CATCH PATTERN OF SQUIDS UNDER LAMP, IN RELATION TO QUANTITY OF CATCH

Hiroshi MAÉDA and Yutaka NAKADA

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The angling is one of the most leading methods in coastal fisheries, and lives of majority of coastal fishermen depend on this method. But few reports have been published against its importance. In some of them, biological problems on the captured fish or technical problems on the gears were treated, while the others discussed the change of catch in relation to oceanographic, meteorological or other environmental conditions. In this report, we wish to give a short discussion on such problem that in what pattern are the squids angled up, then, a good catch is successfully got by the man who caught the squids following what pattern.

Materials

The records analyzed here were obtained on July 7, 1960. Twenty eight men were distributed on board nine boats of 3 to 15 tons with lamp of 3 kw, and they angled up the squids by handline with a pair of artificial lures. These boats were distributed around the station about a half mile off Murotsu, where is a small fishing village facing to the Tsushima Strait. At the time a little after the sunset, 7.45 p.m, all the boats put their lamps simultaneously and cut off their lights at 10.45 p.m all together. And as soon as the lamps were put, all the crews began to angle the squids and the angled time of squid by each man was recorded.

Results

The frequency distribution of catch in respective time sections of five minutes long is taken up as the first approach to proceeding with the study on a records such as this in which clear tendency is hardly found out. The catch by each man in each time section is not more than three; in addition, the frequencies of the time sections, in each of which not less than two individuals are caught, are fewer than five. It is, therefore, very hard to examine into the question whether or not the observed series fit for the computed ones. Despite of these facts, the followings may well be said: 1) the observed series of the frequencies of catch by each of nine men took the values considerably approaching to Poisson series, 2) those by each of seven men did to the negative binomial one, 3) those by each of eight men did to the positive binomial one, while 4) those by each of the rest four did not take the series well approaching to any of the theoretical ones.

Shimonoseki College of Fisheries, Shimonoseki, Japan.
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Table 1. Four examples of frequency distributions of the catch in each time-section of five minutes long.

		Ob	P	B	Ob	P	B	Ob	P	B	Ob	P	B
Class	0	18	15.22	16.07	16	17.01	16.10	26	24.40	25.83	28	28.04	
	1	7	13.10	12.16	14	12.75	13.93	7	9.49	7.37	7	7.01	
	2	9	5.64	5.34	5	4.78	4.96	2	1.85	2.03	1	0.88	
	3	2	1.62	1.78	1	1.20	0.92	1	0.24	0.55	0	0.07	
	≧4	0	0.35	0.50	0	0.26	0.09	0	0.02	0.15	0	0.00	
p			−0.138			0.133			−0.363			0	
q			1.138			0.867			1.363			1	
n			−6.230			5.626			−1.071			——	

Notes

Ob: observed frequency P: Poisson series B: binomial series Class: class classified by the number of the individuals caught in each time-section. When p is negative, the frequencies of the binomial series are computed through $36(q-p)^{-n}\cdots$ negative binomial series; while when positive, through $36(q+p)^{n}\cdots$ positive binomial series.

The distribution of angled-times is essentially the phenomena occurred along continuous time series. But the original record is treated in the above-mentioned analysis being sectioned into independent pieces. Therefore, to get the information about the serial relation of catch in respective time sections, the frequency distributions of the intervals between the captured times of any two individuals are examined, adopting the following equations in which it is set as the basic assumption that all the individuals are angled up independently of one another.

$$X_{(0)}=\frac{N(N-1)}{2M}, \qquad X_{(K)}=\frac{N(N-1)(M-K)}{M^2}$$

Here, $X_{(0)}$ is the expectant frequency of combinations of any two individuals picked up from those caught within the same time sections, when N individuals are angled up in M time-sections; while $X_{(K)}$ is that of two individuals passing not shorter than $5(K-1)$ but not longer than $5(K+1)$ minutes each other.

Two examples of the results are depicted in Fig. 1. And the informations about the pattern drawn from this series of analyses are summarized as follows: the time sections of getting a (good) catch occur successively in 17 examples, as if suggesting long stay or long pass of single school; but in six examples these sections are separated into two continuations, as if suggesting two schools; separation of catch into many continuations is suggested in two examples, and scattering occurrence of catch in three examples.

Considerations

Catch may be the result of complicated interaction of a lot of factors, and it may be very hard to seek out some factors expected to have decisive influence on the

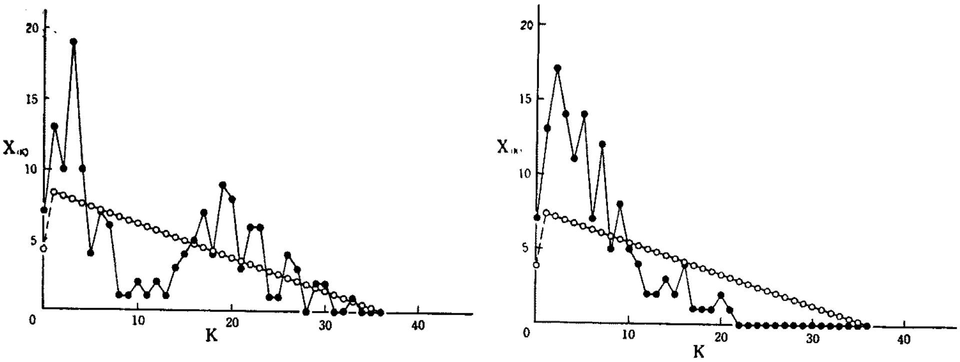

Fig. 1. Two examples of the change in the observed value of $X_{(K)}$ (filled circle) in relation of the expectant value from chance occurrence (open circle).

Note: $X_{(K)}$ is the frequency of the occurrence of the intervals between the captured times of two individuals passing not shorter than $5(K-1)$ but not longer than $5(K+1)$ minutes each other.

catch. There are many factors described in or estimative from the original records or during the above-mentioned analyses. But we are unable to employ some of them as the materials for discussion because of the difficulty in estimating the accurate values or in classifying the examples into several types to which each of the examples is belonged.

Here, taking up the following three characters of the pattern as indices, we try to classify the examples and get Table 2: 1) number of schools attacked (many, two, one including being angled by chance or self-spacingly), 2) type of the frequency distribution to which the observed series most closely approaching (negative binomial, Poisson, positive binomial or "other contagious series") and 3) grade of passing from the time when the man angled his first catch to the time when he did his last one

Table 2. Catch pattern in relation to the number of captured individuals by respective men.

Type		Negative binomial			Poisson			Positive binomial			Contagious series other than negative binomial		
Grade of passing		Long	Medi-um	Short	Long	Medi-um	Short	Long	Medi-um	Short	Long	Medi-um	Short
Number of school attacked	Many							23			23		
	2	18 12			10		9	27			14		
	1		17 14 11	14		9 9	12,9 7,6 5	22 17	15 15		31 18		
	Self-spacingly	14						11 10					

Notes Numerals in columns are the numbers of captured individuals by respective men. For catch pattern, see the second paragraph in considerations.

(long—not shorter than 130 min., medium—neither shorter than 105 min. nor longer than 125 min. and short—not longer than 100 min.). This table suggests the following tendencies: 1) the man who angled up squids following positive binomial or "other contagious series" could get better catch than the man who did following Poisson or negative binomial series, 2) the man who continued to angle up squids for many time sections could get better catch than the man who did in short time but 3) it is difficult to find clear relation of catch to the number of schools attacked.

Summary

Catch records of squids angled up under lamp by 28 men distributed in a fishing ground in the same evening are analyzed, for the purpose of giving a short discussion on such problem that in what pattern are the squids angled up, then, a good catch is got by the man who caught squids following what pattern. The results are summarized in Table 2, which suggests the presence of close relation of pattern to the amount of catch, i. e. the man who continued to angle up squids for many time sections and following positive binomial or "other contagious series" gets better catch than the man who did in short time and following Poisson series.

References

1) BARNES, H. and T. B. BAGENAL: *Jour. Mar. Biol. Assoc.*, **29**, 649-660 (1951).
2) MAÉDA, H.: *This Bull.*, **19**, 305-318 (1953).
3) ———: *Jour. Shimonoseki Coll. Fish.*, **9**, 89-308 (1960), **10**, 119-353 (1961).
4) ———: *This Bull.*, **29**, 996-999 (1963).
5) MORISITA, M.: *Mem. Fac. Sci., Kyushu Univ.*, Ser. E, **1**, 187-197.
6) MURPHY, G. I. and K. C. ELLIOT: *Special Sci. Rept., Fish and Wild.*, No. 119 (1954).
7) UTIDA, S.: *Mem. Coll. Agric., Kyoto Univ.*, (1941-1943).
8) YAMAMOTO, T.: Statistics and survey Div., Min. Agric. Forest., Jap. Gov., (1956).
9) YOSHIHARA, T.: *This Bull.*, **18**, 241-244 (1952).