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Dependence Between Stock Size and Concentration Densities for Scotian Shelf Silver Hake by USSR Observers' Data for 1979 Through 1988

by

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SUMMARY

Dependence between density indices for silver hake concentrations on Scotian Shelf by the USSR observers' data for May (square % with catches per trawling hour of 3000 kg or more) and absolute and relative estimates of total biomass of the species under investigation for 1979 through 1988 has been analysed. It has been suggested that hake anomalous distribution took place in 1983 while in 1982 it was also observed a marked increase in abundance and biomass of the species. There were obtained data which indicated to the fact that the standardized commercial catch per effort unit had been rather reliable index of silver hake total biomass value. It is also recommended that the above-mentioned square percent will be used as the reference index for the stock state which does not require complex calculations and thorough information preparation.

INTRODUCTION

Fishery situation for silver hake to the south of limit for the foreign fishing (SMGL) underwent significant changes in the period under investigation. Areas of certain density concentrations varied year to year. The terms of silver hake concentrations persistence within fishing ground was not stable, as well. Being term fluctuations attributed mainly to oceanographic factors and to a certain degree to sexual maturity rate, concentration densities and areas are evidently dependent on the stock size even in a limited zone of Shelf. This paper is an attempt to obtain reliable data on the above suggestion correctness, basing on the analysis of proper information.

MATERIAL AND METHODS

Data on silver hake distribution to the south of SMGL obtained by the USSR observers on board commercial vessels for 1979 through 1988 (Rikhter et al., 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989), as well as the information on silver hake stock size for the same years (Rikhter, 1989, Waldron et al., 1988, 1989) have been analysed. Distribution has been analysed by blocks of 10'x10' in area (Fig.1) and months (May, June and July). There were calculated total number of blocks where silver hake were caught and number of blocks where catches per trawling hour were of 3000 kg or more. The level was considered to be a conventional one and indicated silver hake concentration average density in the period under investigation.

Biomass estimates used in the paper and obtained by the VPA method were interpreted with the standpoint of stock variation trends, taking into account their unreliability. Standardized commercial catches per unit effort (CPUE) were considered judging from the same point of view.

RESULTS AND DISCUSSION

Data on silver hake frequency in the commercial catches indicate that the species is distributed all over the zone which is open for foreign fishery (59°W through 64°W) during the period of the most stable exploitation (May and June). It is difficult to reveal any regularity, if there are no thorough systematic observations which cover the whole area under investigation. Detailed information can obviously be obtained only by annual trawl surveys. Therefore, to use data available some density criterion must be defined. Calculation results of total number of blocks where silver hake were caught, as well as blocks where the catches were of 3000 kg or more are represented in Table 1.

Although data represented are of rough meaninig, one is able to define periods of silver hake concentration low densities (1979 through 1981) and high densities (1984 through 1989) in the area to the south of SMGL, which agree with standardized catches per unit effort. 1982 and 1983 are special years. If the former year has to do with the period of high concentration densities, the latter one might be attributed to the period of low densities according to the data for May. As to the matter what year is anomalous one, one may admit 1983 to be like this taking into account anomalously yearly hake migration (the third ten-day period of June) from fishing ground. Indeed, such situation was obsrved only once since 1977.

Now, let us investigate silver hake stock state in 1977 through 1988. Relevant data are represented in Table 2. This information has been used to calculate correlation coefficients between the CPUE and biomass estimates by the VPA method and trawl surveys.

The data represented indicate that standardized CPUE are rather reliable indices of silver hake total biomass amount. The highest correlation between biomass estimates calculated by the VPA method is observed when excluding data for 1982, and that between CPUE and trawl survey biomass is noted when excluding data for 1983. Results obtained do not allow for a certain answering the question what year is to be excluded out of calculations. One may suppose that silver hake stock greately increased indeed in 1982 owing to the 1977, 1978 and 1979 year-classes which are according to the Canadian July surveys are by no means weak ones at the age of 2 and 3 years (Waldron et al., 1989). It is hardly possible to attribute sharp increases in commercial and scientific indices of abundance for 1982 to an anomalous distribution and not to the stock augmentation. Formation of highly dense concentrations with low population abundance mean that the species is absent from or is of poor abundance over the major habitat locations. In this case, one cannot expect the abundance and biomass indices to be high as it is shown by the trawl survey results. That was just our case. At the same time, low commercial and experimental catches which were caused by behaviourial and distributional properties of the species under investigation were possible with rather high abundance of the latter as well. Basing on the above-mentioned results, one may suggest that 1982 was not anomalous, being anomalous 1983. It was also characteristic of that year early disappearance of silver hake commercial concentration.

Let us consider once more Table 1 information. It is logic to suggest that such an index of concentration abundance as block percentage (BP) with a certain CPUE level is also characteristic of silver hake stock state in the period under investigation.

When analysing fishery conditions by years and months, May must be singled out as the period of the most stable silver hake commercial concentrations, being practically excluded species migration out of the area open for foreign fishing. April is probably such a month too. However, long-term data for this month are lacking. Late in June concentration density over the fishing area is usually going to reduce, but late in June or early in July mass silver hake migration can sometimes be observed towards the north of SMGL.

Therefore, we have at our disposal information for May which can be used to reveal the relation between block percentage with catches of 3000 kg or more and corresponding biomass estimates (Table 4).

Data represented indicate that the BP obtained by the observers' information for May can serve as the reference index for the silver hake stock state on Scotian Shelf. Thus, block shares with the catches of 3000 kg or more which exceed 40% suggest that the stock is at high level of 1984-1988. Share decrease to 20% or less will be indicative of a decrease in population abundance to 1979-1981 level. The highest correlation in all the versions is observed between BP and biomass estimates with the VPA tuning by Rivard (Rikhter, 1989). Waldron et al. (1988) data using gives high correlation only when excluding 1982. The relationship between BP and trawl survey biomass resulted to be an average one with r-values lower than critical ones in each case. As it may be expected, very strong relationship was obsrved between BP and CPUE. It was no need in excluding any year.

CONCLUSION

Results of the investigations carried out suggest that within the series of fishing years considered the anomalous one was 1983 and not 1982. In 1982 a marked increase in the silver hake biomass and abundance in fact took place on Scotian Shelf.

Analysis of dependence between different biomass estimates and block percentage (BP) where the catches were of 3000 kg or more per trawling hour indicates that CPUE is probably a reliable enough index of total biomass value for the species under consideration. At the same time, BP, according to May data, can evidently also be used as a preliminary index of stock state which does not require any complex calculation or obtaining and summarizing information for the whole fishing season by each country every year.

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Table 1

Absolute and relative (%) number of blocks where silver hake catches were of 3000 kg or more, by years and months

Year	May			June			July		
	Blocks of 3000 kg or more catches	Total block number where catches were taken	% of blocks where catches of 3000kg or more were taken	Blocks of 3000kg or more catches	Total number of blocks where catches were taken	% of blocks where catches of 3000kg or more were taken	Blocks of 3000kg or more catches	Total number of blocks where catches were taken	% of blocks where catches of 3000kg or more were taken
I979 I)	6	25	24.0	3	24	I2.5	-	-	-
I980	4	24	I6.7	2	I7	II.8	4	26	I5.4
I98I	I	I5	6.7	0	26	0.0	3	2I	I4.3
I982	8	I0	80.0	I6	22	72.7	4	27	I4.8
I983 2)	4	2I	I9.0	I0	I7	60.0	-	-	-
I984	I8	23	78.3	4	I8	22.2	6	II	54.5
I985	I0	20	50.0	I8	26	69.2	II	I8	8I.I
I986 3)	-	-	-	I9	29	65.5	24	32	75.0
I987	I2	I3	92.3	6	22	27.3	II	I8	6I.I
I988 4)	I0	22	45.4	2	23	8.7	-	-	-
I989	I3	27	48.I	-	-	-	-	-	-

1) Information for July is lacking.

2) Information is available for the two first ten-day period of June. In the third ten-day period the situation sharply worsened, and fishing stopped at the end of June.

3) In May USSR observers did not work on board fishing vessels.

4) In the beginning of July fishing stopped.

Table 2

Absolute and relative estimates of silver hake total biomass by years

Estimation Methods	Years												Information source
	I977	I978	I979	I980	I98I	I982	I983	I984	I985	I986	I987	I988	
VPA, thous.t	9I	35	286	262	240	327	298	343	375	44I	477	-	NAFO SCR Doc. 89/I4
VPA, thous.t	240	I95	234	2I9	204	292	300	400	482	797	884	-	NAFO SCR Doc. 88/5I
Groundfish survey, thous.t	I2.8	I3.0	54.4	I6.4	63.8	I06.7	38.0	79.8	69.4	75.9	58.5	4I.I	NAFO SCR Doc. 88/5I 89/48
CPUE	2.76I	2.239	2.642	I.946	2.205	5.652	2.809	4.57I	4.7I4	6.253	6.23I	4.395	NAFO SCR Doc. 89/48

Table 3

Relationship between total biomass estimates (VPA and groundfish survey) and standardized CPUE

Relationship	Parameters	The whole data series is used	1982 is excluded	1983 is excluded
CPUE and VPA (NAFO SCR Doc. 89/14)	Intersection	- 4.57	- 2.7I	- 2.42
	Slope	0.03	0.02	0.02
	τ	0.88	0.98	0.92
CPUE and VPA (NAFO SCR Doc. 88/51	Intersection	I.54	I.I3	I.62
	Slope	0.006	0.006	0.006
	τ	0.84	0.96	0.84
CPUE and survey biomass (NAFO SCR Doc. 88/51; 89/48	Intersection	I.84	I.60	I.78
	Slope	0.04	0.04	0.04
	τ	0.70	0.67	0.7I

Table 4

Relationship between total biomass estimates (VPA, groundfish survey, CPUE) and block percentage (BP) with catches of 3000 kg or more

Relationship	Parameters	The whole data series is used	I982 is excluded	I983 is excluded
BP and VPA (NAFO SCR Doc. 89/14)	Intersection	27.20	248.39	255.2I
	Slope	I.83	2.27	I.86
	r	0.69	0.79	0.68
BP and VPA (NAFO SCR Doc. 88/51)	Intersection	I55.98	I3I.60	I37.26
	Slope	4.82	6.28	5.04
	r	0.72	0.87	0.72
BP and survey biomass (NAFO SCR Doc. 88/51, 89/48)	Intersection	35.4I	38.93	37.75
	Slope	0.5I	0.33	0.48
	r	0.62	0.5I	0.57
BP and CPUE (NAFO SCR Doc. 89/48)	Intersection	I.76	-	-
	Slope	0.047	-	-
	r	0.95	-	-

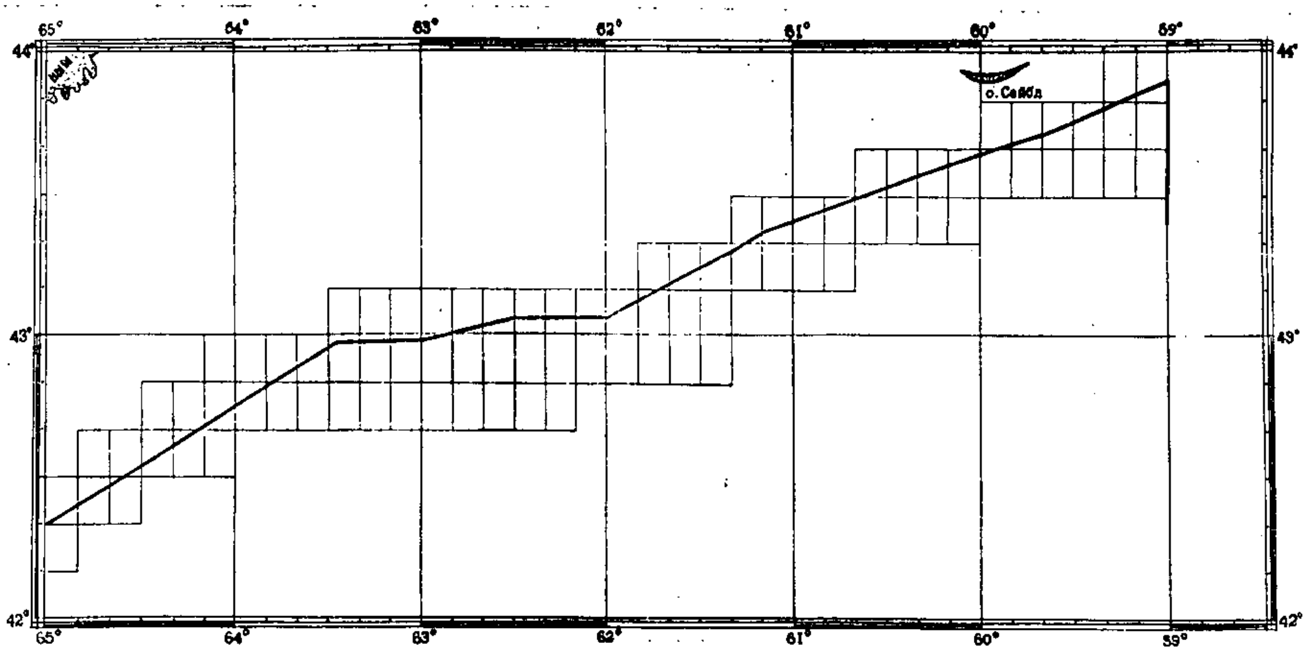

Figure 1. Fishing area scheme used to analyse USSR Observers' data.