Northwest Atlantic Fisheries Organization

Serial No. N2667 NAFO SCR Doc. 96/3

SCIENTIFIC COUNCIL MEETING - JUNE 1996

Trends of Silver Hake Abundance Variability in Scotian Shelf Area and Other Gadoids in the North-Western Atlantic

by

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ABSTRACT

Comparative analysis of abundance variability (total and recruitment) after 200-mile zone introduction in 4VWX for silver hake and NAFO Subareas 2-5 for 12 other gadoids populations has been made. Good correlation between total abundance dynamics of silver hake, cod 2J+3KL, 3NO and 4T, pollack 4+5 and haddock 3Ps was revealed. On the basis of recruitment dynamics analysis of the units mentioned the explanation of the trends similarity is proposed. The possibility is discussed to use the results obtained for prediction purposes.

INTRODUCTION

At present it is evident that introduction of Canadian 200-mile zone provided no guarantees of gadoids stocks stabilization at high level, though the latter distribution areas, excluding cod 3NO, actually occure totally within the above - mentioned zone. During the period after 1977 significant abundance fluctuations were observed in populations (stock units) of silver hake, cod, haddock and pollack within NAFO Subarea 2-4, inspite of the management system implementation with firm restriction of fishery and efficient control of the latter. In the work presented the attempt is made to analyse and compare abundance variability trends of silver hake in Scotian area and other above mentioned species populations and provide a general idea on similarity and probable utilization of appropriate data to estimate approximately future abundance and biomass variability trends without detailed consideration of the latter variations reasons.

MATERIAL AND METHODS

The following abundance data by years were used after 200-miles zone

introduction: silver hake 4VWX (Showell and Bourbonnais, 1995), cod 2J+3KL (Bishop et al., 1994), 3NO (Stansbury et al., 1995), 3Ps (Bishop et al., 1995), 4T (Sinclair et al., 1995); 4VsW (Fanning et al., 1995) and 5Zj (Nunt and Buzeta, 1995), haddock 3NO and 3Ps (Murphy and Bishop, 1995) and 5Ze (Gavaris and Eeckhaute, 1995), pollack 3Ps (Murphy and Bishop, 1995) and 4+5 (Neilson and Perley, 1995) and white hake 4T (Hurlbut et al., 1995). Coefficients of correlation were calculated for the total silver hake abundance and other stocks units. Based on the results obtained the correlation coefficients were estimated for silver hake recruitment abundance and some selected populations of other species. Estimates obtained by means of SPA method were preferred. In the cases when no appropriate information is available, abundance indices of trawling surveys were used. Methods of assessment of the above-mentioned populations and recruitment age of those selected to perform a comparative analysis, are shown below:

Species	Stock unit	Method of abundance assessment	Recruitment age
1	2	3	4
Silver hake	4 VWX	SPA	1
Cod	2J+3KL	SPA	3
	3NO	SPA	3
	3Ps	trawling survey	
	4T	SPA	3
	4VsW	trawling survey	
	5Zj	SPA	
Haddock	3NO	trawling survey	
	3Ps	trawling survey	2
	5Ze	SPA	
Pollack	3Ps	trawling survey	
	4+5	SPA	2
White hake	4T	trawling survey	

Since the researches were aimed at abundance variability analysis, and absolute stock size and recruitment were of no interest, the values scale used to draw figures was selected in the way providing the above trends demonstration.

RESEARCH RESULTS

Comparison of abundance values (total and recruitment) was performed for the same years and year-classes in all cases. Table 1 presents the idea of similarity of total abundance trends for silver hake and other gadoids. The data shows that among 12

populations considered the correlation at 95 % probability occured in cod 3NO and that of 99% probability in cod 2J+3KL and 4T, haddock 3Ps and pollack 4+5. Total abundance dynamics of silver hake and 5 above-mentioned stock units is presented in Figures 1-5. The curves of the figures show correlation, however non-complete one, of high and low abundance periods between silver hake and other populations. Thus, the latter increase was observed during 1981-1986 with subsequent decrease till the terminal year of observations, used in this work.

Evidently that interpretation of the above trends similarity is possible only taking in account recruitment abundance dynamics for the same period. As to the similarity extent of its variability trends, results of correlation coefficient estimation presented in Table 2, show the lack of any correlation. Silver hake recruitment dynamics for 5 selected populalations is shown in Figures 6-10 . Comparison of curves reveals some interesting things. Thus, year-classes of 1981 in all stock units are strong or at least average in terms of abundance. The same is true for year-classes of 1979, 1980 and 1982 in all cod and pollack populations. It is evident that the period of strong year-classes occurence in three cod and pollack populations is shifted for 2-3 years back as compared to silver hake which defined subsequent similarity of the total abundance variation trends.

DISCUSSION

Results of research of silver hake and other gadoids abundance variations reveal sufficient similarity of the total abundance dynamics in same cases, as well as the total absence of the latter in reference to recruitment. However, no contradiction appears here. Fluctuations of fish year-classes abundance in different species, living sometimes rather far from each other, may correlate by years only in rare occasions. Environmental factors (biotic and abiotic) effect upon year-classes abundance is observed in specific spawning grounds, areas of eggs, larvae and young fish development during the first year of life , therefore no totally similar year-classes may occure in different stock units and species. Nevertheless, the results obtained suppose that large-scale climatic variations may in some cases affect approximately similarly population abundance dynamics trends, even when different (though closely relative) species are considered. The above fact is likely to be used in prediction purposes, e.g. to provide approximate estimate of total abundance and biomass trends of one species during 2-3 nearest years, if appropriate information on the other species population is available. Evidently, the species with the most reliable and latest information on abundance trends for the nearest years available should be used as a predictor. In our

case silver hake 4VWX seems to be such species, since the trawling survey of O-group in 1995 provides a preliminary estimate of the latter year-class as the most strong one during the period following 200-miler zone introduction. Therefore, in 1997-98 it is reasonable to expect considerable increase of silver hake fishable stock. If the trends correlation observed during the period discussed remain in future, recovery of cod 2J+3KL, 3NO, 4T, pollack 4+5 and haddock 3Ps will occure during above-mentioned years.

In conclusion, it should be noted that in 1981 at least average year-classes occured in silver hake of Scotian area and 5 other populations. The latter fact seems to deverse a special research concerning environment impact on abundance of gadoid year-classes during the above year. Probably, the results of such research will highlight the mechanism of strong and poor year-classes formation in gadoids on the Nortgh-Western Atlantic and, in particular, will provide better understanding of cod stocks depression reasons in early 1990s.

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Table 1

Correlation between total abundance of silver hake

and other gadoids populations in NAFO Subareas 2-5

Species	Stock unit	r
Cod	2J+3KL	0.70 **
	3NO	0.58 *
	3Ps	0.22
	4T	0.65 **
	4VsW	0.44
	5Zj	0.38
Haddock	3NO	0.36
	3Ps	0.62 **
	5Ze	-0.20
Pollack	3Ps	0.40
	4+5	0.66 **
White hake	4T	0.06

1) One or two asterics below correlation coefficient value denote statistical significant level of 5% and 1% respectively.

Table 2

Correlation between recruitment abundance of silver hake

and other selected stock units

Species	Stock unit	r
Cod	2J+3KL	0.17
	3NO	0.11
	4T	-0.02
Haddock	3Ps	0.05
Pollack	4+5	-0.01

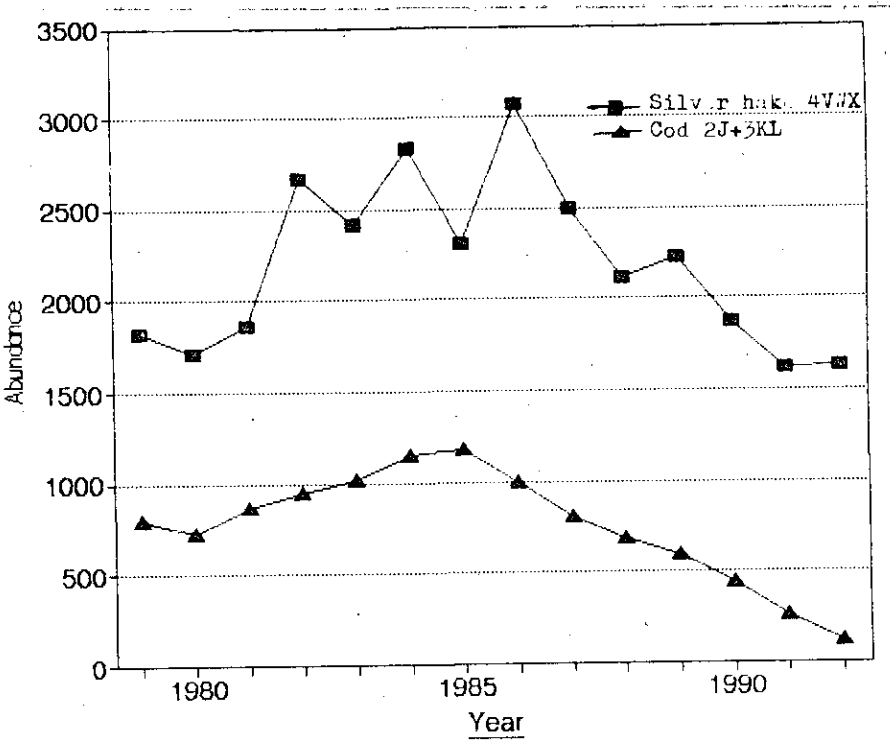

Fig. 1. Total abundance dynamics of silver hake 4VWZ and cod 2J+3KL, 1979-1992.

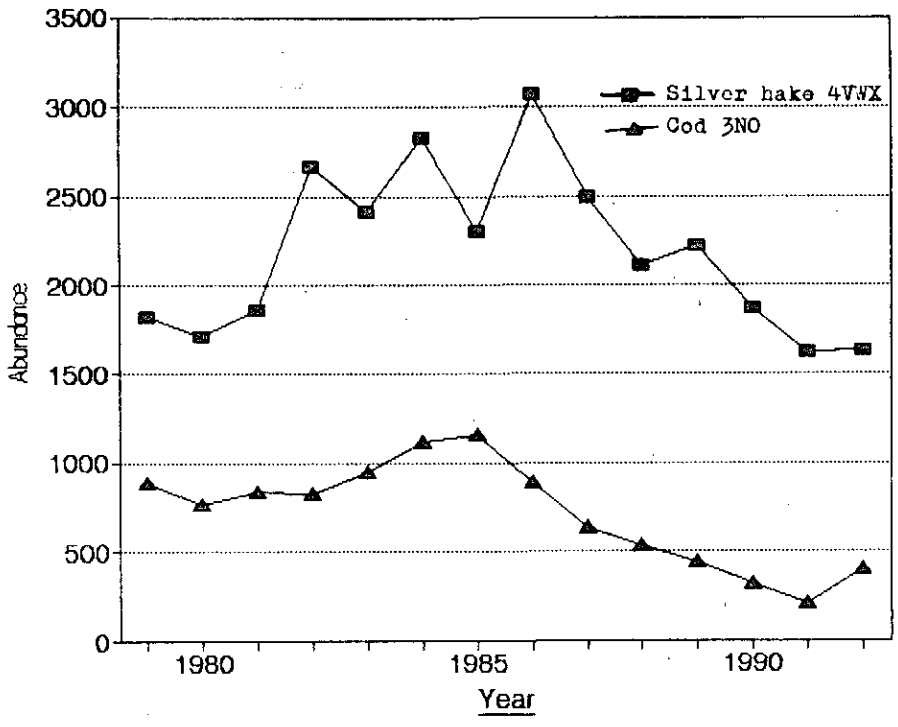

Fig. 2. Total abundance dynamics of silver hake 4VWX and cod 3NO, 1979-1992.

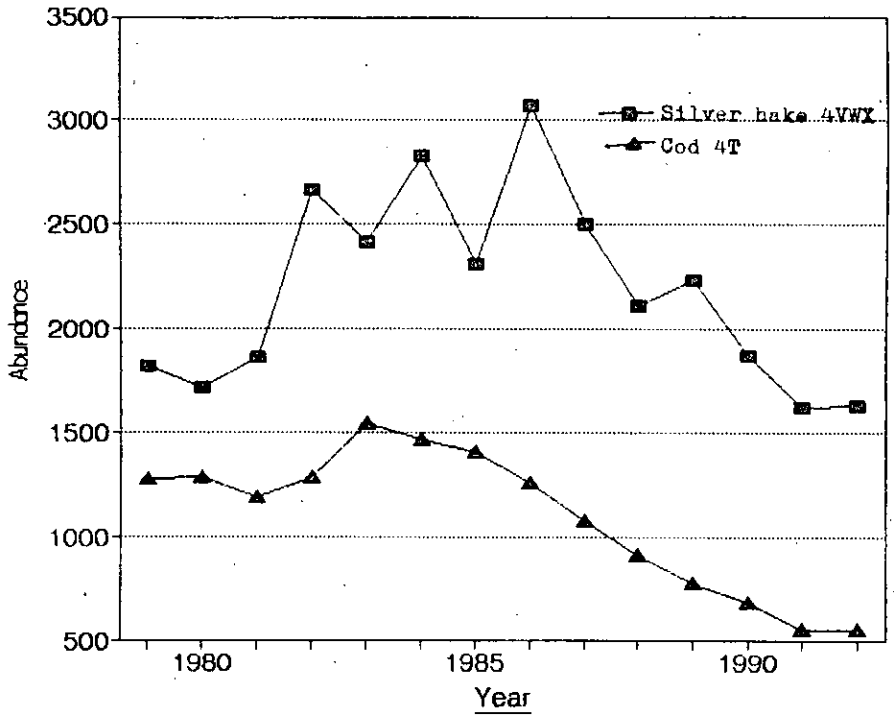

Fig. 3. Total abundance dynamics of silver hake 4VWX and cod 4T, 1979-1992.

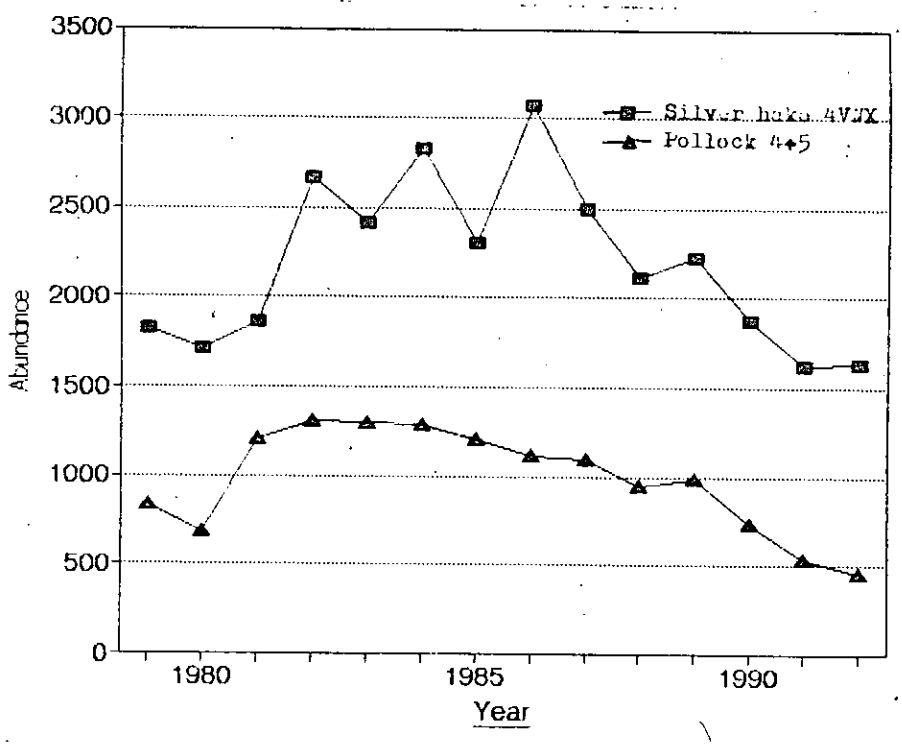

Fig. 4. Total abundance dynamics of silver hake 4VWX and pollack 4+5, 1979-1992.

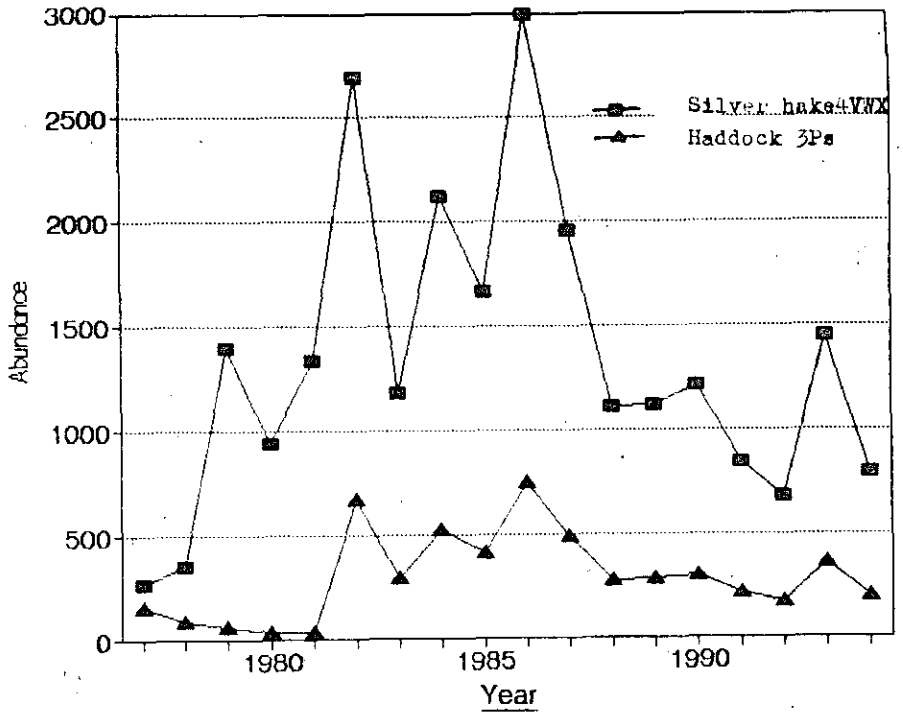

Fig. 5. Total abundance dynamics of silver hake 4VWX and haddock 3Ps, 1977-1994.

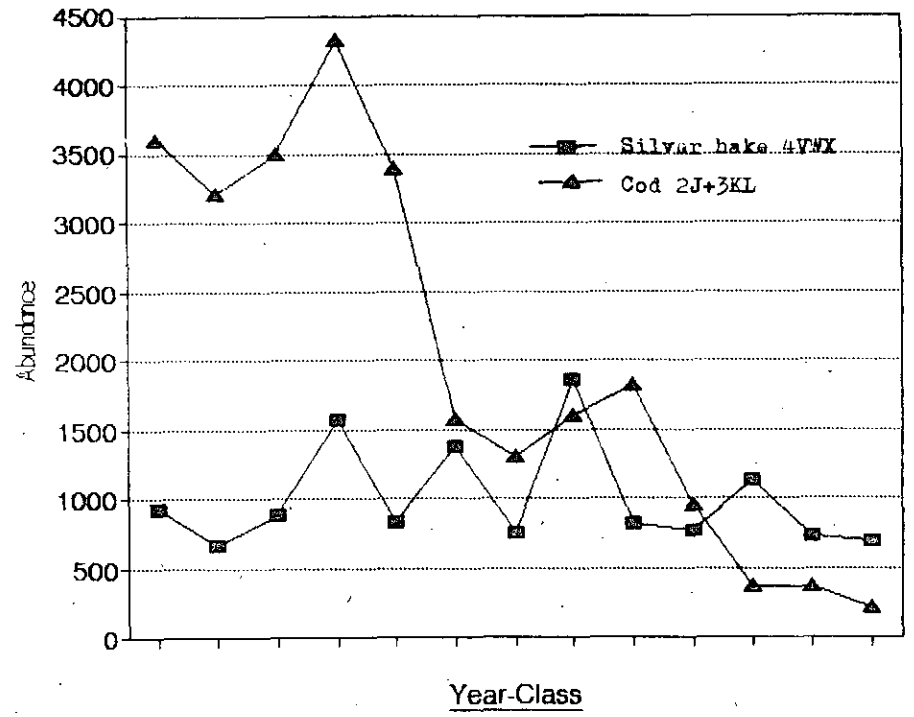

Fig. 6. Recruitment dynamics of silver hake 4VWX and cod 2J+3KL, year-classes 1978-1990.

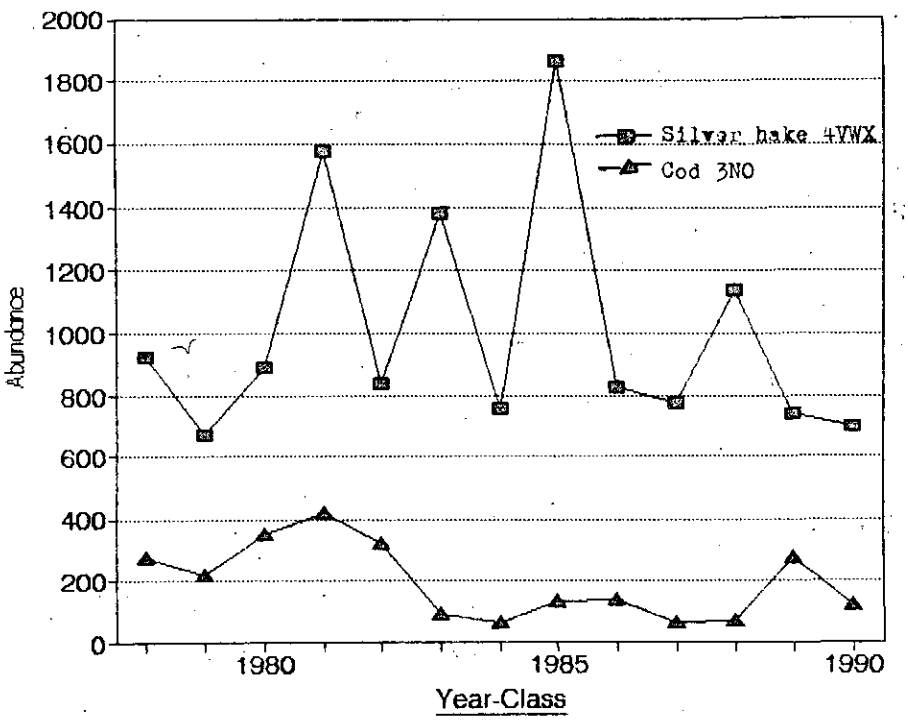

Fig. 7. Recruitment dynamics of silver hake 4VWX and cod 3NO, year-classes 1978-1990.

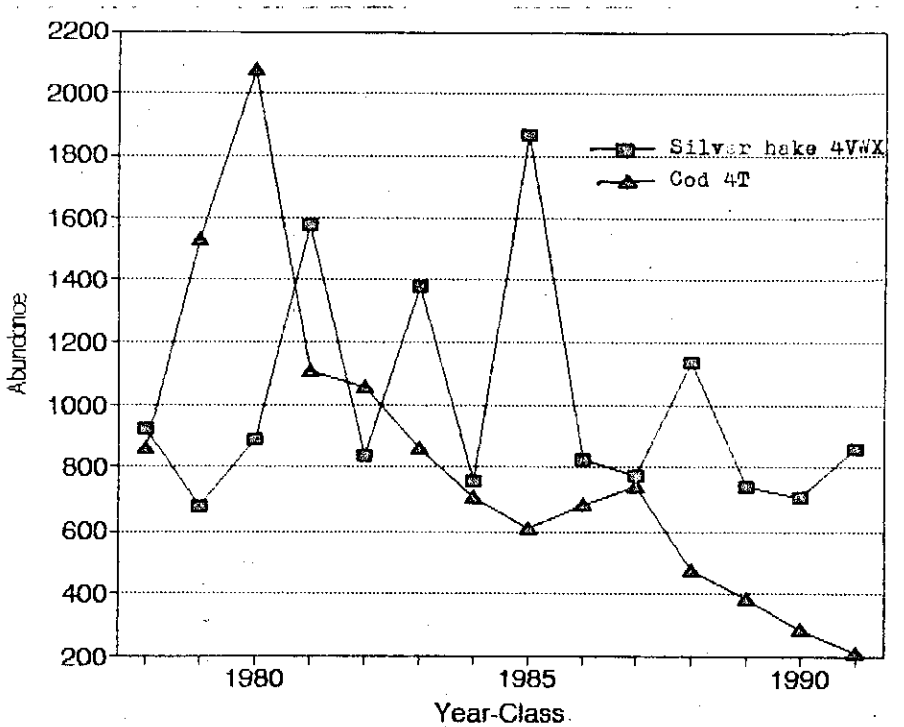

Fig. 8. Recruitment dynamics of silver hake 4VWX and cod 4T, year-classes 1978-1991.

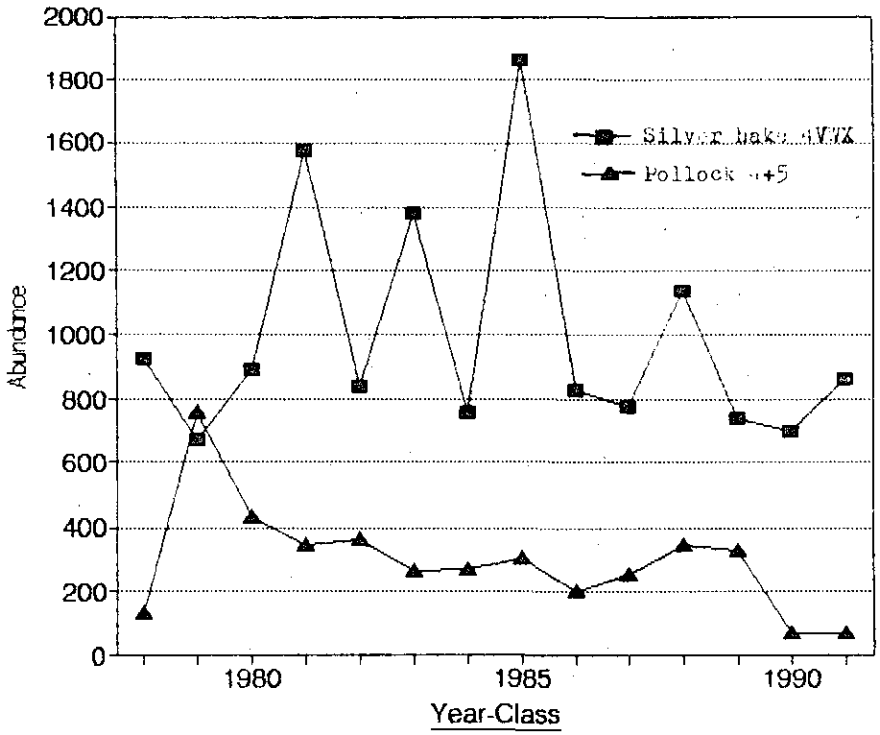

Fig. 9. Recruitment dynamics of silver hake 4VWX and pollack 4+5, year-classes 1978-1991.

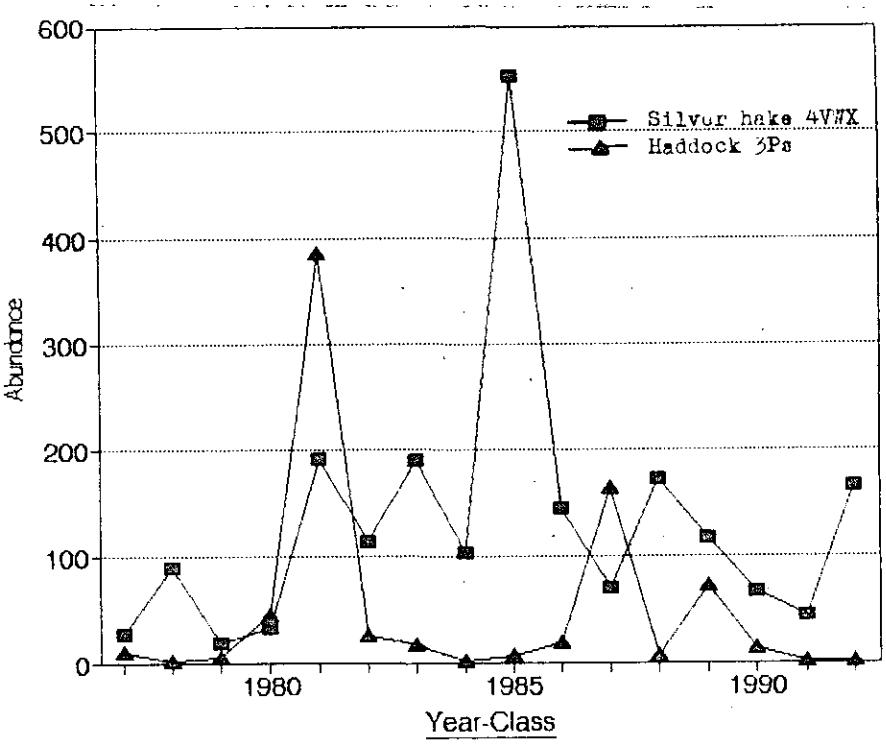

Fig. 10. Recruitment dynamics of silver hake 4VWX and haddock 3Ps; year-classes 1978-1992.