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Shift and Catch of the Danish Seiner during the Alaska Pollack Trawling—Ⅲ.*

The Distance of Shift and the Amount of Catch by the Shooting just after the Shift

By

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The popularization of wireless telephone and echo-sounder on fishing boat made it possible to supply the fishing boat with abundant informations as the bases of determining the location of shooting the gear. And the determination of fishing location became far more rational than that before their popularization. Accordingly, in the first report[1] was examined the multiple linear regression of the amount of catch after the shift on both the distance of shift and the amount of catch before the shift. But it was hard to find any trend other than the rough one of yielding a good catch by the shooting after a good catch or after a long shift. One of the reasons why it is hard to find any clear results was that among the three factors used in the examination two (one as the independent variable and the other as the dependent one) were the amount of catch in spite of the fact that the amount of catch affected by many factors was unstable. The catch-shift-catch relation was sectioned into the relation between catch and shift and that between shift and catch, and the second report[2] revealed as the relation in the former step that the Danish seiner inclined to shift over a long distance after a poor catch but to stick to the similar position after a good catch. This result suggested that the amount of catch by the shooting just before the shift should be one of the most important motives of the shift. But there remained a doubt as to the shift waisting the workable hours bringing the seiner a good catch. To clarify this doubt, the present report dealt with the relation in the latter step.

Material and Method

The same materials as those of the preceding reports[1,2] of this series were used in

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the present report. They were the catch records on the 15 3-consecutive days chosen randomly from all the catch records on the 15 10-consecutive days in the entire season of 1964 by the 22 Danish seiners fished along the outer edge of the continental shelf of the Eastern Bering Sea. The records on each day (t) were stratified according to the amount of catch (x in tons) by the shooting just before the shift (hereafter, for convenience of representation, the groups of the records thus stratified were called the $x-t$ strata), for the amount of catch shows a seasonal change and the evaluation of the same amount of catch after the shift differs according to that before the shift. The distance of shift (y in miles) was transformed into the square root value, for the frequency distribution of $\sqrt{y}$ was agreeable to the normal series. And the quadratic and linear regressions of the amount of catch (x' in tons) by the shooting just after the shift on the distance of shift were estimated, and the changes of the estimated relations according to the season and the amount of catch by the shooting just before the shift were examined. For the purpose of using the common symbols throughout the present series, the expression of the independent variable in the present report resulted in $\sqrt{y}$ and the dependent one in x'.

Results

1. The quadratic and linear regression equations of the amount of catch (x' in tons) on the distance of shift (y in miles, after the square root transformation)

As shown in Table 1, the quadratic regression coefficient was significantly (at 0.05 level) positive in the eight $x-t$ strata out of the 249 ones, insignificantly positive in the 106 ones, but insignificantly negative in the 123 ones, and significantly negative in the 12 ones. When the records of the accidental shootings were excluded and those of the long shifts were added, the similar results were obtained: the quadratic regression coefficient was significantly positive in the seven $x-t$ strata out of the 230 ones, insignificantly positive in the 100 ones, but insignificantly negative in the 112 ones, and significantly negative in the 11 ones.

The similar results were obtained in the examination of the linear regression, as shown in Table 2: the linear regression coefficient was significantly positive in the 12 $x-t$ strata out of the 249 ones, insignificantly positive in the 139 ones, but insignificantly negative in the 92 ones, and significantly negative in the six ones. The exclusion of the records of the accidental shootings and the addition of those of the long shifts did not cause any notable difference in the results: the linear regression coefficient was significantly positive in the 19 $x-t$ strata out of the 230 ones, insignificantly positive in the 124 ones, but insignificantly negative in the 85 ones, and significantly negative in the two ones.

These results meant that either the quadratic regression or the linear one is meaningful only when the distribution of the $x-t$ strata taking the positive coefficient (or the

Table 1. The estimated quadratic regression equations of the amount of catch (x' in tons) by the shooting just after the shift on the distance of shift (y in miles, used after the square root transformation), after the twofold stratification of the records according to the amount of catch (x in tons) by the shooting just before the shift and the date (t).

		The records of the accidental shootings included but those of the long shifts excluded					The records of the accidental shootings excluded but those of the long shifts included				
Date (t)	Catch (x in tons)	$a_{2\cdot0}$	$a_{2\cdot1}$	$a_{2\cdot2}$	F_2	n	$a'_{2\cdot0}$	$a'_{2\cdot1}$	$a'_{2\cdot2}$	F'_2	n'
April 24	2	83.16	−65.20	13.37	5.49	4	83.16	−65.20	13.37	5.49	4
	3	5.43	2.57	−0.90	0.15	6	5.43	2.57	−0.90	0.15	6
	4	−31.33	43.20	−11.89	2.12	6	−31.33	43.20	−11.89	2.12	6
	5	1.29	5.62	−2.03	1.88	16	1.29	5.62	−2.03	1.88	16
	7	5.62	0.80	−0.13	0.004	11	5.62	0.80	−0.13	0.004	11
	8	5.43	0.76	−0.06	0.00005	5	5.43	0.76	−0.06	0.00005	5
April 25	3	−11.12	18.62	−4.76	0.28	6	−11.12	18.62	−4.76	0.28	6
	4	−11.19	25.56	−8.43	0.22	8	−11.19	25.56	−8.43	0.22	8
	5	−30.26	38.32	−9.29	13.14*	6	−30.26	38.32	−9.29	13.14*	6
	7	5.49	0.03	0.68	0.09	15	5.49	0.03	0.68	0.09	15
	8	−5.26	22.04	−8.87	1.27	7	−5.26	22.04	−8.87	1.27	7
	10	8.17	8.22	−4.69	0.40	10	8.17	8.22	−4.69	0.40	10
	12	43.60	−46.98	13.65	162.64*	4	43.60	−46.98	13.65	162.64*	4
	13	−53.10	68.67	−17.62	1.11	4	—	—	—	—	—
April 26	2	926.64	−1191.75	354.86	41.55	4	926.64	−1191.75	354.86	41.55	4
	3	−13.20	27.09	−9.51	1.29	4	—	—	—	—	—
	4	18.67	−20.15	7.26	0.05	10	−5.76	17.48	−6.29	0.03	8
	5	3.71	6.63	−3.01	0.71	13	3.71	6.63	−3.01	0.71	13
	6	−0.13	7.44	−1.90	0.17	10	−0.13	7.44	−1.90	0.17	10
	7	−0.50	9.77	−3.31	0.38	8	−0.50	9.77	−3.31	0.38	8
	8	−25.81	45.88	−15.10	7.66*	10	−25.81	45.88	−15.10	7.66*	10
May 3	7	17.24	−16.18	6.33	0.002	4	17.24	−16.18	6.33	0.002	4
May 4	3	24.10	−30.45	10.56	0.41	4	24.10	−30.45	10.56	0.41	4
	4	−16.89	41.34	18.33	0.94	5	9.71	−7.29	2.36	0.56	8
	5	39.18	−87.58	50.25	1.78	4	39.18	−87.58	50.25	1.78	4
	6	−69.40	120.75	−47.15	19.74*	5	−69.40	120.75	−47.15	19.74*	5
	7	−30.70	64.46	−28.40	1.14	7	−38.94	77.50	−32.86	10.76*	6
	8	24.98	−44.51	27.42	2.98	4	24.98	−44.51	27.42	2.98	4
May 5	4	1.58	3.43	−0.15	0.003	5	1.58	3.43	−0.15	0.003	5
	5	−30.49	102.44	−64.71	325.47*	4	−30.49	102.44	−64.71	325.48*	4
	6	36.70	−41.61	11.60	40.49	4	—	—	—	—	—
	7	8.48	−8.46	5.14	0.20	5	8.48	−8.46	5.14	0.20	5
	8	—	—	—	—	—	—	—	—	—	—
	9	26.68	−17.72	4.49	0.05	4	26.68	−17.72	4.49	0.05	4
	10	6.27	2.38	0.13	0.01	15	6.27	2.38	0.13	0.01	15
	11	4.84	23.95	14.53	1.04	4	4.84	23.95	14.53	1.04	4
	12	161.64	−199.24	63.07	7.31	4	161.64	−199.24	63.07	7.31	4

Table 1. — (Cont'd)

Date (t)	Catch (x in tons)	$a_{2.0}$	$a_{2.1}$	$a_{2.2}$	F_2	n	$a'_{2.0}$	$a'_{2.1}$	$a'_{2.2}$	F_2	n'
May 14	1	−5.58	7.89	−1.83	0.49	5	−5.88	9.59	−2.43	0.89	4
	2	1.08	2.07	−0.38	0.36	13	1.08	2.07	−0.38	0.36	13
	3	1.90	1.39	−0.16	0.02	34	0.76	3.15	−0.67	0.46	32
	4	3.12	−0.60	0.46	0.27	21	3.12	−0.60	0.46	0.27	21
	5	4.22	−0.25	0.44	0.05	17	4.22	−0.25	0.44	0.05	17
	6	12.51	−13.78	4.71	4.16	8	12.51	13.78	4.71	4.16	8
	7	9.40	−9.70	3.45	1.54	5	9.40	−9.70	3.45	1.54	5
	8	−2.44	14.18	−4.76	0.24	4	−2.44	14.18	−4.76	0.24	4
May 15	1	1.55	−0.72	0.40	0.40	14	1.55	−0.72	0.40	0.40	14
	2	4.03	−2.25	0.56	0.52	15	4.03	−2.25	0.56	0.52	15
	3	5.28	−5.22	2.03	5.10*	27	4.97	−4.30	1.65	4.41*	25
	4	−1.94	9.13	−3.69	0.76	7	−1.94	9.13	−3.69	0.76	7
May 16	2	−8.45	18.98	−8.56	57.52	4	—	—	—	—	—
	3	−3.72	11.86	−4.26	0.86	9	−3.72	11.86	−4.26	0.86	9
May 25	0	−4.27	8.51	−2.51	0.71	8	—	—	—	—	—
	1	−4.92	11.80	−4.80	0.63	6	−4.92	11.80	4.80	0.63	6
	2	1.96	0.87	−0.43	1.16	31	2.44	0.08	−0.15	0.12	30
	3	5.22	−4.03	1.04	1.48	21	4.26	−2.00	0.39	0.27	18
	4	−9.58	26.67	−13.64	1.61	9	−9.58	26.67	−13.64	1.61	9
May 26	0	5.31	−4.85	1.38	0.39	14	—	—	—	—	—
	1	2.02	−0.89	0.25	2.53	53	1.94	−0.63	0.19	1.55	48
	2	1.54	0.39	0.28	0.63	29	1.98	−0.91	0.62	1.38	25
	3	−2.53	8.40	−3.62	1.09	17	−1.52	7.84	−3.75	1.76	15
May 27	0	−3.83	8.80	−3.33	0.76	7	—	—	—	—	—
	1	2.11	−1.68	0.69	5.96*	52	1.83	−1.00	0.46	3.41	46
	2	1.40	0.13	−0.001	0.000007	41	1.34	0.39	−0.09	0.06	37
	3	4.29	−3.65	1.54	1.67	25	4.17	−3.02	1.18	1.43	23
May 31	0	−1.05	5.72	−2.55	2.07	11	−1.59	6.08	−2.58	0.66	4
	1	0.87	0.84	−0.23	0.10	31	1.96	−0.34	0.13	0.04	25
	2	2.44	−1.27	0.46	2.77	51	2.15	−0.72	0.30	1.39	48
	3	4.67	−4.96	2.18	1.74	15	4.67	−4.96	2.18	1.74	15
June 1	0	1.96	1.30	−0.70	0.004	6	—	—	—	—	—
	1	5.75	−3.64	0.83	0.01	6	46.04	−44.99	10.73	10.47	5
	2	2.51	1.91	−1.01	0.69	32	4.29	−1.14	0.21	0.03	30
	3	5.45	−3.18	0.81	1.02	24	5.19	−2.63	0.73	1.06	22
	4	4.22	−1.21	0.24	0.05	33	4.00	−0.87	0.20	0.04	32
	5	−15.13	33.40	13.03	0.21	7	−15.13	33.40	13.03	0.21	7
	6	6.86	−8.63	5.44	0.91	5	6.86	−8.63	5.44	0.91	5
June 2	0	2.82	1.22	−0.79	0.16	7	—	—	—	—	—
	1	0.54	2.08	−0.48	0.07	13	−0.42	2.84	−0.55	0.21	11
	2	2.58	−2.13	1.12	1.54	28	1.53	−0.01	0.34	0.17	25
	3	3.27	0.29	−0.43	0.14	50	3.27	0.29	−0.43	0.14	50
	4	2.85	2.01	−1.61	1.15	20	3.59	−0.35	0.12	0.01	18
	5	3.71	1.04	−1.13	0.04	8	5.48	−3.14	1.19	0.05	7

Table 1. — (Cont'd)

Date (t)	Catch (x in tons)	$a_{2\cdot0}$	$a_{2\cdot1}$	$a_{2\cdot2}$	F_2	n	$a'_{2\cdot0}$	$a'_{2\cdot1}$	$a'_{2\cdot2}$	F'_2	n'
June 17	1	1.84	0.22	−0.09	0.09	31	1.84	0.22	−0.09	0.09	31
	2	1.54	0.23	0.12	0.06	69	1.65	0.14	0.13	0.09	67
	3	1.49	2.37	−1.31	0.86	30	1.49	2.37	−1.31	0.86	30
June 18	1	1.46	0.24	−0.16	0.10	55	1.47	0.30	−0.16	0.38	54
	2	1.08	1.40	−0.44	0.47	30	1.31	0.92	−0.23	0.79	32
	3	2.42	−1.33	0.97	0.87	22	2.42	−1.33	0.97	0.87	22
June 19	1	1.47	0.96	−0.46	3.84	30	1.47	0.95	−0.46	3.59	29
	2	1.07	1.62	−0.76	0.88	42	0.77	2.10	−0.82	1.24	39
	3	3.63	−1.76	0.42	0.06	25	3.48	−1.06	0.002	0.000001	24
	4	−5.01	17.28	−9.16	168.16**	4	−5.01	17.28	−9.16	168.16*	4
June 29	1	−19.72	36.90	−13.54	2.33	5	−19.72	36.90	−13.54	2.33	5
	2	0.26	2.70	−0.46	0.16	18	0.26	2.70	−0.46	0.16	18
	3	−0.53	2.38	0.33	0.02	22	−0.53	2.38	0.33	0.02	22
	4	3.83	−0.58	−0.06	0.01	11	3.83	−0.58	−0.06	0.01	11
	5	7.75	−3.92	1.01	0.49	12	7.75	−3.92	1.01	0.49	12
	6	42.36	−56.85	19.70	20.23**	8	42.36	−56.85	19.70	20.23**	8
June 30	1	−0.26	1.79	−0.05	0.01	13	−0.26	1.79	−0.05	0.01	13
	2	2.55	0.13	−0.13	0.01	25	2.55	0.13	−0.13	0.01	25
	3	4.15	−0.72	0.08	0.01	28	4.15	−0.72	0.08	0.01	28
	4	2.08	2.46	−0.63	0.04	10	2.08	2.46	−0.63	0.04	10
	5	4.11	−3.51	1.77	0.10	6	4.11	−3.51	1.77	0.10	6
July 1	1	2.67	0.29	0.21	0.01	13	2.67	0.29	0.21	0.01	6
	2	3.18	−1.05	0.33	0.43	18	3.22	−1.15	0.37	0.50	17
	3	−2.40	7.53	−2.36	1.00	23	−2.40	7.53	−2.36	1.00	23
	4	38.57	−43.88	12.94	2.27	10	38.25	−42.13	12.10	2.15	9
	5	23.46	−46.81	27.87	0.04	5	23.46	−46.81	27.87	0.04	5
	6	−4.38	15.70	−6.36	1.04	7	−4.96	16.39	−6.56	0.82	6
	10	−31.53	68.50	29.87	0.79	7	−31.53	68.50	−29.87	0.79	7
July 2	1	7.46	−3.81	0.61	0.38	18	7.46	−3.81	0.61	0.38	18
	2	0.44	4.13	−1.33	0.42	19	0.44	4.13	−1.33	0.42	19
	3	0.39	3.40	−0.73	0.64	35	2.34	0.19	0.47	0.23	34
	4	5.61	−4.59	2.05	0.66	17	5.61	−4.59	2.05	0.66	17
	5	4.25	0.11	−0.36	0.64	5	4.25	0.11	−0.36	0.64	5
	6	−3.52	11.24	−3.56	1.05	8	−3.52	11.24	−3.56	1.05	8
	7	4.24	−3.45	2.29	0.35	4	4.24	−3.45	2.29	0.35	4
July 3	1	1.11	5.16	1.24	1.21	15	−1.11	5.16	1.24	1.21	15
	2	4.02	−2.96	1.55	2.02	12	4.02	−2.96	1.55	2.02	12
	3	0.68	2.01	−0.32	0.05	20	2.11	0.67	−0.02	0.0002	19
	4	3.46	0.73	−0.38	0.10	16	3.46	0.73	−0.38	0.10	16
	5	5.08	−5.27	3.08	2.64	14	11.82	−13.58	5.37	9.74*	12
	7	0.28	5.95	−1.42	2.19	5	0.28	5.95	−1.42	2.19	5
July 4	0	17.12	−17.36	5.64	0.46	4	—	—	—	—	—
	1	−1.71	1.18	1.15	0.06	10	−1.71	1.18	1.15	0.06	10
	2	2.70	−0.80	0.66	0.58	27	2.70	−0.80	0.66	0.58	27

Table 1. — (Cont'd)

Date (t)	Catch (x in tons)	$a_{2.0}$	$a_{2.1}$	$a_{2.2}$	F_2	n	$a'_{2.0}$	$a'_{2.1}$	$a'_{2.2}$	F'_2	n'
July 4	3	−0.38	4.55	−1.46	1.74	25	−0.38	4.55	−1.46	1.74	25
	4	6.42	−7.57	2.86	26.56**	16	6.86	−7.85	2.90	39.38**	15
	5	0.66	5.98	−2.49	0.13	4	0.66	5.98	−2.49	0.13	4
	7	36.37	−58.77	23.52	42.68	4	—	—	—	—	—
July 10	1	3.18	−1.91	0.46	0.18	9	2.45	0.22	−0.16	0.03	9
	2	0.43	3.51	−1.31	0.71	9	1.93	0.31	−0.03	0.02	17
	3	3.22	−0.39	0.13	0.01	25	2.94	−0.34	0.15	0.15	33
	4	−0.51	5.52	−1.52	0.09	12	1.67	2.22	−0.48	0.01	14
	5	—	—	—	—	—	11.09	−15.56	5.64	4.78	6
July 11	0	9.55	−9.15	4.09	1.54	4	—	—	—	—	—
	3	−0.04	4.36	−0.81	0.69	10	−0.04	4.36	−0.81	0.69	10
	4	0.80	3.92	−0.76	0.71	23	0:05	5.04	−0.94	1.87	21
	5	−5.81	15.58	−5.47	10.11**	16	−2.77	11.59	−4.15	6.02	14
	6	1.19	8.15	−2.99	0.66	10	1.19	8.15	−2.99	0.66	10
	7	3.70	7.70	−4.18	1.42	12	3.70	7.70	−4.18	1.42	12
	8	−6.25	18.63	−6.14	1.74	10	−6.25	18.63	−6.14	1.74	10
	9	−11.14	23.74	−7.66	0.34	4	−11.14	23.74	−7.66	0.34	4
July 12	3	−17.76	38.62	−16.01	18.74*	6	1.11	2.87	−0.21	0.02	6
	4	0.04	4.91	−1.25	1.53	12	0.04	4.91	−1.25	1.53	12
	5	−2.21	12.69	−5.41	1.69	16	−2.21	12.69	−5.41	1.69	16
	7	9.05	−10.82	6.54	1.75	6	9.05	−10.82	6.54	1.75	6
	8	−4.63	16.61	−6.51	0.17	5	−4.63	16.61	−6.51	0.17	5
	10	−1.69	24.27	−15.94	1.24	7	−1.69	24.27	−15.94	1.24	7
July 28	0	5.28	−2.84	0.85	0.01	5	—	—	—	—	—
	1	−46.91	62.97	−18.51	8.78	4	−46.91	62.97	−18.51	8.78	4
	2	8.79	−8.28	2.83	5.91*	17	8.79	−8.28	2.83	5.91*	17
	3	−4.09	10.23	−3.21	2.43	14	−3.57	10.48	−3.39	2.09	12
	4	10.61	−12.55	5.32	1.20	15	13.17	−15.26	6.00	2.05	14
	5	−4.48	11.71	−3.82	0.53	8	−4.48	11.71	−3.82	0.53	8
	7	−8.58	33.03	−17.98	1.92	4	−8.58	33.03	−17.98	1.92	4
July 29	1	−56.28	82.00	−25.60	2.31	4	—	—	—	—	—
	3	−18.49	23.38	−5.59	0.67	4	−18.49	23.38	−5.59	0.67	4
	4	16.17	−8.98	2.00	0.99	12	16.64	−9.48	2.10	1.20	13
	5	3.88	2.18	0.49	0.28	10	3.65	2.52	−0.54	0.36	13
	6	10.61	−9.08	3.90	1.15	14	10.61	−9.08	3.90	1.15	14
	7	11.23	−9.94	4.35	1.44	15	7.42	−1.77	0.84	0.40	15
	8	−0.69	11.27	−3.94	0.11	10	−7.66	22.77	−7.79	0.47	9
	9	−15.92	47.62	−20.19	33.29	4	−15.92	47.62	−20.19	33.29	4
	10	−5.37	20.75	−7.52	3.80	12	3.33	4.80	−1.11	1.16	14
	12	9.75	−6.97	5.56	2.01	5	9.75	−6.97	5.56	2.01	5
July 30	2	37.02	−58.58	26.87	8.96	4	37.02	−58.58	26.87	8.96	4
	3	11.95	−10.11	3.49	0.85	8	11.95	−10.11	3.49	0.85	8
	4	−5.96	16.99	−5.66	9.66**	16	−3.81	14.70	−5.08	15.14**	15
	5	3.31	2.68	−0.67	0.67	22	3.15	2.96	−0.79	1.15	23
	6	0.18	8.06	−1.65	0.12	16	0.18	8.06	−1.65	0.12	16

Table 1. —(Cont'd)

Date (t)	Catch (x in tons)	$a_{2.0}$	$a_{2.1}$	$a_{2.2}$	F_2	n	$a'_{2.0}$	$a'_{2.1}$	$a'_{2.2}$	F'_2	n'
July 30	7	3.53	2.76	−1.15	0.17	12	3.53	2.76	−1.15	0.17	12
	8	−0.82	10.10	−3.08	0.71	10	−0.82	10.10	−3.08	0.71	10
Aug. 8	3	23.92	−10.74	1.36	0.07	6	23.92	−10.74	1.36	0.07	6
	4	5.64	−1.40	0.84	1.60	14	5.64	−1.40	0.84	1.60	14
	5	4.96	−0.13	−0.03	0.002	16	4.96	−0.13	−0.03	0.002	16
	6	−7.08	21.06	−7.67	1.65	9	−7.08	21.06	−7.67	1.65	9
	7	7.06	−3.83	1.75	0.47	17	6.99	−2.53	1.02	0.21	16
	10	7.08	−0.48	0.003	0.000002	9	7.08	−0.48	0.003	0.000002	9
Aug. 9	0	4.26	−1.60	0.84	0.12	5	—	—	—	—	—
	1	5.25	1.58	−1.45	0.06	5	—	—	—	—	—
	2	−107.83	155.25	−53.89	1.70	6	−107.83	155.25	−53.89	1.70	6
	3	2.57	1.29	−0.32	0.18	20	3.43	−0.63	0.56	0.71	19
	4	−1.33	6.16	1.48	3.00	19	−2.34	7.67	−1.84	5.80*	18
	5	2.64	2.85	−0.86	0.69	27	3.39	2.25	−0.74	0.60	26
	6	3.11	1.94	−0.52	0.09	14	3.11	1.94	−0.52	0.09	14
	7	5.16	3.00	−2.59	0.06	5	5.16	3.00	−2.59	0.06	5
Aug. 10	2	1.38	2.23	−0.60	0.16	9	0.31	2.93	−0.50	0.54	15
	3	−0.02	4.59	−0.96	0.26	11	−1.22	6.35	−1.55	7.45*	15
	4	7.75	−4.99	1.70	0.86	13	1.61	3.54	−0.96	1.14	15
	5	1.22	5.49	−2.15	1.00	22	2.42	3.29	−1.25	1.93	24
	6	282.15	−432.85	163.58	1.02	5	20.64	−25.34	10.62	0.002	4
Aug. 15	1	4.95	−2.15	0.49	0.70	17	4.95	−2.15	0.49	0.70	17
	2	2.52	0.06	−0.06	0.05	27	1.77	0.90	−0.22	0.73	26
	3	1.74	1.74	−0.67	0.82	27	1.74	1.74	−0.67	0.82	27
	4	2.90	−1.53	1.19	0.53	12	2.90	−1.53	1.19	0.53	12
	6	488.65	−803.30	330.98	0.08	4	488.65	−803.30	330.98	0.08	4
Aug. 16	1	−3.32	7.37	−2.18	0.91	16	−3.32	7.37	−2.18	0.91	16
	2	0.65	2.12	−0.60	0.62	40	0.31	2.34	−0.53	0.47	35
	3	1.72	1.45	−0.43	0.56	47	1.70	1.44	−0.38	0.43	45
	4	2.87	−1.01	0.75	0.17	19	2.87	−1.01	0.75	0.17	19
Aug. 17	0	20.66	−29.38	11.90	2.26	5	—	—	—	—	—
	1	−1.93	10.34	−5.35	177.92*	4	—	—	—	—	—
	2	4.67	−3.84	1.46	4.72*	19	4.26	−3.01	1.23	3.52	17
	3	2.85	0.18	0.05	0.002	25	2.60	0.92	−0.25	0.07	24
	4	5.85	−3.90	1.47	1.16	22	5.75	−3.34	1.21	0.91	21
	5	−0.62	4.20	−0.17	0.0003	8	16.77	−24.40	10.71	2.72	7
Aug. 23	1	2.07	0.55	0.08	0.01	14	1.07	2.33	−0.60	0.59	15
	2	2.96	−1.09	0.33	0.28	23	2.63	−0.53	0.18	0.56	24
	3	−1.71	7.22	−2.51	6.73*	40	1.02	2.20	−0.48	0.97	40
	4	3.16	−0.51	0.31	0.10	20	2.55	0.67	−0.13	0.08	21
	5	—	—	—	—	—	2.26	0.34	0.01	0.0001	5
Aug. 24	0	−3.47	13.08	−5.24	1.36	7	—	—	—	—	—
	1	4.62	−0.48	−0.43	0.30	6	4.62	−0.48	−0.43	0.30	6
	2	0.69	3.67	−1.13	1.42	22	2.38	1.69	−0.59	0.44	21

Table 1. — (Cont'd)

Dats (t)	Catch (x in tons)	$a_{2\cdot0}$	$a_{2\cdot1}$	$a_{2\cdot2}$	F_2	n	$a'_{2\cdot0}$	$a'_{2\cdot1}$	$a'_{2\cdot2}$	F'_2	n'
Aug. 24	3	1.45	4.59	−2.04	2.94	37	0.52	6.28	−2.57	6.87*	35
	4	4.73	−1.99	0.84	0.43	36	5.40	−2.85	1.20	1.12	34
	5	6.17	−6.50	3.43	0.35	8	6.17	−6.50	3.43	0.35	8
	7	17.38	−35.93	20.80	44.95	4	17.38	−35.93	20.80	44.95	4
Aug. 25	1	15.22	−16.68	5.24	0.93	12	−0.76	3.33	−0.82	0.08	11
	2	3.27	−1.29	0.71	0.25	17	2.81	−0.52	0.38	0.53	23
	3	4.93	−3.53	1.45	0.68	25	2.86	0.16	−0.07	0.02	27
	4	2.79	0.73	−0.08	0.001	25	3.71	0.31	−0.14	0.10	23
	5	−2.17	11.66	−5.14	0.26	12	−0.07	17.10	−7.22	0.73	11
Sept. 2	1	9.20	−8.98	2.90	3.24	6	9.20	−8.98	2.90	3.24	6
	2	2.11	−0.23	0.15	0.12	22	2.12	0.44	0.33	0.80	21
	3	3.73	−1.32	0.41	0.05	11	3.73	−1.32	0.41	0.05	11
	4	22.72	−31.62	12.07	7.47	6	22.72	−31.62	12.07	7.47	6
Sept. 3	0	247.51	−298.12	90.00	1.08	5	—	—	—	—	—
	1	−2.27	7.24	−2.79	2.08	13	0.74	1.67	−0.32	0.12	12
	2	2.61	−1.27	0.63	1.00	26	2.58	−0.93	0.46	0.59	25
	3	3.40	−1.56	0.80	1.71	50	3.36	−1.44	0.79	2.12	48
	4	0.76	4.16	−1.63	1.23	18	0.76	4.16	−1.63	1.23	18
Sept. 18	3	9.50	−7.40	1.80	0.06	5	19.82	−30.10	12.24	3.61	4
	4	7.84	−4.10	1.31	0.80	15	7.84	−4.10	1.31	0.80	15
	5	11.42	−8.71	2.91	0.40	14	11.42	−8.71	2.91	0.40	14
	6	1.42	5.29	−1.66	0.07	11	1.42	5.29	−1.66	0.07	11
	7	22.31	−27.46	8.21	1.48	5	18.94	−18.04	5.50	1.46	5
	8	34.06	−60.07	29.54	13.56*	6	34.06	−60.07	29.54	13.56*	6
Sept. 19	0	9.08	−2.36	−0.49	0.02	5	—	—	—	—	—
	2	—	—	—	—	—	−1.00	6.30	−1.25	1.15	4
	3	1.52	5.03	−1.50	0.43	9	1.02	5.97	−1.90	0.97	10
	4	2.56	2.11	−0.41	0.06	22	3.03	2.40	−0.66	0.21	20
	5	10.78	−13.20	7.06	1.08	19	9.33	−9.52	5.22	0.58	18
	6	−14.84	30.91	−10.43	15.99**	13	−13.48	29.23	−9.95	9.03*	11
	7	−9.74	42.54	−22.17	3.22	6	−9.74	42.54	−22.17	3.22	6
	10	7.04	−4.08	2.40	8.82	5	7.04	−4.08	2.40	8.82	5
Sept. 20	0	−1.01	9.53	−3.00	6.67*	10	—	—	—	—	—
	3	3.19	1.88	−0.38	0.04	8	3.19	1.88	−0.38	0.04	8
	4	2.23	1.63	−0.48	0.06	22	3.24	0.46	0.19	0.01	18
	5	2.46	3.22	−1.42	0.14	22	4.45	0.06	0.31	0.07	19
	6	5.25	−0.59	−0.23	0.02	17	5.25	−0.59	−0.23	0.02	17
	7	−1.32	13.15	−6.44	1.64	10	15.22	−27.13	18.78	0.17	6
	8	8.49	−3.74	0.04	0.000002	5	8.49	−3.74	0.04	0.000002	5

Note: $x'=a_{2\cdot0}+a_{2\cdot1}\sqrt{y}+a_{2\cdot2}(\sqrt{y})^2$ or $x'=a'_{2\cdot0}+a'_{2\cdot1}\sqrt{y}+a'^{2}_{2\cdot2}(\sqrt{y})^2$

F_2……The estimated Snedecor's F for $a_{2\cdot2}$ or for $a'_{2\cdot2}$ with 1 and $(n-3)$ degrees of freedom

* significant at 0.05 level **significant at 0.01 level

Table 2. The estimated linear regression equations of the amount of catch (x' in tons) by the shooting just after the shift on the distance of shift (y in miles, used after the square root transformation).

$x' = a_{1\cdot0} + a_{1\cdot1}\sqrt{y}$ or $x' = a'_{1\cdot0} + a'_{1\cdot1}\sqrt{y}$

The records of the accidental shootings included but those of the long shifts excluded. / The records of the accidental shootings excluded but those of the long shifts included.

Date (t)	Catch (x in tons)	$a_{1\cdot0}$	$a_{1\cdot1}$	F_0	n	$a'_{1\cdot0}$	$a'_{1\cdot1}$	F'_0	n'
April 24	2	−4.82	4.64	7.35	4	−4.82	4.64	7.35	4
	3	8.09	−0.84	0.26	6	8.09	−0.84	0.26	6
	4	9.09	−1.77	0.59	6	9.09	−1.77	0.59	6
	5	5.53	−0.61	0.71	16	5.53	−0.61	0.71	16
	7	5.88	0.37	0.13	11	5.88	0.37	0.13	11
	8	5.58	0.56	0.17	5	5.58	0.56	0.17	5
April 25	3	3.64	1.61	0.32	6	3.64	1.61	0.32	6
	4	8.72	−1.46	0.13	8	8.72	−1.46	0.13	8
	5	4.03	1.58	0.51	6	4.03	1.58	0.51	6
	7	4.05	2.16	1.74	15	4.05	2.16	1.74	15
	8	4.74	2.25	0.52	7	4.74	2.25	0.52	7
	10	16.67	−5.12	3.68	10	16.67	−5.12	3.68	10
	12	12.69	−2.20	0.49	4	12.69	−2.20	0.49	4
	13	−4.34	6.30	2.88	4	—	—	—	—
April 26	2	11.61	−4.07	0.53	4	11.61	−4.07	0.53	4
	3	3.58	1.24	0.24	4	—	—	—	—
	4	3.81	0.88	0.03	10	7.08	−0.73	0.02	8
	5	6.00	0.29	0.02	13	6.00	0.29	0.02	13
	6	3.98	1.59	0.46	10	3.98	1.59	0.46	10
	7	3.38	2.35	1.72	8	3.38	2.35	1.72	8
	8	7.98	−1.31	0.52	10	7.98	−1.31	0.52	10
May 3	7	6.39	0.94	0.03	4	6.39	0.94	0.03	4
May 4	3	−3.08	4.65	1.72	4	−3.08	4.65	1.72	4
	4	7.91	−2.76	0.30	5	3.30	1.01	0.38	8
	5	4.39	−1.93	0.10	4	4.39	−1.93	0.10	4
	6	13.08	−5.38	0.82	5	13.08	−5.38	0.82	5
	7	6.93	−2.31	0.37	7	4.73	0.09	0.001	6
	8	1.75	6.64	6.87	4	1.75	6.64	6.87	4
May 5	4	2.21	2.77	2.55	5	2.21	2.77	2.55	5
	5	18.09	−12.05	8.32	4	18.09	−12.05	8.32	4
	6	4.29	1.07	0.07	4	—	—	—	—
	7	−4.78	8.46	5.43	5	−4.78	8.46	5.43	5
	9	13.59	−1.27	0.05	4	13.59	−1.27	0.05	4
	10	5.86	2.91	6.87*	15	5.86	2.91	6.87*	15
	11	14.49	−3.19	0.33	4	14.49	−3.19	0.33	4
	12	29.61	−13.21	3.82	4	29.61	−13.21	3.82	4

Table 2 . — (Cont'd)

Date (t)	Catch (x in tons)	$a_{1\cdot 0}$	$a_{1\cdot 1}$	F_0	n	$a'_{1\cdot 0}$	$a'_{1\cdot 1}$	F'_0	n'
May 14	1	0.41	0.87	0.35	5	1.76	0.38	0.06	4
	2	2.16	0.66	2.02	13	2.16	0.66	2.02	13
	3	2.40	0.79	1.54	34	2.79	0.69	1.39	32
	4	2.06	0.91	3.28	21	2.06	0.91	3.28	21
	5	3.49	0.98	0.96	17	3.49	0.98	0.96	17
	6	6.18	−2.00	3.70	8	6.18	−2.00	3.70	8
	7	6.37	−2.45	3.75	5	6.37	−2.45	3.75	5
	8	0.86	5.43	10.39	4	0.86	5.43	10.39	4
May 15	1	0.38	0.72	4.53	14	0.38	0.72	4.53	14
	2	2.65	−0.38	0.66	15	2.65	−0.38	0.66	15
	3	1.38	0.64	1.35	27	1.85	0.43	0.83	25
	4	1.67	1.05	1.05	7	1.67	1.05	1.05	7
May 16	2	5.15	−3.06	26.80*	4	—	—	—	—
	3	1.27	1.88	1.37	9	1.27	1.88	1.37	9
May 25	0	2.85	−0.21	0.05	8	—	—	—	—
	1	3.97	−1.61	1.15	6	3.97	−1.61	1.15	6
	2	2.97	−0.55	5.65*	31	2.76	−0.38	2.80	30
	3	2.98	−0.68	1.56	21	3.43	−0.75	2.96	18
	4	1.83	0.94	0.18	9	1.83	0.94	0.18	9
May 26	0	2.06	−0.46	0.39	14	—	—	—	—
	1	1.38	0.01	0.003	53	1.47	0.04	0.05	48
	2	1.98	−0.38	1.36	29	1.42	0.37	1.16	25
	3	1.36	0.61	0.36	17	2.52	−0.23	0.07	15
May 27	0	2.66	−0.81	0.93	7	—	—	—	—
	1	0.80	0.37	3.78	52	0.96	0.38	5.33*	46
	2	1.41	0.13	0.17	41	1.49	0.13	0.17	37
	3	2.59	−0.26	0.27	25	2.87	−0.41	1.02	23
May 31	0	3.10	−1.18	3.81	11	1.99	−0.44	0.33	4
	1	1.33	0.15	0.16	31	1.69	0.05	0.02	25
	2	1.39	0.25	1.11	51	1.48	0.26	1.59	48
	3	0.84	1.14	2.44	15	0.84	1.14	2.44	15
June 1	0	3.09	−0.54	0.06	6	—	—	—	—
	1	2.67	−0.30	0.03	6	4.70	−1.21	0.61	5
	2	4.56	−1.11	4.96*	32	3.89	−5.54	1.24	30
	3	4.12	−0.86	2.81	24	4.03	−0.57	1.44	22
	4	3.93	−0.63	1.54	33	3.76	−0.38	0.63	32
	5	6.09	−0.70	0.01	7	6.09	−0.70	0.01	7
	6	1.22	3.14	10.19*	5	1.22	3.14	10.19*	5
June 2	0	4.42	1.21	2.65	7	—	—	—	—
	1	1.36	0.70	1.17	13	0.48	1.29	8.22*	11
	2	0.72	0.94	3.93	28	0.98	0.92	5.14*	25
	3	3.74	−0.66	1.95	50	3.74	−0.66	1.95	50
	4	3.58	−0.55	0.69	20	3.54	−0.18	0.12	18
	5	5.24	−1.81	1.45	8	3.94	−0.23	0.02	7

Table 2 . — (Cont'd)

Date (t)	Catch (x in tons)	$a_{1\cdot0}$	$a_{1\cdot1}$	F_0	n	$a'_{1\cdot0}$	$a'_{1\cdot1}$	F'_0	n'
June 17	1	2.04	−0.07	0.11	31	2.04	−0.07	0.11	31
	2	1.34	0.55	5.05*	69	1.42	0.50	4.41*	67
	3	2.26	0.23	0.27	30	2.26	0.23	0.27	30
June 18	1	1.66	−0.14	0.23	55	1.76	−0.18	0.59	54
	2	1.61	0.35	0.83	30	1.80	0.16	0.41	32
	3	1.65	0.60	1.11	22	1.65	0.60	1.11	22
June 19	1	2.16	−0.31	3.13	30	2.15	−0.31	2.94	29
	2	1.93	−0.09	0.06	42	1.68	0.26	0.52	39
	3	3.43	−1.12	2.49	25	3.47	−1.06	2.65	24
	4	2.46	−0.69	0.09	4	2.46	−0.69	0.09	4
June 29	1	0.96	1.43	0.25	5	0.96	1.43	0.25	5
	2	0.90	1.55	4.53*	18	0.90	1.55	4.53*	18
	3	−1.33	3.44	11.58**	22	−1.33	3.44	11.58**	22
	4	3.94	−0.75	2.17	11	3.94	−0.75	2.17	11
	5	5.39	−0.67	0.84	12	5.39	−0.67	0.84	12
	6	9.44	−3.81	2.21	8	9.44	−3.81	2.21	8
June 30	1	−0.01	1.55	9.20*	13	−0.01	1.55	9.20*	13
	2	2.83	−0.28	0.28	25	2.83	−0.28	0.28	25
	3	3.85	−0.38	0.30	28	3.85	−0.38	0.30	28
	4	4.05	0.09	0.001	10	4.05	0.09	0.001	10
	5	2.69	−0.03	0.0004	6	2.69	−0.03	0.0004	6
July 1	1	2.11	1.01	0.74	13	2.11	1.01	0.74	13
	2	2.25	0.18	0.23	18	2.20	0.19	0.25	17
	3	2.91	0.16	0.02	23	2.91	0.16	0.02	23
	4	9.85	−4.65	1.40	10	11.55	−5.53	2.08	9
	5	1.14	3.37	0.16	5	1.14	3.37	0.16	5
	6	2.33	0.97	0.19	7	2.25	1.02	0.14	6
	10	−2.72	7.97	0.88	7	−2.72	7.97	0.88	7
July 2	1	5.58	−1.52	2.92	18	5.58	−1.52	2.92	18
	2	3.12	0.20	0.03	19	3.12	0.20	0.03	19
	3	2.41	0.85	1.34	35	1.18	1.73	5.31*	34
	4	2.99	0.25	0.08	17	2.99	0.25	0.08	17
	5	4.60	−0.90	7.65	5	4.60	−0.90	7.65	5
	6	4.93	−0.79	0.33	8	4.93	−0.79	0.33	8
	7	1.40	1.79	9.78	4	1.40	1.79	9.78	4
July 3	1	3.02	0.36	0.17	15	3.02	0.36	0.17	15
	2	1.30	1.61	3.56	12	1.30	1.61	3.56	12
	3	1.57	0.89	1.35	20	2.16	0.61	0.65	19
	4	4.43	−0.60	0.75	16	4.43	−0.60	0.75	16
	5	−1.22	4.02	12.62**	14	−0.20	3.30	5.95*	12
	7	3.63	0.86	0.53	5	3.63	0.86	0.53	5
July 4	0	3.41	1.32	0.29	4	—	—	—	—
	1	−4.70	4.97	9.22*	10	−4.70	4.97	9.22*	10
	2	1.43	1.18	5.19*	27	1.43	1.18	5.19*	27

Table 2. —(Cont'd)

Date (t)	Catch (x in tons)	$a_{1\cdot0}$	$a_{1\cdot1}$	F_0	n	$a'_{1\cdot0}$	$a'_{1\cdot1}$	F'_0	n'
July 4	3	2.64	0.06	0.0005	25	2.64	0.06	0.0005	25
	4	0.56	1.58	6.26*	16	0.89	1.43	5.11*	15
	5	3.76	−0.25	0.02	4	3.76	−0.25	0.02	4
	7	4.31	−1.15	0.07	4	—	—	—	—
July 10	1	2.29	−0.48	0.43	9	2.78	−0.31	0.29	9
	2	1.92	0.38	0.37	9	2.04	0.19	0.75	17
	3	3.04	−0.06	0.01	25	2.58	0.16	0.22	33
	4	2.23	1.29	0.52	12	2.52	0.91	0.29	14
	5	—	—	—	—	2.53	−0.33	0.07	6
July 11	0	2.99	1.78	1.62	4	—	—	—	—
	3	2.83	1.06	2.82	10	2.83	1.06	2.82	10
	4	3.23	0.92	2.02	23	3.04	1.32	6.21*	21
	5	2.16	1.62	2.24	16	3.20	1.16	1.22	14
	6	6.32	−0.10	0.004	10	6.32	−0.10	0.004	10
	7	9.22	−2.20	2.37	12	9.22	−2.20	2.37	12
	8	6.10	0.69	0.19	10	6.10	0.69	0.19	10
	9	−1.98	6.58	8.14	4	−1.98	6.58	8.14	4
July 12	3	1.65	2.21	2.08	6	1.57	2.19	9.14*	6
	4	2.77	1.00	2.46	12	2.77	1.00	2.46	12
	5	4.05	0.32	0.05	16	4.05	0.32	0.05	16
	7	2.68	2.77	4.16	6	2.68	2.77	4.16	6
	8	1.44	3.81	2.28	5	1.44	3.81	2.28	5
	10	13.35	−7.75	7.47*	7	13.35	−7.75	7.47*	7
July 28	0	3.82	−0.47	0.04	5	—	—	—	—
	1	−0.90	3.12	1.08	4	−0.90	3.12	1.08	4
	2	1.23	1.43	3.44	17	1.23	1.43	3.44	17
	3	2.53	0.46	0.13	14	4.50	−0.49	0.15	12
	4	1.01	2.05	1.41	15	2.29	1.25	0.63	14
	5	1.86	1.52	0.98	8	1.86	1.52	0.98	8
	7	9.40	−4.35	1.01	4	9.40	−4.35	1.01	4
July 29	1	2.96	1.06	0.03	4	—	—	—	—
	3	6.33	−0.89	0.20	4	6.33	−0.89	0.20	4
	4	9.64	−1.41	1.25	12	9.83	−1.57	1.76	13
	5	5.02	0.56	0.59	10	5.17	0.55	0.54	13
	6	4.46	1.52	0.81	14	4.46	1.52	0.81	14
	7	5.56	0.60	0.08	15	5.57	1.04	0.97	15
	8	5.62	0.63	0.04	10	4.90	1.64	0.29	9
	9	4.09	3.76	1.08	4	4.09	3.76	1.08	4
	10	4.59	2.38	1.62	12	6.31	0.67	0.52	14
	12	8.78	0.27	0.02	5	8.78	0.27	0.02	5
July 30	2	4.39	2.96	0.62	4	4.39	2.96	0.62	4
	3	4.18	0.91	0.23	8	4.18	0.91	0.23	8
	4	3.16	1.71	2.24	16	4.52	0.91	0.89	15
	5	4.81	0.51	0.85	22	5.03	0.32	0.43	23
	6	1.69	4.70	7.10*	16	1.69	4.70	7.10*	16

Table 2 . —(Cont'd)

Date (t)	Catch (x in tons)	$a_{1\cdot0}$	$a_{1\cdot1}$	F_0	n	$a'_{1\cdot0}$	$a'_{1\cdot1}$	F'_0	n'
July 30	7	5.01	−0.01	0.0001	12	5.01	−0.01	0.0001	12
	8	2.42	3.40	3.01	10	2.42	3.40	3.01	10
Aug. 8	3	16.76	−4.39	5.64	6	16.76	−4.39	5.64	6
	4	4.34	1.05	2.95	14	4.34	1.05	2.95	14
	5	5.02	−0.21	0.15	16	5.02	−0.21	0.15	16
	6	2.18	3.49	3.13	9	2.18	3.49	3.13	9
	7	5.00	0.25	0.03	17	5.80	−0.15	0.01	16
	10	7.09	−0.50	0.37	9	7.09	−0.50	0.37	9
Aug. 9	0	3.24	0.45	0.32	5	—	—	—	—
	1	9.34	3.44	3.21	5	—	—	—	—
	2	10.32	−4.72	1.44	6	10.32	−4.72	1.44	6
	3	3.26	0.26	0.18	20	2.32	1.08	3.70	19
	4	2.88	0.70	0.66	19	2.89	0.84	1.05	18
	5	4.92	−0.21	0.09	27	5.38	−0.41	0.39	26
	6	3.66	0.77	0.76	14	3.66	0.77	0.76	14
	7	8.03	−2.73	1.34	5	8.03	−2.73	1.34	5
Aug. 10	2	3.01	0.19	0.06	9	2.61	0.67	1.40	15
	3	2.01	1.65	2.99	11	4.14	0.07	0.02	15
	4	3.51	0.71	0.59	13	4.76	−0.28	0.23	15
	5	4.15	0.21	0.05	22	5.05	−0.60	0.84	24
	6	9.86	−4.00	0.32	5	2.73	2.72	0.21	4
Aug. 15	1	3.01	−0.07	0.02	17	3.01	−0.07	0.02	17
	2	2.78	−0.22	0.44	27	2.70	−0.11	0.13	26
	3	3.01	−0.25	0.20	27	3.01	−0.25	0.20	27
	4	1.41	1.48	3.66	12	1.41	1.48	3.66	12
	6	−93.88	75.50	7.19	4	−93.88	75.50	7.19	4
Aug. 16	1	2.70	−0.04	0.002	16	2.70	−0.04	0.002	16
	2	2.08	0.15	0.16	40	1.54	0.63	3.10	35
	3	2.40	0.33	1.13	47	2.28	0.45	2.07	45
	4	1.97	0.73	1.10	19	1.97	0.73	1.10	19
Aug. 17	0	0.71	3.36	1.42	5	—	—	—	—
	1	4.90	−2.02	17.53	4	—	—	—	—
	2	0.14	1.64	5.90*	19	0.51	1.59	6.18*	17
	3	2.76	0.32	0.28	25	3.05	0.20	0.14	24
	4	3.55	0.03	0.001	22	3.86	−0.08	0.01	21
	5	−0.39	3.79	3.48	8	1.18	2.61	2.65	7
Aug. 23	1	1.91	0.80	1.98	14	2.40	0.39	0.58	15
	2	2.41	−0.18	0.25	23	2.13	0.14	0.40	24
	3	2.39	0.33	0.40	40	2.05	0.66	2.42	40
	4	2.68	0.36	0.60	20	2.83	0.23	0.36	21
	5	—	—	—	—	2.22	0.38	0.87	5
Aug. 24	0	5.70	−1.54	0.63	7	—	—	—	—
	1	5.25	−1.64	49.09**	6	5.25	−1.64	49.09**	6
	2	2.88	0.29	0.25	22	3.57	−0.10	0.04	21

Table 2. —(Cont'd)

Date (t)	Catch (x in tons)	$a_{1\cdot0}$	$a_{1\cdot1}$	F_0	n	$a'_{1\cdot0}$	$a'_{1\cdot1}$	F'_0	n'
Aug. 24	3	4.11	−0.39	0.40	37	3.89	−0.02	0.002	35
	4	3.96	−2.29	0.10	36	4.28	−0.39	0.22	34
	5	2.73	0.60	0.31	8	2.73	0.60	0.31	8
	7	1.98	2.26	1.07	4	1.98	2.26	1.07	4
Aug. 25	1	2.45	0.03	0.0004	12	1.50	0.52	0.28	11
	2	1.91	0.77	1.29	17	1.61	0.91	5.74*	23
	3	2.77	0.17	0.06	25	3.06	−0.10	0.09	27
	4	2.87	0.57	0.30	25	4.11	−0.24	0.24	23
	5	3.36	0.57	0.06	12	2.73	1.46	0.50	11
Sept. 2	1	0.29	1.47	4.93	6	0.29	1.47	4.93	6
	2	1.96	0.13	0.16	22	1.78	0.35	1.41	21
	3	3.24	−0.38	0.26	11	3.24	−0.38	0.26	11
	4	−0.37	2.55	4.62	6	−0.37	2.55	4.62	6
Sept. 3	0	−3.06	3.13	0.38	5	—	—	—	—
	1	2.70	−0.63	0.33	13	1.62	0.49	0.69	12
	2	1.86	0.25	0.34	26	2.04	0.18	0.19	25
	3	2.50	0.25	0.49	50	2.47	0.36	1.18	48
	4	3.12	−0.01	0.0001	18	3.12	−0.01	0.0001	18
Sept. 18	3	7.11	−2.84	1.62	5	5.91	−1.56	0.27	4
	4	4.57	0.54	0.48	15	4.57	0.54	0.48	15
	5	6.94	−1.21	0.45	14	6.94	−1.21	0.45	14
	6	3.76	1.17	0.25	11	3.76	1.17	0.25	11
	7	4.60	1.13	0.12	5	7.23	0.50	0.04	5
	8	−0.51	5.78	2.27	6	−0.51	5.78	2.27	6
Sept. 19	0	9.44	−3.29	15.54*	5	—	—	—	—
	2	—	—	—	—	3.56	0.82	1.56	4
	3	4.22	0.66	0.35	9	4.68	0.22	0.05	10
	4	3.17	1.04	0.64	22	4.02	0.65	0.31	20
	5	4.79	0.55	0.06	19	4.92	0.67	0.09	18
	6	1.14	3.18	2.15	13	4.29	1.18	0.23	11
	7	8.66	−0.18	0.001	6	8.66	−0.18	0.001	6
	10	6.18	−0.20	0.04	5	6.18	−0.20	0.04	5
Sept. 20	0	5.38	−0.11	0.01	10	—	—	—	—
	3	3.75	0.90	0.88	8	3.75	0.90	0.88	8
	4	3.04	0.32	0.09	22	2.95	0.96	1.18	18
	5	4.16	−0.06	0.001	22	3.83	1.00	1.16	19
	6	5.54	−1.13	2.21	17	5.54	−1.13	2.21	17
	7	6.48	−2.82	1.61	10	5.37	1.02	0.03	6
	8	8.46	−3.67	1.71	5	8.46	−3.67	1.71	5

Note: F_0……The estimated Snedecor's F for $a_{1\cdot1}$ with 1 and ($n-2$) degrees of freedom
*significant at 0.05 level　　**significant at 0.01 level

negative one) shows a change relating either to the amount of catch (x in tons) by the shooting just before the shift or to the passing of season (t).

2. The change of the $x' - \sqrt{y}$ relation in accordance with the amount of catch (x in tons) by the shooting just before the shift

The examination in the preceding section revealed that 1) about a half of the estimated regression equations took the positive quadratic coefficient but the other half took the negative one, 2) less than 10% of the coefficients took the significant value,and 3) the same was true to the estimated linear regression equations. The amount of catch by a shooting showed a seasonal change. It was possible to estimate the $x' - \sqrt{y}$ relation till the 13-ton class (for the records of the shootings yielding 13 tons of catch by those just before the shift) on the days of good catch but till the 3-ton class on the days of poor catch. It is natural that the evaluation of the catch and the shift of the same level differs according to the daily average of catch by a shooting. Accordingly, the sampled days were stratified according to the class of the catch by the shooting just before the shift into the following four groups: the 0–4 ton group or simply the 4-ton group (the maximum catch class applicable to the estimation of the $x' - \sqrt{y}$ relation being 0 to 4 tons), the 5–7 ton group or simply the 7-ton group, the 8–10 ton group or simply the 10-ton group, and the 11–13 ton group or simply the 13-ton group. And the change of the rate of the strata taking the positive coefficient in accordance with the amount of catch (x in tons) by the shooting just before the shift was examined in the present section. Here, few days were classified into the 13-ton group, but this group was omitted in the further examination, for the insufficient sample size.

As shown in Table 3, the catch-classes (x classes) were clearly dishomogeneous in respect of the rate of the x–t strata taking the positive coefficient, either before or after the stratification of the days according to the daily maximum of x, and either in the quadratic equations or in the linear ones. But it was hard to find any clear regression of the rate on x. One of the most probable reasons why it is hard to find any clear result was the insufficient number of the estimated regression equations. This fact made the rate in some of the x classes fluctuated greatly. Accordingly, the rate was estimated pooling the x classes with less than five strata taking either the positive coefficient or the negative one, and the regression of the rate (after the arc sine transformation) on x was examined. But it was also hard to find any clear result, for it was hard to estimate the rate-x relation covering wide range of x. And only the probable relation found out was the decreasing trend of the regression coefficient $b_{1.1}$ (for either $a_{2.2}$, or $a'_{2.2}$, or $a_{1.1}$, or $a'_{1.1}$) in accordance with the daily maximum of x (i.e. with k). This fact meant as follows: on the days of poor catch the trend of yielding a good catch after a long shift became clearer in accordance with the amount of catch by the shooting just before the shift, but on the days of good catch this trend became less clear or the trend contrary to this became clearer.

Table 3. The change of the rate of the strata taking the positive regression coefficient in accordance with the amount of catch (x in tons) by the shooting just before the shift.

1) Estimated from all the catch classes (x classes) used for the estimation of the regression equations

k		χ_0^2	df	$\Pr\{\chi_0^2>\chi^2\}$	$b_{3.0}$	$b_{3.1}$	$b_{3.2}$	$b_{3.3}$	F_3
All the k groups pooled		1393.70	8	0.005>	51.60	−11.609	2.4305	−0.12410	0.92
$a_{2.2}$	4	246.33	2	0.005>	39.77	−6.182	8.9482	−1.87363	2.53
	7	451.58	5	0.005>	49.25	−9.598	3.0072	−0.23121	0.60
	10	724.42	4	0.005>	36.08	14.998	−4.4421	0.29367	2.38
All the k groups pooled		1250.84	7	0.005>	7.72	27.206	−5.6398	0.33411	19.78**
$a'_{2.2}$	4	179.61	2	0.005>	0.97	50.672	−13.9897	0.88144	0.17
	7	441.45	5	0.005>	49.67	−13.672	5.0126	−0.44644	1.77
	10	587.72	4	0.005>	35.62	13.042	−3.7095	0.23887	0.68
All the k groups pooled		737.33	8	0.005>	31.80	19.304	−3.8556	0.19792	3.87
$a_{1.1}$	4	211.86	2	0.005>	26.61	22.691	−7.7236	1.03514	107.15
	7	272.49	4	0.005>	40.41	17.796	−5.8149	0.49270	24.42**
	10	198.18	3	0.005>	55.07	5.930	−1.4021	0.07978	0.08
All the k groups pooled		607.31	7	0.005>	15.14	21.199	−2.9365	0.10227	0.79
$a'_{1.1}$	4	99.90	1	0.005>	−0.77	80.814	−33.5684	4.19645	6.16
	7	311.73	5	0.005>	49.34	7.070	−3.5122	0.38055	0.92
	10	160.84	3	0.005>	130.32	−46.880	8.7724	−0.49350	2.90

k		$b_{2.0}$	$b_{2.1}$	$b_{2.2}$	F_2	$b_{1.0}$	$b_{1.1}$	F_1	n
All the k groups pooled		40.96	0.516	0.0106	0.0006	40.68	0.653	0.18	14
$a_{2.2}$	4	37.52	9.931	−2.2935	2.09	42.10	0.757	0.12	5
	7	46.82	−3.240	0.5795	1.15	42.76	0.817	0.56	8
	10	46.66	−1.800	−0.0370	0.004	47.21	−2.170	2.22	11
All the k groups pooled		29.77	−0.525	0.3741	0.84	21.54	3.965	8.68*	13
$a'_{2.2}$	4	2.02	43.091	−8.7011	27.72*	19.43	8.287	1.81	5
	7	33.59	4.631	−0.3446	0.34	37.73	1.875	3.90	7
	10	56.11	−5.136	0.2318	0.11	51.01	−2.586	2.50	10
All the k groups pooled		48.79	−0.032	0.0038	0.0001	48.69	0.017	0.0002	14
$a_{1.1}$	4	27.85	13.789	−1.5127	4.11	30.88	7.738	37.73**	5
	7	45.58	4.246	−0.6416	2.06	50.08	−0.245	0.06	8
	10	57.94	1.367	−0.2053	0.08	61.02	−0.687	0.13	11
All the k groups pooled		21.89	12.711	−1.0957	8.96*	45.99	−0.437	0.08	13
$a'_{1.1}$	4	4.27	44.725	−8.3896	6.69	21.05	11.166	2.92	5
	7	63.04	−8.532	1.0544	2.81	50.39	−0.097	0.01	7
	10	87.97	−9.324	0.6296	0.63	74.12	−2.398	1.51	10

2) Estimated after pooling the catch classes (x classes) having not more than five equations taking either the positive or the negative coefficient

	k	$b_{3.0}$	$b_{3.1}$	$b_{3.2}$	$b_{3.3}$	F_3	$b_{2.0}$	$b_{2.1}$	$b_{2.2}$	F_2	$b_{1.0}$	$b_{1.1}$	F_1	n
$a_{1.2}$	All the k group pooled	43.39	-0.324	0.0343	-0.00242	0.003	43.30	-0.176	-0.0038	0.001	43.36	-0.215	0.40	9
	4										40.94	1.933	297.99*	3
	7	46.60	-4.714	1.1466	-0.05083	0.01	45.75	-3.226	0.6129	0.52	40.59	1.064	0.48	6
	10	13.41	28.718	-6.9710	0.45189	55.68	47.80	-2.406	0.1025	0.05	45.59	-1.325	1.74	5
$a'_{2.2}$	All the k group pooled	40.24	2.188	-0.4276	0.02280	0.07	41.51	0.704	-0.0676	0.14	42.79	-0.001	0.000002	8
	4										40.01	2.662	4.11	3
	7	43.00	-5.129	2.2007	-0.18036	0.15	37.27	1.764	0.0528	0.01	36.71	2.159	6.59	6
	10	4.49	31.465	-6.8929	0.42139	4.15	47.92	-1.302	-0.0154	0.001	48.31	-1.473	2.56	5
$a_{1.1}$	All the k group pooled	37.25	12.806	-2.7311	0.15677	14.66*	43.24	3.216	-0.2548	1.90	47.26	0.621	0.85	9
	4										36.40	5.694	55.51	3
	7	39.18	20.114	-6.6449	0.57374	2.51	47.94	3.016	-0.5444	0.65	52.10	-0.748	0.39	5
	10						65.77	-4.867	0.3738	0.93	58.44	-0.970	1.16	4
$a'_{1.1}$	All the k group pooled	52.59	0.849	-0.2915	0.01950	0.05	53.68	-0.421	0.0165	0.01	53.37	-0.249	0.22	8
	4													
	7	34.57	26.223	-9.9294	0.98006	29.58*	64.11	-9.267	1.1296	1.93	52.14	-0.819	0.29	6
	10						79.79	-8.713	0.6329	4.25	63.10	-1.540	2.26	4

Note:

χ_0^2 ·········The chi square value for the homogeneity test of the rate of the strata taking the positive regression coefficient

$b_{i.j}$ ·········The estimated j-th order coefficient in the i-th order regression equation of the rate(after the arc sine transformation) on x.

F_i ·········The estimated Snedecor's F for $b_{i.i}$ with 1 and (n-i-1) degrees of freedom

k: 4 ·········Estimated from the $x'-\sqrt{y}$ regression equations on the days of the 4-ton group(the day's maximum of the catch class applicable to the estimation of the regression equations being 0 to 4 tons   7·········on the days of the 7-ton group(the maximum x being 5 to 7 tons)   10·········on the days of the 10-ton group(the maximum x being 8 to 10tons)

*significant at 0.05 level   **significant at 0.01 level

3. The seasonal change of the $x' - \sqrt{y}$ relation

As shown in Tables 4-1 and 4-2, the 10-calendar-day intervals or the months were clearly dishomogeneous in respect of the rate of the $x-t$ strata taking the positive $a_{2.2}$. The same was true to either $a'_{2.2}$, or $a_{1.1}$, or $a'_{1.1}$. But it was hard to find any clear regression of the rate (after the arc sine transformation) on the number of the 10-calendar-day interval or on the month. This difficulty may be due to the fact that the relation was estimated pooling the regression equations on all the sampled days, in spite of the probable difference of the evaluation of the shooting of the same amount of catch according to the difference of the daily average of the amount of catch by a shooting. Accordingly, the days were stratified according to the maximum of x into the four groups like in the preceding section, and the regression of the rate of the

Table 4. The seasonal change of the rate of the strata taking the positive regression coefficient.

1) Estimated after pooling the days in the same 10-calendar-day groups

	χ_0^2	df	$\Pr\{\chi_0^2>\chi^2\}$	$b_{3.0}$	$b_{3.1}$	$b_{3.2}$	$b_{3.3}$	F_3
$a_{2.2}$	1629.21	14	0.005>	40.69	1.549	−0.3299	0.01830	0.19
$a'_{2.2}$	1650.37	14	0.005>	26.97	12.220	−2.0175	0.08959	3.92
$a_{1.1}$	790.97	14	0.005>	61.64	−10.666	1.7976	−0.07741	8.24*
$a'_{1.1}$	651.99	14	0.005>	49.68	−0.773	0.1806	−0.00679	0.05

	$b_{2.0}$	$b_{2.1}$	$b_{2.2}$	F_2	$b_{1.0}$	$b_{1.1}$	F_1	n
$a_{2.2}$	45.17	−1.353	0.1093	0.52	40.21	0.396	0.49	15
$a'_{2.2}$	48.90	−1.988	0.1325	0.50	42.89	0.132	0.03	15
$a_{1.1}$	42.69	1.611	−0.0602	0.22	45.42	0.648	1.87	15
$a'_{1.1}$	48.02	0.303	0.0177	0.03	47.22	0.586	2.04	15

Note : $b_{i.j}$……The estimated j-th order coefficient in the i-th order regression equation of the rate (after the arc sine tranformation) on the number of the 10-calendar-day intervals counted from the late in April

F_i…… The estimated Snedecor's F for $b_{i.i}$ with 1 and (n-i-1) degrees of freedom

*significant at 0.05 level **significant at 0.01 level

2) Estimated after pooling the days in the same months

	χ_0^2	df	$\Pr\{\chi_0^2>\chi^2\}$	$b_{3.0}$	$b_{3.1}$	$b_{3.2}$	$b_{3.3}$	F_3
$a_{2.2}$	1485.25	5	0.005>	−0.86	43.233	−12.6512		2.31
$a'_{2.2}$	1419.34	5	0.005>	−28.25	78.259	−24.3647	2.26492	32.20*
$a_{1.1}$	737.20	5	0.005>	79.38	−39.304	−13.4887	−1.30445	3.84
$a'_{1.1}$	624.76	5	0.005>	40.54	8.083	−2.0599	0.19017	0.04

	$b_{2.0}$	$b_{2.1}$	$b_{2.2}$	F_2	$b_{1.0}$	$b_{1.1}$	F_1	n
$a_{2.2}$	27.66	7.359	−0.7689	0.42	34.84	1.977	1.55	6
$a'_{2.2}$	28.83	6.461	−0.5830	0.11	34.27	2.379	1.08	6
$a_{1.1}$	46.51	2.047	−0.2080	0.03	48.45	0.591	0.14	6
$a'_{1.1}$	45.33	2.055	−0.0631	0.004	45.92	1.613	1.59	6

Note : $b_{i.j}$……The estimated j-th order cofficient in the i-th order regression equation of the rate (after the arc sine transformation) on the number of the month counted from April

F_i…… The estimated Snedecor's F for $b_{i.i}$ with 1 and (n-i-1) degrees of freedom

*significant at 0.05 level **significant at 0.01 level

3) Estimated after the stratification of the $x'-\sqrt{y}$ regression equations according to the day's maximum of the catch class(x in tons by the shooting just before the shift) used to estimation of the regression equstions

	k	$b_{3.0}$	$b_{3.1}$	$b_{3.2}$	$b_{3.3}$	F_3	$b_{2.0}$	$b_{2.1}$	$b_{2.2}$	F_2	$b_{1.0}$	$b_{1.1}$	F_1	n
$a_{2.2}$	4	− 9.27	2.530	−0.0398	−0.00019	0.96	50.57	−0.512	0.0044	0.76	27.34	0.230	3.19	14
	7	124.54	−3.038	0.0353	−0.00013	1.79	98.36	−1.311	0.0072	7.19*	62.14	−0.173	2.41	15
	10	32.35	0.513	−0.0082	0.00003	0.15	37.81	−0.033	0.0003	0.02	36.72	0.017	0.04	12
$a'_{2.2}$	4	−38.53	4.429	−0.0721	0.00033	1.82	57.86	−0.653	0.0049	0.52	32.60	0.169	1.10	12
	7	99.92	−0.461	−0.0085	0.00007	0.44	113.99	−1.377	0.0062	5.71*	81.27	−0.380	13.56**	17
	10	28.47	0.697	−0.0126	0.00006	0.37	38.00	−0.257	0.0022	0.94	30.31	0.100	1.01	12
$a_{1.1}$	4	102.93	−2.693	0.0346	−0.00013	0.61	62.00	−0.611	0.0044	1.03	39.17	0.118	1.16	14
	7	137.53	−4.438	0.0612	−0.00025	3.16	87.67	−1.149	0.0077	3.55	49.26	0.057	0.14	15
	10	41.01	0.774	−0.0076	0.00002	0.11	43.82	0.492	−0.0032	6.59*	54.79	−0.017	0.07	12
$a'_{1.1}$	4	139.41	−3.671	0.0444	−0.00016	0.91	93.00	−1.224	0.0073	2.78	55.08	0.010	0.01	12
	7	133.99	−4.131	0.0569	−0.00023	3.20	85.12	−0.949	0.0058	2.43	54.86	−0.026	0.04	17
	10	32.41	1.799	−0.0250	0.00009	5.63*	47.39	0.299	−0.0017	2.02	53.23	0.028	0.27	12

Note: $b_{i.j}$ ·········The estimated j-th order coefficient in the i-th order regression equation of the rate (after the arc sine transformation) on the number of the days counted from April 19.

F_i ········ The estimated Snedecor's F for $b_{i.i}$ with 1 and($n-i-1$) degrees of freedom

*significant at 0.05 level **significant at 0.01 level

4) Estimated after the stratification of the $x'-\sqrt{y}$ regression equations according to the day's maximum of x then pooling the equations of the same k groups for the estimation of the rate

	k	$b_{3.0}$	$b_{3.1}$	$b_{3.2}$	$b_{3.3}$	F_3	$b_{2.0}$	$b_{2.1}$	$b_{2.2}$	F_2	$b_{1.0}$	$b_{1.1}$	F_1	n
$a_{2.2}$	4	22.02	13.143	−2.3653	0.11706	1.06	66.87	−8.032	0.5311	2.34	36.15	1.133	1.42	8
	7	141.97	−33.091	3.4503	−0.11354	1.54	115.51	−16.755	0.9034	11.41*	74.47	−2.946	4.12	8
	10	28.53	9.794	−1.4568	0.05747	0.32	41.71	− 0.091	−0.0038	0.0002	41.84	−0.147	0.02	8
$a'_{2.2}$	4	19.40	20.601	−3.9880	0.19474	1.94	90.59	−13.551	0 7786	1.73	47.51	−0.138	0.01	6
	7	109.74	−9.473	−0.1942	0.04093	0.15	119.62	−15.504	0.7329	7.51*	85.73	−4.339	11.49*	9
	10	21.40	13.939	−2.1451	0.09018	0.61	42.09	−1.572	0.1349	0.18	37.53	0.431	0.13	8
$a_{1.1}$	4	89.70	−17.937	2.1792	−0.07597	0.48	58.70	−3.580	0.2644	0.66	43.66	0.950	1.47	8
	7	180.39	−61.292	8.1711	−0.32571	11.80*	104.48	−14.427	0.8648	3.42	65.19	−1.207	0.44	8
	10	33.33	10.451	−1.0374	0.02568	0.11	39.22	6.034	−0.3881	3.82	52.35	0.274	0.08	8
$a'_{1.1}$	4	102.27	−20.264	2.3779	−0.08188	0.46	72.34	−5.904	0.3737	0.86	51.66	0.533	0.37	6
	7	168.09	−52.869	6.8478	−0.26968	7.57*	103.00	−13.127	0.7389	3.65	68.84	−1.870	1.43	9
	10	22.08	22.447	−3.0307	0.11174	2.54	47.71	3.229	−0.2058	0.81	54.67	0.175	0.04	8

Note : $b_{i.j}$·····The estimated j-th order coefficient in the i-th order regression equation of the rate (after the arc sine transformation) on the number of the 10-calender-day intervals counted from the late in April

F_i·····The estimated Snedecor's F for $b_{i.i}$ with 1 and ($n-i-1$) degrees of freedom

*significant at 0.05 level **significant at 0.01 level

strata taking the positive coefficient on the number of the days counted from April 19 (the first day of the season) was examined (Table 4-3). However, the rates of the strata taking the positive coefficient fluctuated greatly, mainly because the rates were estimated from insufficient number of strata. Accordingly, as the next step of the examination, the sampled days were stratified according to the day's maximum of x into the four groups, then the rates were estimated pooling the equations on the days in the same groups and in the same 10-calendar-day intervals. And the regression equations of the rate on the number of the 10-calendar-day intervals counted from late in April were examined (Table 4-4). These examinations showed that the significant quadratic relation to the season was found only in the rate of the x-t strata taking the positive coefficient of $\sqrt{y}$ on x' ($a_{2.2}$ or $a'_{2.2}$) in the 7-ton group, regardless of the method of examination.

The rate of the strata taking the positive linear regression coefficient of $\sqrt{y}$ on x' ($a_{1.1}$ or $a'_{1.1}$) showed the significant cubic regression on the number of the 10-calendar-day intervals, but not on the number of the days counted from April 19. The estimated date showing either the maximum or the minimum of the rate of the x-t strata taking the positive regression coefficient varied according to the method of examination (either through the cubic relation or through the quadratic one, either the regression on the number of the 10-calendar-day intervals or that on the number of the days counted from April 19, and either before or after the exclusion of the records of the accidental shootings and the addition of those of the long shifts). And only the following rough trend was found out: the rate of the strata in the 4-ton group and taking the positive quadratic regression coefficient showed the minimum late in June, that in the 7-ton group showed the maximum early in August and the minimum at the middle of July. In regard to the change of the rate in accordance with the increase in the value of k, the following two trends were found out, although they were rough: 1) the rate of the strata taking the positive quadratic regression coefficient of x' on $\sqrt{y}$ showed a concave relation to t in all the k groups, although the regression coefficient of the rate on t was significant only in the 7-ton group, and 2) the rate of the strata taking the positive linear regression coefficient of x'on $\sqrt{y}$ showed the concave relation to t when the daily maximum of catch by a shooting was poor (in the 4-ton group and in the 7-ton one), but showed the convex one to t when the daily maximum of catch was good (in the 10-ton group). Or the rate showed the negative cubic regression on t when the daily maximum of catch by a shooting was poor, but showed the positive cubic one when the daily maximum of catch by a shooting was good.

Discussion

The clearest finding in the preceding two and the present reports was the following trend found in the second report: the seiner shifted over a long distance after a poor catch but she inclined to stay around the position of the preceding shooting after a good catch. The first report revealed that the seiner inclined to yield a good catch after another. These facts seemed to suggest a possibility of yielding a good catch after a short shift. But the examination in the present report did not show any facts in support of this possibility. Namely, as above-mentioned, the amount of catch after the shift hardly showed any clear regression on the distance of shift. Some trends of the change of the regression coefficient in accordance with either the passing of season or the amount of catch before the shift were found out, but they were rough. And it may be said that it was hard to find any clear trend of the change of the coefficient in accordance with the change of these factors. The different result of the present report from the above-mentioned possibility was due to the following reasons: the above-mentioned suggestion was deduced from the results of the first and the second reports. The exact meaning of the resuit of the first report used in the deduction concerned with the relation after the shooting yielding the same amount of catch, but that of the second report concerned with the change of the distance of shift in accordance with the amount of catch before the shift. The present result was under the same conditions to those of the first report but contradicting ones to those of the second report. Accordingly, this suggestion was a false one, and it is naturally hard to find any facts supporting this.

The other finding in the first report was that the seiner inclined to yield a good catch after a long shift. The suggestion from this trend was contrary to the former one. This possibility was supported in the present report by the fact that the linear regression coefficient was positive in a slightly more strata than those taking the negative one. But it is hard to give much importance to this trend, because it is highly doubtful whether this difference would be practically meaningful for the trend found in the first report was very rough. And it is better to regard that the amount of catch by the shooting just after the shift hardly had any clear relation to the distance of shift.

The major reasons why it is hard to find any clear relation of the amount of catch by the shooting just after the shift to the distance of shift could be classified into 1) those mainly relating to the nature of the distance of shift, 2) those relating to the nature of the amount of catch, and 3) those relating to the method of analysis. When the catch was under a satisfactory level, the skipper intends to shift towards the probably profitable ground paying attention to the information from the fellow seiners. The fishing ground was along the outer edge of the continental shelf, and the objective fish shows a somewhat clear bathymetric difference in the density. And the shifts were mainly to the profitable depth zone. It is clear that the amount of catch is one of the most important motives of the shift. The seiner shifts either a short distance or a long one between the succeeding shootings, waisting the workable hours. There may be no doubt that the shift between the succeeding shootings is indispensable or at least unavoidable. But, as above-mentioned, it was hard to find any clear relation between the amount of catch after the shift and the distance of shift. This fact threw a doubt as to the shift being exclusively for increasing the catch, because the records used here were during the fleet operation and the seiner could not shift freely. The catch in the present case was very good. And the seiner has to transship it to the factory ship during the hour of poor catch. But sometimes she does so even during the hour of good catch, when she approaches to the factory ship or when the plant on the factory ship has only insufficient carry over of the material fish. Sometimes the fleet shifts gradually pursueing the probable migration of the objective school, and the member seiners have to follow it neglecting of the distribution of the fish in the restricted point under attacking. The seiner has to change the fishing position taking into account of the behavior and the distribution of the fellow seiners. These shifts having no direct relation to increasing the catch may make the shift-catch relation obscure.

The amount of catch depends on the two factors: whether the seiner fortunately finds a dense school in the suitable conditions to attack or not, and whether she attacks it successfully or not. The former possibility seemed to have a close relation to the distance of shift. But this is true only when the seiner engages exclusively in the scouting work. Actually the seiner sails for scouting the schools till finding out the school of a certain density, then she attacks it. And the long shift means the difficulty in finding out a profitable school, but does never mean the careful selection of the detected schools. Accordingly, it is hard to consider that the size of the detected school has a close relation to the distance of shift. It is also hard to consider that the possibility of successful attacking depends on the distance of shift. These facts meant that it is natural that the amount of catch after the shift hardly shows any close relation to the distance of shift just before the shooting.

Another factor making it hard to find any clear result may be the daily rhythmic change: the objective fish shows a well-defined daily rhythmic change of the behavior pattern—floating up at night but being settled down in the daytime. And the possibilities of finding out a school in the profitable conditions and of attacking it successfully depend on the hour—high around the noon but low in the morning and evening. Accordingly, the evaluation of the shift of the same distance and the catch of the same amount differs according to the hour. But this fact was not taken into account in the analysis, which made the shift-catch relation obscure.

The other possibility of making it hard to find any clear result was as follows: for examining the relations, the records were not stratified according to the seiner, in spite of the fact that the working pattern and the fishing ability differ according to the seiner. The meaning of both the same distance of shift and the same amount of catch by a shooting after the shift differ according to the catch before the shift. The daily average of catch differs according to the season. Accordingly, the records were stratified according to the date (t) and the amount of catch (x) before the shift. The seiner usually repeats less than eight shootings a day. And the number of records in a x-t stratum was insufficient capable of estimating the x'–$\sqrt{y}$ relation after stratifying the records according to the seiner. Even when the records on the three consecutive days in the same 10-calendar-day intervals were pooled, the sample size was too small to estimate the $x' - \sqrt{y}$ relation after stratification according to the seiner. But the first report and the second one did not show any notable difference between the results before and after the stratification of the records according to the seiner. This fact suggested that the catch-shift relation should not differ clearly according to the seiner, in spite of the above-mentioned possibility. And it was hard to consider that the difficulty in finding out any clear $x' - \sqrt{y}$ relation was due to the fact that the relation was examined pooling the records of the different seiners.

Conclusion

There is no doubt that the skipper pays many efforts for how to yield a good catch. The information from the fellow seiners should be the good bases for determining the location of shooting the net in the fleet operation. As above-mentioned the distance of shift depended closely on the amount of catch by the shooting just before the shift, but the amount of catch after the shift had no clear relation to the distance of shift. But the pattern of shift, especially its relation to the informations from the fellow seiners, should be examined more in detail, for clear understanding of the meaning of the fleet operation and the meaning of the shift which is the indispensable but seemingly workable-time-waisting step of work.

Summary

The relations between the shift and catch in the records of the fishing for the Alaska pollack during the entire season of 1964 along the outer edge of the continental shelf in the Eastern Bering Sea by the 22 Danish seiners consisting of a fleet were examined in the present series. The second report revealed that the Danish seiner inclined to shift over a long distance after a poor catch but to stick to the similar position after a good catch. And the present report dealt with the relation of the amount of catch by the shooting after the shift to the distance of shift, and the following results were obtained:

1. Regardless of either before or after the exclusion of the records relating to the accidental shootings and the addition of those relating to the long shifts, the quadratic regression coefficient of the amount of catch by the shooting just after the shift on the distance of shift (after the square root transformation) was positive in a half of the strata of the records of the shift and shooting after that yielded the same amount of catch before it on the same day. And the coefficient in less than 10% of the strata took the significant value (at 0.05 level) (either positive or negative).
2. The same was true to the linear regression coefficient.
3. The regression coefficient (either quadratic or linear) differed according to the day and the amount of catch by the shooting just before the shift. But it was hard to find its change closely relating to either of them.
4. The discussion was given to the reasons why it is hard to find any clear relation of

the amount of catch after the shift and the distance of shift, classifying them into 1) those mainly relating to the nature of the distance of shift, 2) those relating to the nature of the amount of catch, and 3) those relating to the method of analysis.

References

1) MAÉDA, H. and S. MINAMI, 1974: *This Jour.,* **23**, 67–86.
2) MAÉDA, H. and S. MINAMI, 1975: *ibid.,* **24**, 147–179.