient surplus of the power. It is assumed that the warps in teardrop shape are pulled together into a very long spindle shape, and the noise and cloud of mud caused by the approaching warps sweep together the fish enclosed by the warps. The approaching speed is the key to the efficiency of sweeping together the fish. And the estimation on the change of the shape of warp in water and the preferable speed of approaching of the warps differ according to the skipper. It was, accordingly, hard to neglect the possibility of the pulling speed differing according to the different way of thinking among the skippers. During this sub-step, the engine was used for propulsion, too. But this was not for dragging the net but for preventing the boat from being dragged back toward the net working like an anchor. And it was hard to consider that the full power was needed for this purpose. The Alaska pollack is a roundfish capable of living loosely depending on the sea bed. There are, accordingly, the two ways of fishing it with the Danish seine. One is the fly dragging and the other is anchor fishing. If in the former case, the boat tows her net at full power and the power may be influential in the time for this sub-step. But the possibility like this was denied, because our fishermen did not prefer to using the former way of fishing. It is accordingly natural that the working speed is like the pattern found here.

3. The length of the hauling-brailing time

The time required for the hauling-brailing step of work (t_h) was seriously affected by the amount of catch. The regression equation of t_h on x makes it possible to divide the between-boat difference of t_h into that not relating to the amount of catch and that relating to it. The former is represented by b_{0n} and the latter by b_{1n}. And the between-boat difference of t_h may be found through these values. The two boats (Nos. 11 and 2) took larger b_{0n} and smaller b_{1n} than the others. The other two boats (Nos. 20 and 14) took larger b_{0n}, the three boats (Nos. 6, 10, and 17) took larger b_{1n}, and the three boats (Nos. 3, 18, and 1) took smaller b_{1n} than the others. The boats were classified into some groups according to the significant difference in either b_{0n} or b_{1n}. It was, however, hard to find any clear relation between the power and this classification.

The work pattern during this step and the probable relation between its speed and the power were described in detail in the preceding report[11]. And, only a short description was given here. The time for the hauling-brailing step of work can be divided into that for the hauling sub-step and that for the brailing one. The latter sub-step consists of the repetition of the brailing by a large stalked hoop-net. The brailing speed depends on the handling speed and the amount of fish brailed out by a handling. The brailing work is assisted by the gypsy drum driven by main engine. But it was driven at a reduced power. The hoop-net is handled by the crew. Its speed depends on the working pace of the crew and the construction and performance of the brailing system. It is accordingly hard to consider that the handling speed depends on the power of main engine. And it is natural that the time for the brailing sub-step increases in accordance with the amount of catch but is independent of the power. The difference of b_{1n} may mainly be due to the different speed in this sub-step.

The time for the hauling sub-step depends on the length of warp and the speed to wind up the warp. The fishing depth in the present case was shallow and all the boats used the warp of the same and minimum length. And the possibility of the difference in the time for the hauling sub-step due to the different warp length according to the boat was denied. There remained, thus, its possibility due to the different winding speed. The speed depends on the construction of the winding system and the load of warp. The former differs according to the boat, but it is less probable that the former should have a direct relation to the power. The load during the step before the net leaving from the sea floor depends on the winding speed and the different way of use of engine for propulsion. The former depends on the construction of the winding system and the latter on the different decision of the use of engine according to the skipper. Both have no direct relation to the power. The load is largest just after the net leaving from the sea floor. In accordance with the progress of winding up the warp, the buoyancy of the catch acts on reducing the load. The boats are constructed suitable for working in deeper grounds than the present case. It is accordingly doubtful that the boat needs full power during this sub-step. In consequence, the speed does not depend on the power of main engine.

4. The length of the time required for completing a haul

The time required for completing a haul consists of t_l, t_s, and t_h. The work pattern during respective steps and the probable relations between their speed and either the power or the individuality of the boat were shown in the preceding reports[7)-11)] and in the preceding sections of the present report. The detailed discussion was accordingly omitted. Among the times for these three steps of work, the difference of t_l was far smaller than those of the others, and has negligibly small influence on the difference of t_c. And the significant difference of either b_{0n} or b_{1n} of t_c was mainly due to that of t_h. The difference of the results of t_c from those of t_h was found in the four boats. The larger value of b_{0n} of t_h of the boat Nos. 20 and 2 was offset by the significantly smaller t_s. The boat No. 3 took significantly smaller b_{1n} of t_h and the boat No. 6 took significantly larger b_{1n} of t_h. Their b_{1n} of t_c were either smaller or larger than the others but they did not show any significant difference, because the residual of the sum of square of t_c was larger than that of t_h. Any other notable difference was not found between the results of t_h and those of t_c.

5. The comparison with the difference of the working speed due to the difference in the other factors

It was hard to consider that the laying time depends on the amount of catch. The preceding reports revealed that the maximum difference of the laying time due to the depth regression was about 40 seconds[3)], and that due to the different wave grade was

Table 10. The comparison of the regression coefficient of t_h on x with that of t_c on x.

Engine (Hp)	Boat No.	t	n
220	11	−1.175	463
230	21	0.635	462
250	3	−0.070	491
	5	−0.613	500
	6	0.302	500
	8	−0.914	492
	9	0.475	479
270	7	−0.841	462
	12	0.601	501
	13	0.004	486
	15	0.577	470
	16	0.773	478
	20	−1.261	480
275	22	−0.038	447
290	2	−1.212	480
310	4	−0.381	472
320	10	−1.074	471
	14	0.058	321
	17	−1.509	453
	18	0.756	212
	19	−0.057	288
340	1	0.785	429

1.4 minutes[5]. The time for this step of work did not show any significant regression on the power[7]. The present examination found out that the maximum between-boat difference was about two minutes.

The maximum difference of the time for the sinking-pulling step due to the depth regression was about four minuets[3], and that due to the different wave grade was about 45 seconds[5]. The maximum between-boat difference of the time for this step was about six minutes, in spite of the fact that the time difference due to the power regression was about 1.3 minutes[7]. It was hard to consider that the time for this step depends on the amount of catch.

The time for the hauling-brailing step increased significantly in accordance with the amount of catch at a rate of 3 to 5 minutes per ton[2)-10)]; and the catch varied from 0 to 21 tons a haul. About 80% of the hauls yielded a catch of less than five tons. For the hauls with five tons of catch, the time difference due to the catch regression was 20 to 25 minutes, while the between-boat difference was seven minutes. About 95% of the hauls yielded a catch of less than 10 tons. For the hauls with 10 tons of catch, the time difference due to the catch regression was 40 minutes, while the between-boat difference was 15 minutes. The influence of either the depth fished, or the height of wind wave, or the power, after the elimination of the influence of the different amount of catch relating to them, was very small, slightly modifying the time-catch relation[11].

From these findings, it may be concluded that the different work pattern according to the boat was the factor second to the amount of catch in respect of the influence on the working speed. And it was hard to neglect the difference in the working speed due to this reason, especially when the difference in the working speed of the laying step or the sinking-pulling one was examined.

Conclusion

All the results shown in the preceding sections were summarized into Table 11, for

Table 11. The summarized results of the examinations on the difference in the working speed of the boats.

Engine (Hp)	Boat No.	t_l		t_s		t_h		t_c	
		$\bar{t}_l$	u_l	$\bar{t}_s$	u_s	b_0	b_1	b_0	b_1
220	11	—	—	+			—	(+)	
230	21								
250	3		—				—		
	5		+	+	—				
	6		—		—		+		
	8		+	+	+				
	9			+	—				
270	7								
	12		—		—				
	13	—	—	—					
	15		—	—	+				
	16	—	+						
	20	+	+	—	+	(+)			
275	22	+	+	—					
290	2	—	+	—		(+)	—		—
310	4				+				
320	10		—				+		+
	14			+	+	(+)		(+)	
	17			+	+		+		+
	18	—			—		—		—
	19		—	—					
340	1			—			—		—

Note: +……significantly (0.05 level) larger than that of more than 11 boats out of the 21 ones
—……significantly smaller

the purpose of easy understanding the variety of the boats in respect of the working speed. This table revealed the following facts: The classification of the boats according to b_{0n} and b_{1n} of t_c was similar to that according to those of t_h. It was, however, hard to find any clear relation between the classification of the boats according to b_{0n} and that according to b_{1n}, and also it was hard to find any clear relation between either of them and either of the classifications according to either of the average and the unbiased estimate of variance of either t_l or t_s. The more powerful boat inclined to finish the sinking-pulling work in a shorter time than the less powerful one. It was hard to find any clear relation between the power and any of the other seven characters of the working speed examined.

It is accordingly concluded that the working speed differed according to the boat, and whether a boat finished a step of work in a shorter (or longer) time than the others or in an ordinary time length, differed according to the step of work. It was hard to find any clear relation between the working speed and the power except the average of the sinking-pulling time.

The comparison of the results of the present report with those of the preceding ones showed that the different work pattern according to the boat was the factor second to the amount of catch in respect of the influence on the working speed.

Summary

The difference of the working speed of the Danish seiners during the Alaska pollack fishery in the Bering Sea was examined in the preceding reports of this series[2)-11)]. The large between-boat difference in the working speed found during the examination in the precceding report[7)] necessitated the further examination on the relation between the power regression of the working speed and the between-boat difference. In the present report, the between-boat difference observable in the average of either the laying time or the sinking-pulling time, and the catch regression of either the hauling-brailing time or the time for completing a haul were examined, and the results obtained were summarized as follows:

1. The between-boat difference of the time for the laying step of work (t_l) was significant (0.05 level) in the 100 pairs of the boats out of the 231 ones (22 x 21/2), because of the large value of the two boats and the small value of the five boats (showing significant difference to more than 11 boats out of the 21 ones).

The significant difference between the unbiased estimates of variance of t_l was found in the 174 pairs of the boats, because of the large value of the six boats and the small value of the eight boats.

It was hard to find any clear relation between either $\bar{t}_l$ or the unbiased estimate of variance and the power of the boats.

2. The significant difference (0.05 level) between the times for the sinking-pulling step (t_s) was found in the 167 pairs of the boats, mainly because of the large value of the six boats and the small value of the seven boats. That of the unbiased estimate of variance

was found in the 154 pairs, mainly because of the large value of the six boats and the small value of the five boats. The average of t_s showed a rough trend of decrease in accordance with the power; but the maximum between-boat difference was 6.5 minutes, in spite of the fact that the difference due to the power regression was 1.3 minutes.

3. The four boats took the larger constant of the linear regression equation of the hauling-brailing time (t_h) on the amount of catch than the other boats. The significant between-boat difference of the regression coefficient was found in the 103 pairs of the boats; about 85% of them were due to either the large value of the three boats or the small value of the five boats.

4. Even within the boats of the same power, $\bar{t}_h$ of the hauls yielding the same amount of catch showed a large between-boat difference. And the ranges of their distribution of the different power groups were widely overlapping.

5. The two boats took the larger constant of the linear regression equation of the time for completing a haul on the amount of catch than the other boats. The significant between-boat difference of the regression coefficients was found in the 96 pairs of the boats; about one third of them was due to the large value of the two boats and the small value of the three boats.

6. Whether a boat finished a step of work in a shorter time or longer time or in an ordinary length of time, differed according to the boat and according to the step of work. And it was hard to find nay clear relation between the working speed and the power except the average of the sinking-pulling time.

7. The comparison of the results of the present report with those of the preceding ones revealed that the different work pattern according to the boat was the factor second to the amount of catch in respect of the influence on the working speed. And it was hard to neglect the difference in the working speed due to this reason, especially when the difference in the working speed of the laying step or the sinking-pulling step was examined.

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