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# Some Comments About the Exploitation Pattern on the Flemish Cap Cod Stock

by

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**ABSTRACT.-**

The exploitation pattern estimated from results presented by Wells et al. (1984) for Flemish Cap cod could be considered as an argument supporting the existence of an emigration from 3M division.

The information against and in favour of this possible emigration of 3M cod stock is briefly revised and analysed.

## INTRODUCTION

Cod tagging experiments carried out by several countries over the last forty years seem to show that Flemish Cap support a single population that does not intermingle with any other in the Northwest Atlantic.

More than 35,000 cod were tagged by the USSR along the period 1960-66 on areas other than Flemish Cap, and none of the recaptures was made in Flemish Cap waters (Konstantinov, 1967). The same author reports that the 15 recaptures obtained in Flemish Cap corresponded to individuals tagged there. This author concluded that Flemish Cap sustaines an isolated population (Konstantinov, 1970).

Templeman (1974) reported that none of the cod tagged by Canada in the Newfoundland area was recaptured on Flemish Cap. The same author (1976 and 1979) reported that one from 98 recaptures of cod tagged on Flemish Cap along the same year was recaptured out of there, therefore 1 vs. 97 recaptures on place ; also, six from forty cod tagged in Flemish Cap were recaptured after the tagging year out of that area. Tagging was made in the periods 30 May to 3 June 1962 and 5 to 11 July 1964.

He concluded that tagging studies on Flemish Cap cod stock indicate a small percentage of migrants away from the Cap, and an even lower tendency for cod to inmigrate to the area.

Biological markers also seem to distinguish Flemish Cap population from the others :

The cod nematode Terranova (=Porrocaecum) decipiens cannot be found on fillets of cod caught in Flemish Cap waters (Templeman et al., 1957). The same is true for Hermaphrodera brachiata (Templeman & Fleming, 1963).

The isolation of Flemish Cap cod stock seems also to be confirmed by some studies about the allele frequency of some genetic loci.

Jamieson (1975) found highly significant differences in frequencies of transferrine alleles in blood serum, between Flemish Cap cod and the adjacent area Northeast Grand Bank.

Cross & Payne (1978) studied again the frequency of this allele, and concluded that it was possible to distinguish distinctly the population of Flemish Cap cod based on it. They even asserted that Flemish Cap may have maintained a relict cod population during the last glaciation, while the remainder populations were forced far South, and the two groups have not introgressed subsequently.

In spite of the arguments in favour of the isolation of this stock we have just described, certain pieces of information allow to cast some doubts about that isolation; furthermore, they seem to support a possible migration of mature cod from Flemish Cap :

The fishery in Flemish Cap has ever caught cod of an intermediate sizes, but catches of large cod are not frequent. Templeman (1976) cites Collins & Rathbun (1887) who said that "no trouble was ever observed - in Flemish Cap - in obtaining large quantities of medium-size cod, below the standard size required in the US market. Large fishes were less common, although occasionally very successful trips for large cods have been made".

A document by Fleming (1960) devoted to growth and maturity of cod in the Newfoundland area, shows, in its figures 5 and 6 the very different length and age distribution in the catch of Flemish Cap compared with that of the remainder stocks in the area. The age distribution from 3M is truncated from age 6, showing that there are practically no presence of 6+ cod in the catch made there. That cannot be the consequence of heavy exploitation, because fishing activities were scarce along those years (1947-50).

It was reported on several occasions that strong year-classes decrease dramatically as they become five or six years old. Figure 1 in Wells (1980) shows the truncation of the 73 year-class at six years old. The STACFIS report (1988) remarked that "the 1981 year class was predominant in 1984 and 1985, and still strong in 1986. In 1987 this year class was no longer strong". Wells & Gavaris (1984) presented the age composition of catches for longliners in April and October; in figure 2 it is possible to follow the truncation of 1977 and 1978 year classes (5 and 6 years old).

This paper intends to add a piece of information in this dispute that seems to support the hypothesis of a migration of mature cod from Flemish Cap.

**EXPLOITATION PATTERN.-**

Partial recruitment per age class was computed from a VPA made by Wells et al. (1984). This partial recruitment corresponded to the period 1978 to 1980, when the data base seems to be more reliable, as it is recognised by STACFIS (1984). The anomalus partial recruitment obtained for age 11 was substituted by that corresponding to neibourgh ages. Table 1 (col. 2), and figure 1, show the resulting partial recruitments, and compare them with partial recruitments for the remainder stocks in Subarea 3 (from Anon. 1988; Baird & Bishop, 1989 a, 1989 b.). It is shown that PR's for ages 7 and older are much lower in Flemish Cap - between .5 and .6 -, than in the other areas (1.0). For ages 4 and 5, however, the opposite is true, and PR's are higher in Flemish Cap.

**SIMULATION.-**

One explanation of this divergence is as follows (see table 2) :

Let us assume that an emigration of cod from Flemish Cap occurs for ages 5 to 7 (E=.5). The emigration rate (E) can be considered as part of an "apparent natural mortality rate"; the apparent M would be equal to M plus E, the corresponding emigration rate .

Now, cod present in Flemish Cap per age class are computed as survivors present there, and the number from one age to the next one is reduced according to : 1) apparent M, and 2) the selection factor, - whose magnitude per age class is set according to selectivity of the gear as found by Hodder (1964), and used by Wells (1981) -, times the

level of fishing mortality, i.e. :

$$N_{i+1} = N_i * \exp(-M-E_i-PR_i*F)$$

Catches are computed from the catch equation as

$$C_i = N_i * PR_i*F*(1 - \exp(-M-E_i-PR_i*F))/(M+E_i+PR_i*F)$$

Now, let us take the array of catch per age class computed in the way we have just described, and make a VPA assuming M=.2 and E=0.

Results are shown in table 2 and figure 2, and they lead to the following conclussion : the partial recruitments obtained from the VPA made by Wells et al. (1984) are consistent with the hypothesis of an emigration from Flemish Cap for ages 5-7, if the selectivity of the gear used in Flemish Cap is the same as that found by Hodder (1964).

**DISCUSSION .-**

Tagging experiments and biological markers seem to be very conclusive to show that there is no immigration to Flemish Cap, but perhaps the same is not true for emigration.

In fact, let us assume that a given fraction of the Flemish Cap stock migrates to a given area, and that some emigrants are tagged; the probability of recapture will be modified. If Flemish Cap cod arriving to the area is a very minor fraction of the cod stock there, the probability of recapture will be very much reduced.

Moreover, we have postulated, on posing our exercise, that the emigration is limited to some age classes; that means that only a fraction of tagged cod will migrate, while those older than 7 years will not. That could justify the very reduced number of recaptures out of Flemish Cap.

Given that we support the hypothesis of an emigration for a given age range, and not immigration , biological markers are not implied at all, because Flemish Cap area is free of infestation.

We are not in a position to discuss results of genetic studies. However, the extreme results found by genetists require a careful interpretation and some check that differences are not found among different ontogenetic phases or among samples coming from the same area. On the other hand, it seems that these genetic analysis have found some differences on just one allelic series among a high number of them that were tried.

Finally, one must forcely state that our argument is speculative; however, we believe it could be useful to judge again pros and cons about the supported assumption of the isolation of the Flemish Cap cod stock.

**REFERENCES**

**ANON. 1988.** Report of the 1987 ad hoc Working Group for assessment of the cod stock in Subdivision 3PS. NAFO SCR Doc. 88/75, Ser. No. N1518. 20p.

**BAIRD, J. W. and C. A. BISHOP 1989.** The assessment of the cod stock in NAFO Div. 3NO. NAFO SCR Doc. 89/35 Ser. No. N1611 61p.

**1989.** Assessment of the cod stock in NAFO Division 2J and 3KL. Cafsac Research Document 89/6. 102p.

**COLLINS, J. W. and R. RATHBUN. 1887.** A.- The sea fishing-grounds of the eastern coast of North America from Greenland to Mexico. IN: U.S. Comm. Fish and Fisheries. The fisheries and fishery industries of the United States, edited by G. B. Goode, Section III. p. 5-75.

**CROSS, T. F. and R. H. PAYNE. 1978.** Geographic variation in Atlantic cod, Gadus morhua, off eastern North America: a biochemical systematics approach. J. Fish. Res. Board Can. 35:117-123.

**FLEMING, A. M. 1960.** Age, growth and sexual maturity of cod (Gadus morhua L.) in the Newfoundland area 1947-1950. J. Fish. Res. Board Can. 17:775-809.

**HODDER, V. M. 1964.** Assessment of the effects of fishing and increases in the mesh size trawls on the major commercial fisheries of the Newfoundland Area. (ICNAF Subarea 3). Fish. Res. Bd. Canada Manu. Rept. Ser. (Biol.) No 801, 116p.

**JAMIESON, A. 1975.** Enzyme types of Atlantic cod stocks on the North American banks. in isoenzymes IV, genetics and evolution, Academic Press, San Francisco, 491-515.

**KONSTANTINOV, K. G. 1967.** Results of cod tagging off Labrador (Subarea 2) and Newfoundland (Subarea 3). ICNAF Res. Doc., No. 49, serial No 1837.

**1970.** On the appropriateness of the Flemish Cap cod stock for experimental regulation of a fishery. ICNAF Redbook 1970, Part III: 49-55.

**NAFO. 1984.** Scientific Council Report. 1984. 126p.

**NAFO. 1988.** Scientific Council Report. 1988. 149p.

**TEMPLEMAN, W. 1974.** Migrations and intermingling of Atlantic cod (Gadus morhua) stocks of the Newfoundland area. J. Fish. Res. Board Can. 31:1073-1092.

**1976.** Biological and oceanographic background of Flemish Cap as an area for research on the reasons for year-class success and failure in cod and redfish. ICNAF Res. Bull., No. 12: 91-117.

**1979.** Migration and intermingling of stocks of Atlantic cod, **Gadus morhua, of the Newfoundland and adjacent areas, from tagging in 1962-66.** ICNAF Res. Bull. 14, 5-50.

**TEMPLEMAN, W. and A. M. FLEMING. 1963.** Distribution of Lernaeocera branchialis (L.) on cod as an indicator of cod movements in the Newfoundland area. Spec. Publ. Int. Comm. Northw. Atlant. Fish., No4:318-322.

**TEMPLEMAN, W., H. J. SQUIRES, and A. M. FLEMING. 1957.** Nematodes in fillets of cod and other fishes in Newfoundland and neighboring areas. J. Fish. Res. Bd. Canada, 14:831-897.

**WELLS, R. 1979.** Status of the cod stock in division 3M. ICNAF Res. Doc. 79/VI/79, Ser No. 5425. 12p.

**1980.** Estimation of total mortality of cod on Flemish Cap in 1978 and 1979 from Canadian research vessel survey data. NAFO SCR Doc. 80/II/26, Ser. No. N058. 3p.

**WELLS, R., M. F. BORGES and A. VAZQUEZ. 1984.** Status of the cod stock in Division 3M. NAFO SCR Doc. 84/VI/94, Ser. No. N889. 8p.

**WELLS R. and S. GAVARIS. 1984.** Status of cod stock in NAFO division 3M. NAFO SCR Doc. 84/VI/47, Ser. No. N833. 4p.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Age | 2J3KL | 3M | 3NO | 3PS |
| 3 | .02 | .04 | .08 | .01 |
| 4 | .21 | .4 | .29 | .15 |
| 5 | .37 | 1 | .67 | .45 |
| 6 | .58 | .97 | .79 | .73 |
| 7 | .85 | .62 | 1 | 1 |
| 8 | 1 | .6 | 1 | 1 |
| 9 | 1 | .5 | 1 | 1 |
| 10 | 1 | .5 | 1 | 1 |
| 11 | 1 | .5 | 1 | 1 |
| 12 | 1 | .5 | 1 | 1 |

Table 1.- Partial recruitment for different stocks of cod in Subarea 3.

1) Baird & Bishop (1989)
2) Wells et al. (1984) from VPA (1978-1980)
3) Appendix I Baird & Bishop (1989)
4) Ad Hoc W.G. (1988)

Annual F=.5

| Age | M+E | Selec.* | Fi | Ni | Ci | $\hat{N}i$ | $\hat{F}i$ |
|---|---|---|---|---|---|---|---|
| 3 | .2 | .07 | .035 | 1000 | 31.19 | 1000 | .034 |
| 4 | .2 | .37 | .185 | 791 | 121.39 | 791 | .568 |
| 5 | .7 | .9 | .45 | 538 | 143.85 | 367 | .939 |
| 6 | .7 | 1 | .5 | 170 | 49.6 | 117 | 1 |
| 7 | .7 | 1 | .5 | 51 | 14.94 | 35 | .625 |
| 8 | .2 | 1 | .5 | 15 | 5.56 | 16 | .5 |
| 9 | .2 | 1 | .5 | 8 | 2.76 | 8 | .5 |
| 10 | .2 | 1 | .5 | 4 | 1.37 | 4 | .5 |
| 11 | .2 | 1 | .5 | 2 | .68 | 2 | .504 |
| 12 | .2 | 1 | .5 | 1 | .34 | 1 | .504 |

Table 2.- Simulation of partial recruitment for cod from Division 3M assuming an emigration for the ages 5-7.

* Hodder (1964)

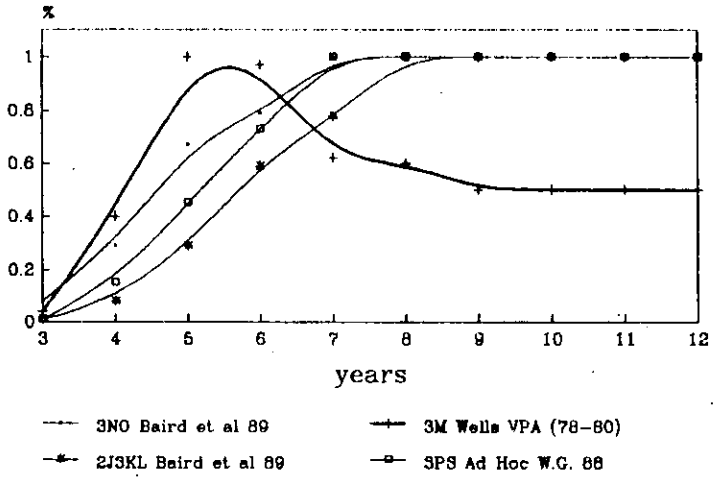


Fig. 1.-PR's for cod stocks in Subarea 3

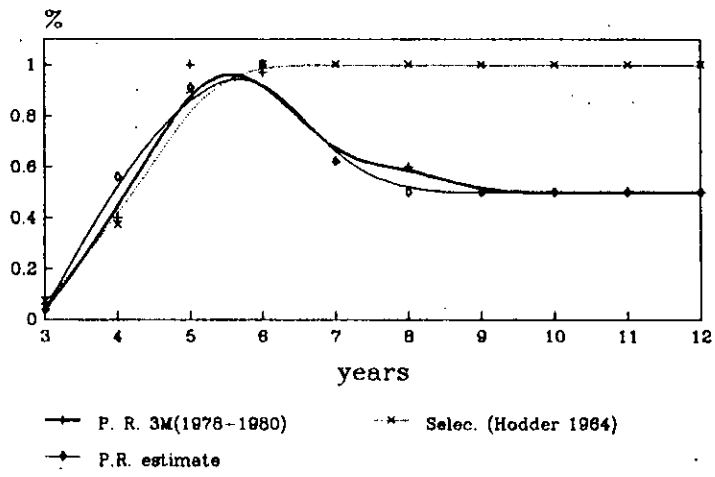


Fig. 2.- Simulation of PR found in 3M