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On Variability of Silver Hake Commercial Catches and Stocks
Within the Scotian Shelf Before and After the Introduction of the
200-mile Zone

by

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Abstract

A comparative estimation of some variability indices characterizing the dynamics of the Scotian silver hake fishery and stocks prior to and after 1977 has been done. Such indices as total catches, CPUE by year, biomass and abundance estimates by SPA and silver hake number and biomass found in the Canadian July surveys were selected for the study. Considerable differences in variability of the indices between two periods were revealed. In all cases but one coefficients of variation (CV) were found to be higher prior 1977. However, as far as variability of abundance and biomass estimates is concerned, considerable differences took place only when an adaptive approach was employed to tune SPA (after 1977). At the same time no differences were found between CV estimates obtained by means of ad hoc methods for both periods. Variability of abundance and biomass indices obtained during the Canadian July surveys (1977-1992) turned out to be high and close to the variability of the investigated indices prior to 1977. An opinion was expressed that considerable differences in variability of the abovementioned indices (trawling survey data excluding) most likely result from the strict silver hake fishery restrictions having been in force since 1977. Up-to-date estimates of the stock size seem to be too smoothed, and this very fact can, possibly, be explained by the underestimating these estimates during the years of the highest abundance.

Much attention should be paid to the selection and interpretation of the initial parameters included in the analytical models to get a reliable picture of the processes going on in the environment.

Introduction

The history of silver hake fishery on the Scotian Shelf can be divided into two periods - prior to and after introduction of the 200-mile economic zone in 1977. The first period was characterized by the limitless possibilities for silver hake fishery. On the contrary, the second one was notable for strict

fishery restrictions. Management measures adopted by the Canadian authorities in fact infringe upon the interests of the foreign fishermen only. As far as the Canadian fishermen are concerned they are given a free hand, but they don't catch silver hake. As for the history of studying the silver hake fishery the same two periods can be mentioned. The 200-mile zone having been introduced, the scope and quality of the studies have increased greatly. However, at the same time we came across new problems connected with the stock estimation. Unfortunately, those problems have not been solved entirely up-to this day. And interpretation of some initial data used in the analytical models makes big difficulties. Thus, opposite phases can sometimes be observed between abundance indices of the Canadian July surveys and CPUE values of the commercial catches. This fact calls the reliability of one of the data independent series in question. And a big difference between biomass and abundance estimates obtained by means of adaptive tuning of the cohort analyses and ad hoc methods is to be explained. The reasons of the considerable differences within the range of variations of silver hake stocks and catches prior to and after 1977. are not quite clear. In short, there are a lot of questions without answers. The present paper aims at paying attention to the existing problems and making a contribution to their solution.

Materials and Methods

A comparative estimation of variability (coefficients of variance) for some indices characterizing silver hake fishery and stock dynamics prior to and after 1977 was used in the study. The following indices were employed: total catches, CPUE values by year, biomass and abundance estimates obtained by SPA and hake number and biomass in the Canadian July surveys (Halliday, 1973; Noskov, 1976; Waldron et al., 1988; Showell et al., 1993). The selection of the method was based on the assumption that distributional pattern for silver hake migration abundance variations by year could not change greatly after the introduction of the 200-mile zone. In this assumption is true the differences in variability of indices between two approximately equal periods (1962-1976 and 1977-1993) can possibly be explained by some anthropogenic factors.

Results

Coefficients of variation (CV) are given in Table 1. The values presented allow to reveal considerable differences in variability of indices between two periods of fishery. In all cases but one the CV values were higher prior to 1977. This fact can hardly be called accidental. But as far as variability of biomass and abundance estimates is concerned considerable differences were found only when an adaptive approach was employed to tune SPA (after 1977). At the same time the tuning by ad hoc methods gave approximately the same results. Abundance and biomass indices obtained during the Canadian July surveys between 1977

and 1992 are characterized by high coefficients of variation. Unfortunately, these data can not be compared with those obtained from 1972 to 1976 due to the short row of observation.

Discussion and Conclusion

Before starting interpretation of the results obtained would like to pay attention to the fact that prior to 1977 silver hake was one of the preferable fishing objects in the former Soviet Union. Soviet fishermen could actually catch the species in any part of the Scotain Shelf and in any season. However, in 1977 the situation changed sharply. Restrictions for silver hake fishery in the Northwest Atlantic turned out to be the strongest as compared to those for other fish species. The area where the fishery for foreign vessels is permitted does not exceed 10% of the total area occupied by the population under study. Successful fishery within the mentioned area is only possible during fourth months (from April to July). Moreover, extremely strict limits for by-catch of some fish species hamper silver hake fishery. Sometimes such situation results in full suspension of the fishery (Halliday, 1993). Cautions TAC estimates announced by NAFO Scientific Council may be considered as one of the fishery limiting factors. It is quite explainable if to take into account the character of the initial information.

Basing the above-mentioned it may be assumed that untill 1977 total catches and CPUE characterized the state and dynamics of silver hake stocks by year more reliable as compared to those in the subsequent period. First of all it is true for the years with a high biomass estimate when the species under consideration became the preferable one for the fishery. At the same time during the periods of abundance depression when catches decreased sharply the fleet could switch over the other species also attractive for the fishermen. Thus, during such years the lower limit of catches did not give (overestimated) a true picture of the stock depletion. That was the case in the mid-1960's.

The 200-mile zone having been introduced, the situation changed sharply. Hake accessibility became to play a decisive part in the light of the above-mentioned restrictions. It is not astonishing that correlation coefficient between CPUE and hake biomass (specimen aged 2 and older) in the catches taken during the July surveys (Waldron et al., 1988) turned out to be statistically unreliable ($r=0.57$). A conclusion can be drawn that since 1977 CPUE values have ceased to be a reliable index of the fishery biomass. It is also evident that in new conditions total catch estimates can't serve as reliable indices of silver hake stock size and dynamics. Variability of catches (both total catches and CPUE) being considerably less as compared to that of prior to 1977 can possibly be explained by the influence of the above-mentioned restrictions. Silver hake abundance and biomass variability according to the July surveys which can be considered as a source of the most reliable information is noticeably higher and close to that of the indices under consideration

prior to 1977 (total catches excluding). The fact that CV of the abundance and biomass indices obtained by means of the adaptive approach turned out to be low, possibly resulted from the joint influence of the initial parameters included into the model. Some of them evidently reflect the real dynamics of silver hake stocks on the Scotian Shelf not quite well. Let's remember CPUE values. At the same time application of the ad hoc methods for tuning purposes brought approximately equal CV values prior to and after 1977. We do not call to come back to the application of the old subjective tuning methods. We simply state the facts and suggest to ponder over them.

And now some brief comments upon estimates of silver hake absolute size of stocks in the surveyed periods which were compared with actual catches and data of the Canadian July surveys. Maximum catch over the history of silver hake fishery occurred in 1973 and accounted for 300,000 t. The biomass estimate amounted to 620,000 t (aged 1 and older) (Noskov, 1976). The picture looks quite time if to compare these two estimates.

According to the Canadian July survey data hake number and biomass in the year mentioned amounted to:

fish aged 1 and older - 449.5 mln specimens and 55,500 t;

fish aged 2 and older - 312 mln specimens and 49,300 t.

The 200-mile zone having been introduced July catches slightly exceeded the 1973 value in separate year (Waldron et al., 1988).

According to the estimates obtained by SPA methods maximum biomass in one case (ADAPT) was found in 1984 and accounted for 360,000 t for specimen aged 1 and older (Showell et al., 1993). As far as tuning by ad hoc method is concerned an estimate of 884,000 t for 1987 was obtained (Waldron et al., 1988). All these facts can not be interpreted if a reliable criterion for comparison is unavailable. However, if Canadian July surveys data are considered to be such a criterion it may be seen that after the 200-mile zone had been introduced silver hake abundance and biomass attained the 1973 level at least in separate years.

According to the results obtained variability of the indices characterizing silver hake stock dynamics could hardly differ greatly between two survey periods. A sharp decrease of the corresponding CV values after 1977 can rather be explained by the impact of the restrictions mentioned above. Hence, a conclusion may be drawn that up-to-date stock estimates are too smoothed, primarily due to their understimation in the years of the abundance peaks. At the same time the results obtained by means of ad hoc methods should be considered as the subjective ones though in separate years they look more reliable.

The author is fully aware of the debatable character of the paper. Nevertheless, he considers it to be his duty to attract attention to the questionable points connected with the estimation of silver hake stocks and possible catches on the Scotian Shelf. Further studies are, possibly, to be connected with selection and interpretation of the initial parameters enabling to

get an objective picture rather than with improvement of the analytical models.

References

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Table 1

Coefficients of Variation (CV,%) for Some Indices Characterizing Silver Hake Fishery and Stock Dynamics on the Scotian Shelf prior to and after the Introduction of the 200-mile Zone

Characteristic	Prior to the introduction of the 200-mile zone	Years	After the introduction of the 200-mile zone	Years
Total catch	87	1962-1976	30	1977-1992
CPUE	67	1965-1975	40	1977-1993
ADAPT biomass	-	-	14	1977-1992
1+ ad hoc	68	1963-1976	63	1977-1987
ADAPT abundance	-	-	22	1977-1992
1+ ad hoc	65	1963-1976	75	1977-1987
Number of hake taken during the July surveys	-	-	56	1977-1992
1+	-	-	52	1977-1992
2+	-	-	-	-
Hake biomass in the July surveys	-	-	53	1977-1987
1+	-	-	61	1977-1987
2+	-	-	-	-