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An Annotated Bibliography of Environmental Factors Affecting Assessment  
of Some Fish Stocks in the Newfoundland Area During 1972-1985

by

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INTRODUCTION

In the early 1970's, catch quota regulation was imposed on many of the finfish stocks in the waters adjacent to Newfoundland and Labrador. In an effort to determine appropriate total allowable catch (TAC) levels, assessments were conducted for most of these stocks on an annual basis over the period 1972 to the present. Table 1 shows the stocks which have been reviewed in this paper. These stocks have been assessed under the auspices of three scientific and regulatory organizations: the International Commission for the Northwest Atlantic Fisheries (ICNAF), the Northwest Atlantic Fisheries Organization (NAFO), and the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC). Table 2 shows under which jurisdiction stocks were reviewed annually.

In many cases environmental factors such as water temperatures, currents, winds, and ice have been shown or assumed to have had an effect on various parameters directly related to the assessment of a stock. This review presents a list of papers which fall into this category, along with a short summary of the relevant passages.

METHODS AND MATERIALS

The primary sources of information used in this review were annual reports and research documents from ICNAF, NAFO, and CAFSAC. Originally, annual reports of ICNAF and NAFO were examined for references to stock assessment papers. These were cross-referenced against the ICNAF and NAFO lists of titles (ICNAF, 1978, 1979; NAFO 1985) by year under the subject index of species. Other papers in these lists of titles which seemed relevant, but were not referenced in the annual reports, were also chosen for review. In the case of stocks assessed by CAFSAC, annual lists of research documents were examined and pertinent papers selected.

Papers which dealt with environmental conditions but did not relate specifically to any stock assessment were not included in the list compiled in this document. For example, information on hydrographic conditions as contained in ICNAF/NAFO member countries' annual research reports was often of a general nature.

Selected references along with brief summaries by year are contained in Appendix I. The authors apologize for any oversights on their part.

RESULTS

A total of 36 relevant references were obtained. Most of the information pertained to cod and capelin stocks under ICNAF/NAFO jurisdiction. There were no references concerning redfish and only infrequently were there any environmental effects mentioned in flatfish stock assessments. A summary of available information can be obtained from Table 2.

The major topics summarized from the referenced papers include how environmental factors affect recruitment to stocks, commercial fisheries, distribution of fish, and research vessel survey coverage. However, it is evident from this extensive review that many stock assessments do not contain even minimal information on environmental conditions.

REFERENCES

- ICNAF. Index and List of Titles of Meeting Documents, 1978. Number 2 for the years 1964-74. Dartmouth, Canada, 140 p.
- ICNAF. Index and List of Titles of Meeting Documents, 1979. Number 3 for the years 1975-79. Dartmouth, Canada, 117 p.
- NAFO. Index of Meeting Documents, 1979-84. 1985. Dartmouth, Canada, 146 p.

Table 1. A list of stocks that have been reviewed for environmental factors related to stock assessment (1972-85).

Species	Stock area	Years documentation reviewed
Cod	2J3KL	1972-85
	3M	1973-85
	3NO	1972-85
	3Ps	1972-85
American plaice	2+3K	1974-85
	3LNO	1972-85
	3Ps	1974-85
Yellowtail	3LNO	1972-85
Greenland halibut	0+1	1974, 1976-85
	2+3KL	1974-85
Witch	2J3KL	1973-85
	3NO	1973-85
	3Ps	1973-85
Redfish	2+3K	1974-85
	3LN	1973-85
	3M	1974-85
	3Ø	1973-85
	3P	1973-85
Capelin	2+3	1974-85

Table 2. Scientific and regulatory organizations responsible for the assessment of reviewed stocks. (I = ICNAF, N = NAFO, C = CAFSAC). Asterisks denote stocks for which information has been found in a given year.

Species	Stock area	Year													
		72	73	74	75	76	77	78	79	80	81	82	83	84	85
Cod	2J3KL	I*	I*	I*	I*	I	I	I*	I	N*	N	N	N	N	N
	3M	-	I*	I	I*	I	I*	I*	I	N*	N*	N*	N	N	N
	3NO	I*	I*	I*	I	I	I	I	I	N	N	N	N	N	N
	3Ps	I	I*	I*	I	I	C	C	C	C	C	C	C	N	N*
A. plaice	2+3K	-	-	I	I	I	I*	C	C	C	C*	C	C	C	C
	3LNO	I	I	I	I	I	I	I	N	N	N	N	N	N	N
	3Ps	-	-	I	I	I	C	C	C	C	C	C	C	C	C
Yellowtail	3LNO	I	I	I	I*	I*	I	I	I	N	N	N	N	N	N
G. halibut	0+1	-	-	I	-	I	I	I*	I*	N	N	N	N	N	N*
	2+3KL	-	-	I	I	I	I	I	I	N	N	N	N	N	N*
Witch	2J3KL	-	I	I	I	I*	I*	I	I	N	C	C	C	C	C
	3NO	-	I	I	I	I	I	I	I	N	N	N	N	N	N
	3Ps	-	I	I	I	I	C	C	C	C	C	C	C	C	C
Redfish	2+3K	-	-	I	I	I	I	C	C	C	C	C	C	C	C
	3LN	-	I	I	I	I	I	I	I	N	N	N	N	N	N
	3M	-	-	I	I	I	I	I	I	N	N	N	N	N	N
	3O	-	I	I	I	I	I	C	C	C	C	C	C	C	C
	3P	-	I	I	I	I	C	C	C	C	C	C	C	C	C
Capelin	2+3	-	-	I	I	I*	I*	I*	I*	N	N	N	N*	N	N*

APPENDIX 1

1972

- (1) Bogdanov, A. S. and T. F. Dementieva. 1972. The state of cod stocks in the Labrador (Div. 2J) and Newfoundland (Div. 30) areas in 1971 and the fishery forecast for 1972. ICNAF Res. Doc. 72/25. Serial No. 2716, 3 p.

Cod 2J3KL: It is stated that a succession of "rich" year-classes followed by a succession of "poor" year-classes is related to periodic fluctuations in oceanological conditions.

Cod 2J3KL: A further contribution to the expected increase in the cod fishery in the Labrador area in 1972 will be made by the following two factors: 1) increasing negative anomalies of the water temperature over the shelf and the continental slope of Labrador will force cod to pass to deeper water layers, which will result in denser commercial concentrations and 2) in the earlier half of 1971, especially in February and March, the ice conditions in the Labrador area were very severe, which restricted the cod fisheries.

- (2) Konstantinov, K. G. 1972. Abundance fluctuations of fishery stocks of cod and haddock on the Grand Bank of Newfoundland. ICNAF Res. Doc. 72/107. Serial No. 2833, 8 p.

Cod 3N0: It was stated that an inverse relationship existed between catches of cod and haddock in Div. 3N0, with cooler water temperatures favoring cod recruitment over haddock recruitment in the area.

1973

- (3) Bulatova, A. Yu. 1973. Distribution and abundance of young cod off Newfoundland in April-June 1972. ICNAF Res. Doc. 73/22, Ser. No. 2955. 6 p.

Cod SA 3: This paper discusses distribution and abundance of young cod in SA 3 for the period April-June 1972 with respect to water temperature.

- (4) ICNAF Redbook. 1973. Part I. Dartmouth, Canada, p. 63.

Cod SA 2: Reference was made to the reduction in catch since the late 1960's, caused by severe ice conditions in the 1970-72 period. Vessels were forced to leave the fishing grounds earlier than in former years.

- (5) Konstantinov, K.G. and A. S. Noskov. 1973. USSR Research Report, 1972. ICNAF Summ. Doc. 73/22. Ser. No. 3018. 14 p.

Cod SA 2: It was stated that the cod fishery off Labrador in February-April 1972 was greatly hampered by severe ice conditions. An improvement was observed in this fishery in 1973, partly due to an increase in water temperatures.

1974

- (6) ICNAF Redbook. 1974. Dartmouth, Canada, pp. 80-81.

Cod 2J3KL: The redbook states that offshore landings in Div. 2J have decreased from 346,000 t and 357,000 t in 1968 and 1969 to 148,000 t in 1972 because of severe ice conditions.

It was noted that very low values of catch per man in Div. 2J in 1970-72 for the inshore fishery may be in part due to low water temperature prevailing in those years.

- (7) Pinhorn, A. T. and R. Wells. 1974. Calculation of total allowable catches (TAC's) for 1975 for the cod stocks in Subareas 2 and 3. ICNAF Res. Doc. 74/89, Ser. No. 3325. 16 p.

Cod 3N0 and 3Ps: The authors stated that decreasing temperatures in these areas from 1969 to 1973 may have affected availability of cod to the fishing gear, resulting in declines in commercial and research abundance indices. Colder temperatures in 1972 and 1973 were also thought to be the cause of poor inshore fisheries in Div. 3Ps in these years.

1975

- (8) ICNAF Redbook. 1975. Dartmouth, Canada, p. 28.

Cod 2J3KL: Severe ice conditions since 1970 have hampered the fishery and have tended to divert fishing effort increasingly to the southern part of the area. In 1973, about 84% of the catch was taken in Div. 3KL and only 16% from Div. 2J.

Cod 2J3KL: Research vessel survey catch rates from FRG, Canadian and USSR surveys show a severe reduction which could have been caused by an increase in natural mortality as a result of the unfavorable environmental conditions in recent years.

Yellowtail 3LNO: It was stated that a decline in survey catch rates from 1971-74 may have been caused by unusually low bottom temperatures which may have had an affect on the behavior of the fish in relation to the survey trawl, or may have contributed to a high natural mortality.

- (9) Konstantinov, K. G. 1975. The impact of water temperature on the fluctuations in the abundance of Flemish Cap Bank cod. ICNAF Res. Doc. 75/115, Ser. No. 3608. 6 p.

Cod 3M: It was stated that lower water temperatures are more favorable for producing large year-classes of cod on the Flemish Cap. The very large catches of the 1973 year-class in the 1974 USSR survey were highlighted, and the low water temperatures observed in 1973 were noted.

1976

- (10) ICNAF Redbook. 1976. Dartmouth, Canada, p. 80.

Witch 2J3KL: It was noted that inshore catches in recent years prior to 1976 were somewhat reduced due to ice conditions.

- (11) Pitt, T. K. 1976. Recent events in the yellowtail fishery in ICNAF Div. 3L, 3N, and 3Ø. ICNAF Res. Doc. 76/VI/67. Ser. No. 3885, 12 p.

Yellowtail 3LNO: The same observations made in the 1975 yellowtail assessment (reference 1975, No. 8) were reiterated.

- (12) Sangott, G and Ø. Ulltang. 1976. Norwegian capelin fishery and capelin investigations in Newfoundland and Labrador waters in 1975. ICNAF Res. Doc. 76/VI/23., Ser. No. 3803. 8 p.

Capelin 3NO: The authors noted that the distribution of capelin on the Southeast Shoal differed in 1975 from that observed in 1972-74 and attributed this difference to lower surface temperatures and higher bottom temperatures in 1975. It was stated that the distribution of capelin in 1975 favored purse seining over midwater trawling as a method of capture.

1977

- (13) Bowering, W. R. and T. K. Pitt. 1977. An evaluation of the status of witch flounder from ICNAF Divisions 2J, 3K, and 3L. ICNAF Res. Doc. 77/VI/10. Ser. No. 5030, 9 p.

Witch 2J3KL: The authors restated the observations made in the 1976 assessment of this stock (reference 1976, No. 10).

- (14) Carscadden, J. 1977. Observations on larval capelin in ICNAF Division 3L. ICNAF Res. Doc. 77/16. Ser. No. 5036. 10 p.

Capelin 3L: The author noted that the presence of ice prevented complete coverage of the northern Grand Banks area during a survey for larval capelin in 1977.

- (15) Konstantinov, K. G. 1977. Fluctuations in the abundance of cod and some other commercial fishes on the Flemish Cap Bank. ICNAF Res. Doc. 77/VI/53, Ser. No. 5106, 17 p.

Cod 3M: The author stated that a good relationship existed between water temperature on the Flemish Cap in May and the strength of the cod year-class of the same year.

- (16) Pitt, T. K. 1977. An update of the Assessment of American Plaice from ICNAF Subarea 2 and Division 3K. ICNAF Res. Doc. 77/VI/9. Serial No. 5029, 7 p.

Am. Plaice 2+3K: The author states that since 1974 Canadian allocations of 3,500 t were not taken because there was no fishing for this stock by the otter trawler fleet and a combination of poor catch rates and adverse ice conditions apparently reduced the gillnet landings.

- (17) Bakanev, V. S. and A. S. Seliverstov. 1978. Capelin investigations in the waters off southern Labrador (Division 2J) and on the north Newfoundland Bank (Division 3K) in the autumn of 1977. ICNAF Res. Doc. 78/VI/30. Ser. No. 5191, 11 p.

- (18) Klochkov, D. N. and A. S. Seliverstov. 1978. Assessment of abundance and biomass of the spawning stock of capelin in ICNAF Division 3N in summer of 1977. ICNAF Res. Doc. 78/VI/29. Ser. No. 5190, 6 p.

Capelin SA 2+3 (Refers to 17 and 18): It was hypothesized that due to anomalous hydrological conditions, the capelin stocks concentrated closer to shore in 1977 than in the 1974-76 period. It was also noted that temperatures were about 2° higher in the offshore spawning areas in 1977, which may have reduced the spawning period for capelin. The authors concluded that their standard acoustic-photo survey in 1977 was not effective, due to these hydrographic conditions.

#### 1978

- (19) Bowering, W. R. 1978. The distribution of Greenland halibut in Statistical Area "0". ICNAF Res. Doc. 78/VI/38. Serial No. 5200, 6 p.

Greenland Halibut SA 0: It is stated by the author that the high incidence of small fish in this area as observed by a research vessel survey may be explained by the cyclic condition of the currents between Greenland and Canada.

- (20) Kudlo, B. P. and V. D. Boytsov. 1978. The effect of water dynamics on the size and recruitment of the Flemish Cap Bank cod stock. ICNAF Res. Doc. 78/23. Ser. No. 5184. 10 p.

Cod 3M: The authors showed that a relationship existed between the intensity of horizontal and vertical water circulation in the central part of the Flemish Cap and the abundance of cod year-classes. They proposed that these dynamic indices could be used to forecast the relative abundance of two year old cod for two years in advance.

- (21) Postolaky, A. I. 1978. Method of forecasting the stock conditions and catches of cod in the Labrador and Newfoundland Bank areas. ICNAF Res. Doc. 78/26. Ser. No. 5187. 9 p.

Cod 2J3KL: It was stated that, in 1974-76, the decrease in the cod catches from the Labrador and the North Newfoundland Bank areas was caused by very hard ice conditions in the first half of the year.

#### 1979

- (22) Chumakov, A. K. and A. I. Postolaky. 1979. On the USSR fisheries of Greenland halibut and roundnose grenadier in the Davis Strait Area. ICNAF Res. Doc. 79/VI/126. Ser. No. 5522, 6 p.

Greenland Halibut SA 0+1: The authors noted that favorable conditions in the 1973-78 period in the Davis Strait area resulted in a considerable increase in abundance of Greenland halibut in that area.

- (23) Ermolchev, V. A., S. M. Kovalev, and A. S. Seliverstov. 1979. Methods and results of Echometric Surveys on the Assessment of the Grand Newfoundland Bank capelin abundance in spring-summer 1978. ICNAF Res. Doc. 79/II/131. Serial No. 5357, 11 p.

Capelin 3NO: The authors state that anomalous high heat content of water masses observed on the spawning grounds in June of 1978 were not appropriate for capelin spawning on the Southeast Shoal. This view was not put forth by the assessment subcommittee (Reference - 1979, No. 25).

1979

- (24) Gomez, Jose A. 1979. Temperatures and salinities on the Southeast Shoal of the Grand Bank in July 1978. ICNAF Res. Doc. 79/II/9. Serial No. 5334, 3 p.

Capelin 3NO: The author stated that bottom temperatures on the Southeast Shoal were considered good for capelin spawning and were unlikely to be responsible for the absence of spawning capelin in this area in 1978. This view was substantiated in the report of the assessment subcommittee (Reference - 1979, No. 25).

- (25) ICNAF Redbook. 1979. Dartmouth, Canada, p. 37.

1980

- (26) Konstantinov, K. G. 1980. Water temperature and strength of cod year-classes on the Flemish Cap. NAFO SCR Doc. 80/VI/55. Ser. No. N092, 6 p.

Cod 3M: The author presented further evidence for a negative correlation between cod year-class strength and water temperatures on the Flemish Cap. See also References 1975 (5) and 1977 (15) by same author.

- (27) Konstantinov, K. G., and A. S. Noskov. 1980. USSR research report for 1979. NAFO SCR Doc. 80/VI/18. Ser. No. N144, 33 p.

Cod 2J3KL: The report stated that Soviet fishing operations in the Southern Labrador area were hampered by ice in February, 1979.

1981

- (28) Konstantinov, K. G. 1981. Influence of water temperature on cod year-classes strength on the Flemish Cap Bank. NAFO SCR Doc. 81/VI/77. Ser. No. N362, 7 p.

Cod 3M: The author made inferences about the 1979 and 1980 year-classes of cod on the Flemish Cap, based on a relationship between temperature and yearling abundance in surveys. See also References 1975 (5), 1977 (15), and 1980 (26) by same author.

- (29) Pitt, T. K. and W. B. Brodie. 1981. Stock assessment of American plaice in NAFO Subarea 2-Division 3K. CAFSAC Res. Doc. 81/51, 17 p.

Am. plaice 2+3K: The authors noted that the large increase in the offshore catch of this stock in January-March 1981 was caused in part by increased trawler effort, made possible by unusually favorable ice conditions for that time of year.

1982

- (30) Akenhead, S. A. 1982. Flemish Cap cod year-class strength and environmental variables. NAFO SCR Doc. 82/VI/41. Serial No. N530, 10 p.

Cod 3M: The author states that neither sea-surface temperature nor salinity nor their combination are significantly correlated with year-class strength on the Flemish Cap. However, the author reports significant correlations between winds and year-class strength.

1983

- (31) Leggett, W. C., K. T. Frank, and J. E. Carscadden. 1983. Estimating year-class strength in capelin from abiotic variables. NAFO SCR Doc. 83/VI/52. Ser. No. N710, 17 p.

Capelin 2J3K+3L: The authors concluded that the poor recruitment to these capelin stocks in 1973-76 was caused by unfavorable meteorological and water temperature conditions during and subsequent to larval emergence from inshore spawning sites. Forecasts, based on relationships between these abiotic factors and capelin abundance, indicated average to strong recruitment to stocks from the 1979-81 year-classes.

1985

- (32) Bakanev, V. S. and K. V. Gorchinsky. 1985. Hydroacoustic survey of capelin stocks in Divisions 2J+3K and trawl survey of capelin prerecruits in Divisions 3KLNO in November 1984-January 1985. NAFO SCR Doc. 85/52. Serial No. N1001, 11 p.

Capelin 2J3K: The authors stated that cooler water temperature on the surface and in the core of the Labrador Current were related to the earlier starting of capelin migrations southwards and distribution of its schools southeasterly.

- (33) Chumakov, A. K. and V. A. Poletaev. 1985. USSR research report for 1984. NAFO SCS Doc. 85/14. Ser. No. N1013, 25 p.

Greenland Halibut SA 0+2: The report stated that severe ice conditions restricted coverage in two Greenland halibut surveys in late 1984.

- (34) Maucorps, A. and J. C. Poulard. 1985. Contribution to the assessment of the cod stock in Subdivision 3Ps. NAFO SCR Doc. 85/32. Ser. No. N982, 7 p.

Cod 3Ps: The authors noted that much colder temperatures were observed over St. Pierre Bank in the winter of 1984-85. They stated that this may have had an effect on the distribution of cod and noted that higher than normal catches in the 1985 survey were observed in the 101-151 fathom range.

- (35) Miller, D. S. 1985. Capelin Hydroacoustic surveys in NAFO Division 3L and 3LNO in 1984. NAFO SCR Doc. 85/73. Serial No. N1028, 7 p.

Capelin 3LNO: Survey coverage during the April-May Div. 3L survey was restricted by ice to the north of the first survey block. High capelin densities were observed on the northern boundary of this block which suggests that the ice-covered area to the north which could not be surveyed contained a significant but unknown proportion of the total capelin stock.

- (36) Nakashima, B. S. and R. W. Harnum. 1985. The 1984 inshore capelin fishery in Division 3L. NAFO SCR Doc. 85/76. Ser. No. N1034, 11 p.

Capelin 3L: It was noted that the delay in the availability of capelin to the 1984 fishery was most likely caused by cooler than normal water temperatures.