The Magnitude And Fishing Rate Of The Population Of Snapper, Pagrosomus Major (Temminck And Schlegel)

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https://doi.org/10.5109/22608

出版情報：九州大学大学院農学研究院紀要. 9 (1), pp.51-57, 1948-03. Kyushu University
バージョン：
権利関係：

Journal of the Faculty of Agriculture, Kyūshū University, Vol. 9, No. 1
March 31, 1948

THE MAGNITUDE AND FISHING RATE OF THE POPULATION OF SNAPPER, *PAGROSOMUS MAJOR* (TEMMINCK AND SCHLEGEL)

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The authors have tried to estimate magnitude of the snapper population and the fishing rate of trawlers for it, statistically based upon the data published by the Fisheries Bureau (Dept. Agr. and Forestry) and also upon the fishing information presented from the trawler operating records of the Nippon Suisan Kabusiki Kaisya, Tobata, Fukuoka Pref.

The fishing season durates in autumn from September to November in the Shanghai region, in winter from October to December in Yellow Sea, icluding the Gulf of Chili, and from December to next February around · Quelpart I. (Saisyû T.). After then, spring fishing season begins again in the Shanghai region, from March to May. From the shift of fishing ground, it will be noticed that the shoals of snapper migrate north along the Chinese coast into Yellow Sea from autumn and appear further north on the Gulf of Chili in winter. Then, they move south probably along the west coast of Korea, appearing in early spring around Quelpart I, and return again to the Shanghai region in late spring, when the water temperature rises to its optimum here. Therefore, the shoals move in clock-wise manner throughout these regions. Kumada (1929) and also Satouti (1943) concluded from their observations that the snappers migrate north for hibernation and return south for spawning. (see figs. 1 and 2)

The catches in these three regions co-variate well with each other in the corelation coefficient greater than 0.7 (see Table 1),

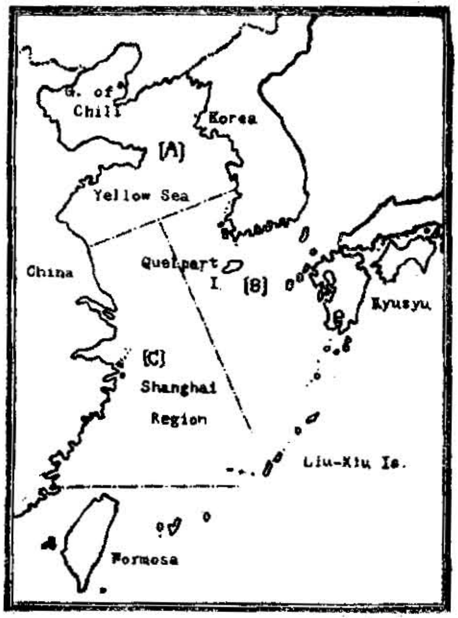

Fig. 1. Division of Fishing grounds. A. Yellow Sea reion, B. Quelpart I. region C. Shanghai region.

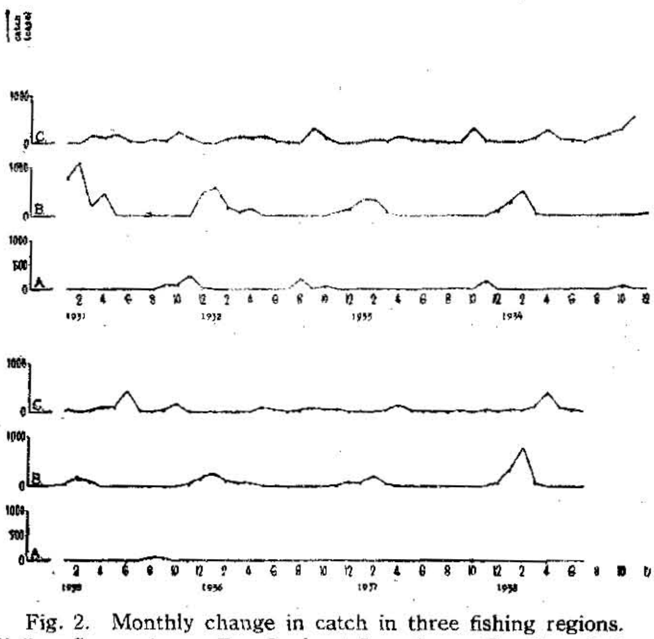

Fig. 2. Monthly change in catch in three fishing regions.
A: Yellow Sea region, B: Quelpart I. region, C: Shanghai region.

so that the snappers of all regions seem to belong to a single race. Therefore, the data can be treated all together. On the other hand, it is also noticed that the snappers of large size are generally prevalent only in the Shanghai region, while those of small size migrate north and dominate in the Yellow Sea regions and also around Quelpart I

Table 1. Co-variation of fluctuation in catch (10^4 kan)

year	Yellow Sea		around Quelpart I.		Shanghai region	
	order	catch	order	catch	order	catch
1931	2	1058.6	1	8120.3	1	11437.0
1932	1	1781.4	2	1688.2	2	4689.5
1933	3	282.1	3	1230.7	4	2564.0
1934	5	87.6	5	1051.4	3	2920.5
1935	4	183.6	7	477.4	5	1836.0
1936	8	0	4	1084.4	7	1084.4
1937	6	17.2	8	452.2	8	853.3
1938	7	12.3	6	752.5	6	1233.6

(1) From the data published by the Fisheries Bureau, it is noticed that the number of trawlers is about 70, being nearly constant recently, but the annual yield attained the maximum value only in the years, 1923—'25, 103.9×10^3 kan (1 kan=3.75 Kg) on an average and then decreased year by year from 1926 to 1932, while it became stable since 1933, amounting to 4.0×10^3 kan on an average. The annual yield seemed increase at first, due to the introduction of Vigneron-Dahl trawl and electric winch, etc. Then it began to decrease, probably due to the resulting overfishing and also to the destruction of fishing ground, though the number of trawlers as a whole remained unchanged. At last the population must be balanced with this intense fishing since 1933, as the annual yield becomes nearly stable (W. F. Thompson, 1937).

When in the years, 1923—'25; the magnitude of population is Sm, the annual yield Fm, fishing rate f, the balanced population since 1933 Se, the yield with same fishing rate Fe, and the yield from 1928 to 1932 Ft, following to Hjort's method of accumulation (J. J. Hjort, G. Jahn. P. Ottestad, 1933), the equation can be established as below

$$Sm \cdot f = Fm = \{Se + \Sigma(Ft - Fe)\} \cdot f$$

where, Fm is 103.9×10^4 kan, Fe 4.0×10^4 kan on an average, and $Se \cdot f = Fe$, then the fishing rate f and also the magnitude of population in every year are computable as are shown in Table 2. The fishing rate (f) is 0.29, the maximum population (Sm) 354.1×10^4 kan and the balanced population 13.4×10^4 kan on an average. Tauti (1941) estimated the fishing rate at 0.29 or less in the Formosa trawl ground. Both rates are nearly equal to one another.

Following to Helland's formula (J. J. Hjort, G. Jahn, P. Ottestad, 1933), the decreasing rate (d) is obtained from the equation below

$$Fm = (1 - d)^t = Ft$$

During the years from 1920 to 1935, decreaing rate (d) varied from 0.163 to 0.333, with 0.278 as an average. And, also following to Tauti's formula (Tauti, M. and K. Miyosi, 1937), the total decreasing (d) is

$$1 - d = \frac{79.6 + 46.3 + 56.8 + 50.9 + 13.9 + 9.2 + 6.9 + 4.0}{103.9 + 79.6 + 46.3 + 56.8 + 50.9 + 13.9 + 9.2 + 6.9 + 4.0}$$

$$= 1 - 0.290$$

Both decreasing rates are also approximately equal to one another and also to that obtained from Hjort's method.

The magnitude of population is computable by the second equation of Helland as

$$F_t / d_t = S_t$$

The magnitude calculated from this equation is generally larger than that from HJORT's method.

Table 2. The magnitude of trawl populations (S), and decreasing rate (d)

year	no. of tralwers	catch ($F \times 10^3$ kan)	HJORT's method of accumulation			HELLAND's method		TAUTI's method
			Ft–Fe	Σ(Ft–Fe)	St	d	St	St
1920	70	244						
1921	70	818						
1922	70	882						

1923	70	1082*						
1924	70	1034*	999	3355	3541	0.232	4460	3575
1925	76	1000*						
1926	69	796	756	2356	2542	0.332	2400	2744
1927	70	463	423	1600	1786	0.182	2550	1600
1928	67	568	528	1177	1363	0.163	4480	1960
1929	69	509	469	629 ↑	835	0.331	1540	1760
1930	72	139	99	180	366	0.332	419	480
1931	71	92	52	81	267	0.322	286	316
1932	70	69	29	29	163	0.333	207	237
1933	71	34**						
1934	73	36**	—	—	134	0.278	144	138
1935	75	50**						

note: * the average catch 1039×10^3 kan from 1923 to 1925; ** the average catch 40×10^3 kan from 1933 to 1935.

(2) In the fishing information presented from the trawlers of Nippon Suisan Kabusiki Kaisya, the number of trawlings and the catch at each trawling are recorded. Being assuming that trawlers always exploit same population during a year, the two equations can be established as below

$$F_{2n+1} = S \cdot (k \cdot N_{2n+1} - (k^2/1) N_{2n+1}^2)$$
$$F_{2n} = S \cdot (k \cdot N_{2n} - (k^2/1) N_{2n}^2)$$

where F_{2n+1} and F_{2n} are respectively the total catches of odd- and even- numbered months and N_{2n+} and N_{2n} also the total numbers of trawlings undertaken respectively in odd- and even-numbered months. By solving these equations, the unit fishing effort (k) of trawl is computable, as F and N are known, and then, the fishing rate is also obtained from the equation below

$$f = \frac{1}{k \cdot N - (k^2/2) N^2}$$

k-value varies considerably every year, between the range from 0.120×10^{-3} to 0.919×10^{-3}, with 0.472×10^{-3} as an average, while the fishing rate (f) is nearly constant every year and 0.386 on an average (see Table 3). Shibata (1940) computed the fishing intensity at 0.384×10^{-3} in the Gulf of Tongking and Miyosi (1941) also estimated the fishing rate at 0.37 in the East China Sea. These values are all nearly equal to those obtained now.

Table 3. Number of trawlings, catch, calculated fishing intensity (k) and fishing rate (f)

year	annual yield (case)	(2n+1) th. months N_{2n+1}	(2n+1) th. months F_{2n+1} (case)	2n th. months N_{2n}	2n th. months F_{2n} (case)	N	fishing intensity ($k\times10^{-3}$)	fishing rate (f)
1928	37180.0							
1929								
1930	10535.0							
1931	11437.0	3190	5038.1	5153	6398.9	8343	0.161	0.373
1932	4689.5	5068	3103.5	4033	1586.0	9101	0.919	0.384
1933	2564.0	2604	784.6	3332	1779.4	5936	0.120	0.474
1934	2920.5	3896	1414.0	3956	1506.5	7852	0.744	0.149
1935	1836.0	2745	68.5	3188	1257.7	5933	0.737	0.459
1936	1084.4	3528	622.8	3161	461.6	6689	0.143	0.279
1937	853.3	2595	350.7	2308	502.6	4903	0.518	0.475
1938	1233.6	4976	463.8	5552	769.8	10523	0.436	0.498
mean	—	—	—	—	—	—	0.472	0.386

Then, the fishing rate, as it is estimated, is not considered so intense as the population would be overfished. The catches are sorted into three groups, large, medium and small. The large size group is composed of the individuals from 0.56 to 0.84 Kg. by weight and 4 or 5 of age; the medium size group of those, 0.48 Kg. by an average weight and 3 or 4 of age, and the small size group of those, 0.16 Kg. by an average weight and 2 or younger of age (see table 4).

Table 4. Size composition of snappers

year	annualy yield (case)	large size case	large size %	medium size case	medium size %	small size case	small size %
1927	15859.5	2592.0	16.3	3742.5	23.6	9525.0	60.1
1928	34562.0	4716.0	13.6	5743.5	16.6	24120.5	69.7
1929	39798.0	6444.5	16.2	5850.0	14.7	27503.5	69.1
1930	10535.5	3350.5	31.8	2319.0	22.0	4866.0	46.2
1931	11437.0	7203.5	63.0	1630.0	14.2	2613.5	22.9
1932	4689.5	1773.0	37.8	913.0	19.5	2003.5	47.7
1933	2564.0	1420.0	55.4	667.0	26.0	477.0	18.6
1934	2920.5	1560.9	53.5	908.1	31.1	451.5	15.5
1935	1836.0	874.8	47.7	240.0	13.1	721.2	39.3
1936	1084.4	539.4	49.7	273.7	25.2	271.3	25.0
1937	853.3	597.1	70.0	190.7	22.3	65.5	7.7
1938	1233.6	—	—	—	—	—	—

During the years from 1927 to 1929, the small size group occupied more than 60% of catch, but it began to decrease in accordance with the decrease in yield since 1930, differing from the general tendency of the small size group which remarkably increases in percentage in case of overfishing, while the large size group increased in percentage, as its catch did not decrease so remarkably as the catch of small size group did.

Then, the decrease in annual yield may not be caused primarily by the decrease in the large size group, but probably by the decrease in the small size group, which may be due not only to the intense fishing in the years, 1928 and 1929, but also to the destruction of nursing grounds during Winter. Therefore, the trawl fishery had better be prohibited in the Yellow Sea region (including the Gulf of Chili) during winter, or at least for November and December. Thus, the snappers of small size are enable to grow well and the nursing ground here becomes favourable.

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