

# NORTHWEST ATLANTIC FISHERIES ORGANIZATION



## Scientific Council Studies Number 24

Impact of Anomalous Oceanographic Conditions at the  
Beginning of the 1990s in the Northwest Atlantic  
on the Distribution and Behaviour of Marine Life

Symposium, 15–16 September 1994



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## Foreword

In accordance with its mandate to disseminate information on fisheries research to the scientific community, the Scientific Council of NAFO publishes the *Journal of Northwest Atlantic Fishery Science*, which contains peer-reviewed primary papers and notes on original research, and *NAFO Scientific Council Studies*, which contains review papers of topical interest and importance, and sometimes includes contributions to special meetings and symposia. Each year since 1981, the Scientific Council has held a Special Session on a topic of particular interest, and many of the documented contributions to those sessions have been published in NAFO publications or in other fishery-oriented periodicals.

During 15–16 September 1994, the Scientific Council held a Symposium on 'Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life', with M. Sinclair (Canada) and M. Stein (Republic of Germany) as co-conveners. Through ICNAF and NAFO times, the scientific community had expressed the interests and values of conducting decadal reviews of the environmental conditions in the Northwest Atlantic. Two such publications were completed for the decades of the 1960s (*ICNAF Special Publication*, No. 8 – Symposium on Environmental Conditions in the Northwest Atlantic, 1960–69, Jul 1972, 254 p.), and the 1970s (*NAFO Scientific Council Studies*, No. 5 – Symposium papers on Environmental Conditions in the Northwest Atlantic, 1970–79 Dec 1982, 114 p.). The September 1994 Symposium addressed the environmental issues in recent years, particularly relating them to marine life.

Interest in the contributions to the Symposium resulted in the Scientific Council recommendation that papers presented should be published in full or as extended abstracts in a special issue of *NAFO Scientific Council Studies*. The Council also recognized the value of recording the discussions that took place at the Symposium, and transcripts of the discussions are accordingly presented at the end of each paper.

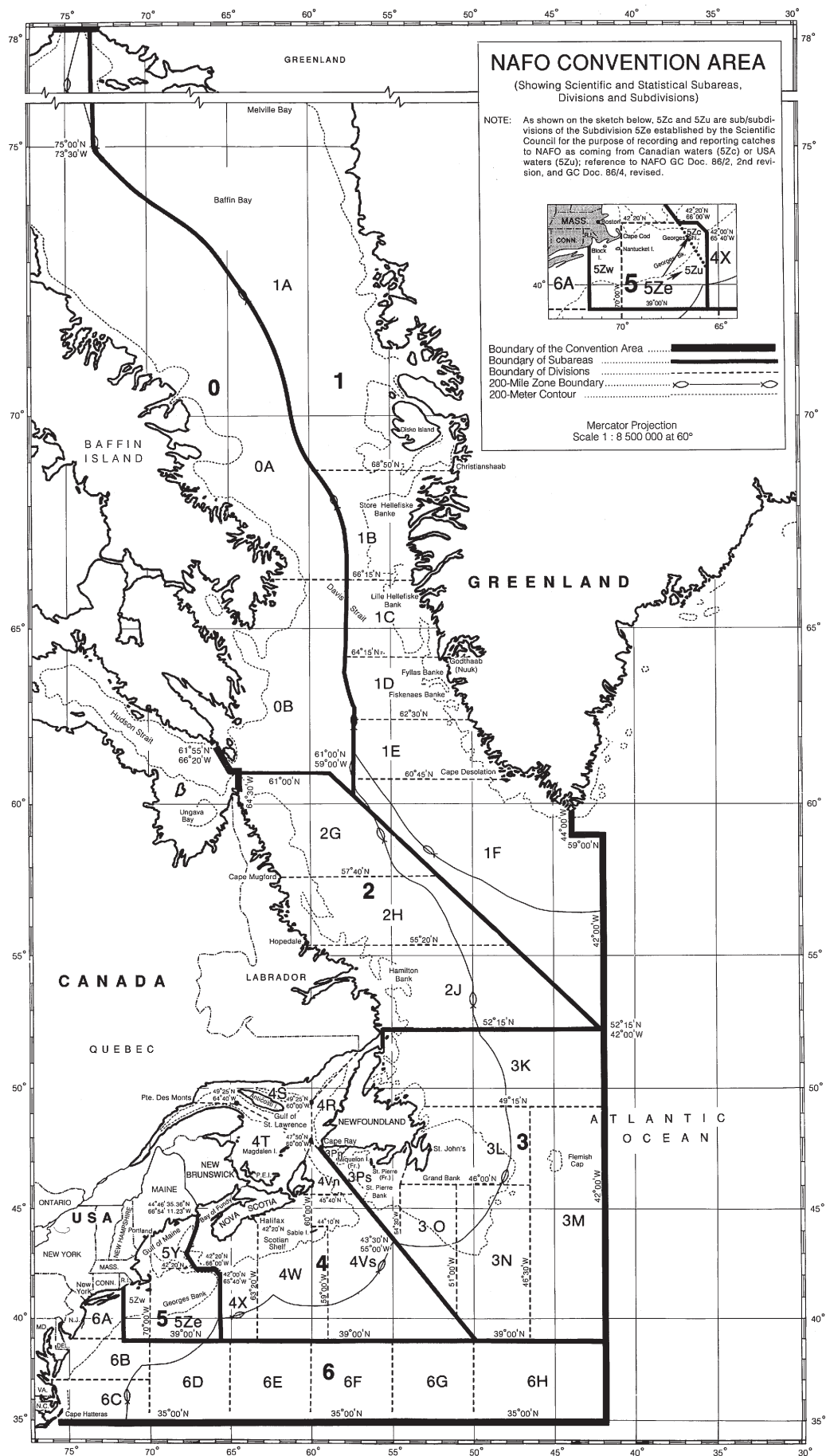
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## Ronald Wilmot Trites

1929–1995



Ronald Wilmot Trites, a well-known Canadian physical oceanographer died in Dartmouth, Nova Scotia, on 12 June 1995, at the age of sixty five. He was born and raised in Moncton, New Brunswick and attended the University of New Brunswick in Fredericton where he obtained a B.Sc. in mathematics and physics in 1950. Upon graduation he was hired by the Fisheries Research Board of Canada, joining the Atlantic Oceanographic Group at the Biological Station in St. Andrews, New Brunswick, where he began investigations into the physical oceanography of the Scotian Shelf. In 1951 he headed west to the Institute of Oceanography at the University of British Columbia in Vancouver completing his M.A. in 1952 and his Ph.D. in 1955. Upon his return to the east coast of Canada he was seconded to the Naval Research Establishment in Dartmouth for a year to work on oceanographic problems for the Department of National Defence. In 1956 he returned to St. Andrews and soon was appointed a member of the research committee of the International Passamaquoddy Fisheries Board to investigate possible effects of a proposed tidal power project in Passamaquoddy Bay. This work was carried out between 1957–59 and firmly estab-

lished a trend towards applied oceanography that was to dominate the remainder of Ron's professional career.

In 1960, the Atlantic Oceanographic Group transferred to Halifax and in 1962 they moved into the newly-built Bedford Institute of Oceanography. Ron assumed an increasing administrative work load, heading a group that undertook surveys and analysis to meet physical oceanographic requirements in fisheries, defence, coastal engineering, navigation and pollution. He also became head of the Environmental Oceanography Program of the newly formed Marine Ecology Laboratory which fostered interdisciplinary ecological studies. His research interests remained broad and included circulation of the waters on the Scotian Shelf and in the Gulf of St. Lawrence, the physical oceanography of the small estuaries and bays that dotted the coasts of eastern Canada, oceanographic instrumentation, pollution studies, marine climate and environmental effects on fish stocks. In 1970 he was heavily involved in the tracking and clean-up of the first major oil spill off Canada's east coast. Later that year he was seconded to Ottawa for 10 months to undertake studies related to long-term planning with the Fisheries Research Board. Returning to BIO in 1971, Ron again became involved in oil spill tracking and the evaluation of the possible environmental impact of spills and proposed oil refineries. This work led him to sit on several international committees concerned with pollution including ones within NATO, ICES and the Intergovernmental Maritime Consultative Organization. In 1975–76 Ron spent a year's sabbatical at the Centre Oceanologique de Bretagne in Brest, France, studying recent ideas on interdisciplinary and multidisciplinary oceanographic research.

Ron's interest in the linkages between physics and fish resulted in his joining the Environmental Subcommittee of ICNAF in 1974. He became a member of the Working Group on Standardization of Hydrographic Sections and an active participant in the planning of the ICNAF sponsored recruitment studies on Flemish Cap and Georges Bank studies in the late-1970s. He also took the lead role in the study of physical oceanographic component of the Georges Bank. Among the important contributions he made, two ICNAF Special Session contributions were particularly valued; convening the one on remote sensing methods and their possible application to fisheries science, and providing a key paper in the other

on environmental conditions in the NW Atlantic during the 1970–79 decade. Feeling strongly that a regular forum was needed to bring oceanographers, biologists and fisheries scientist together on a regular basis to discuss environmental matters, he led the push in 1981 to reestablish the NAFO Environmental Subcommittee, which had been temporarily abandoned under the reorganization of ICNAF into NAFO. He was subsequently appointed its chairman in June 1981, a position he held until 1984. During his tenure as chairman he established a more rigorous and extensive annual review of environmental conditions in the NAFO area, which continues to be published in NAFO Studies. These he began in 1982 and continued as coauthor of the reviews until 1990. Ron also was a member of the Squid Working Group in the 1980s publishing important papers on the influence of the Gulf Stream on the dispersal of squid larvae.

Between 1982 and 1984 Ron played a lead role in the Canada–U.S Georges Bank boundary dispute as a technical advisor in physical oceanography to the Department of External Affairs. Also during the 1980s Ron investigated the physical oceanography of the Baffin Island fjords, the role of currents in dispersing lobster larvae off southwest Nova Scotia, and the interannual variability in ocean climate as

revealed from analysis of sea surface temperature. In his last major study, Ron returned to the Passamaquoddy area of New Brunswick where he carried out a field program and modelling of the physical oceanography of L'Etang Inlet in support of salmon aquaculture.

Ron was a dedicated family man and active in the community being a founding member of his church, involved in school affairs, neighbourhood programs and in later years as a councillor for cancer patients. He and his wife, Lillian, were avid round dancers, often attending dances all over Nova Scotia, and they helped organize dances put on by their local club. They also loved to travel. Ron will be remembered by his colleagues for many fine qualities, including his dry sense of humour, friendly manner, his integrity and his concern for others. To Lillian and their children, Andrew, David, Ian, Lauri and Doreen we extend our deepest sympathies. Although sadly missed by relatives, friends and colleagues alike, his influence and the fond memories will long endure.

Kenneth F. Drinkwater  
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## Introduction

This issue of *NAFO Scientific Council Studies* contains the papers which were presented at the Symposium on 'Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life', held at NAFO headquarters in Dartmouth, Nova Scotia, Canada during 15–16 September 1994. Where available, notes on the discussions which followed the presentations, are given in connection with the individual papers.

As indicated in the attached report on the Symposium, the participants agreed to publish the papers and discussions from the symposium in a special publication. During its June 1995 meeting, the Standing Committee on Publications (STACPUB) decided that publication of Symposium proceedings be issued as supplementary issues of either the Journal or Studies. Given this decision and recognizing the likelihood of many primary literature standard papers being submitted to this Symposium, the conveners of the 1994 Special Session took the necessary action to publish the Symposium papers in a proceedings volume. Some of the following papers are already published in primary literature or are in the editorial processing.

Publication of these papers in the present proceedings volume does not preclude any of these papers from being published in primary literature.

Co-conveners:	M. M. Sinclair Science Branch Dept. of Fisheries and Oceans P.O. Box 1006 Dartmouth, Nova Scotia Canada B2Y 4W2	M. Stein Institut für Seefischerei Palmaille 9 D-22767 Hamburg Republic of Germany
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# Report of the Symposium

## Introduction

The Symposium on 'Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life', with M. Sinclair (Canada) and M. Stein (EU–Germany) as co-conveners, was held at the NAFO Headquarters, Dartmouth, Nova Scotia, Canada during 15–16 September 1994. Twelve papers were presented (SCR Doc. 94/63–74). The Symposium was opened by H.-P. Cornus (STACFIS Chairman – EU–Germany).

M. Sinclair introduced the theme of the meeting with an historical account of the shift in the conceptual framework of the fisheries fluctuations problem that occurred during the first decade of ICES research activities. The title of the talk was "Fisheries Fluctuations: the Paradigm Shift of Committee A (1902–14)". At the turn of the century the existing hypothesis accounting for interannual and decadal scale fluctuations was that migration changes at the species level, forced by changing oceanographic conditions (on ocean-basin scales), generated variable abundance at diverse fishing locations along the coast of Europe. The new hypothesis of Hjort (1914), based largely on the work of Committee A of ICES, emphasized the role of year-class variability of geographically restricted stocks as the major cause of fluctuations in catches. In recent years migration changes due to oceanographic variability are considered to be an important component of the "fisheries fluctuations" problem. Thus the speaker proposed that a balance between the "migration thinking" of the 19th century and the "population thinking" of the 20th century will probably be the conceptual framework of the 21st century.

A total of 31 participants (see page 143) registered for the Symposium, representing 12 countries (Canada, Denmark, Faroe Islands, France, Germany, Greenland, Japan, Portugal, Spain, Russian Federation, United Kingdom and the United States of America).

## Summary of Contributions

Four papers (SCR Doc. 94/69–94/72, see List of Documents, page 144) were presented on the changes in the environmental conditions of the North Atlantic on a range of time and space scales. On a time scale of a century, it was shown that the cold atmospheric conditions off West Greenland during the past two decades were comparable to those at the turn of the century, and as such were not anomalous. On a shorter time scale (i.e. the past

several decades), however, the oceanographic conditions of the 1980s and the early-1990s were shown to be colder than average (relative to the 1961–90 mean) for most of the Northwest Atlantic from West Greenland to about the eastern Scotian Shelf. In contrast the conditions in the eastern part of the North Atlantic (Iceland to Europe) had been warmer than average during the past decade. The environmental conditions over the western Scotian Shelf, the Gulf of Maine area and the Mid-Atlantic Bight had been average. The changes in environmental conditions, as well as their pattern, were described. The major change had been shifts in the winter wind conditions (the intensity and direction of the northwesterlies) over time, which in turn modified the advection of cold water from the Davis Strait via the Labrador Current. The shift in the winter winds (which are generated by the relative air pressure strengths of the Icelandic Low and the Bermuda-Azores High) bring warmer air temperatures over the eastern seaboard of the United States, when the cooler than normal conditions are being generated in the Northwest Atlantic. Thus the southern part of the NAFO area had been experiencing average environmental conditions during the past decade, while the northern part had been cooler than average. On shorter time scales (within season) it was shown that anomalous advection of Scotian Shelf water across the Northeast Channel can displace Georges Bank water. This occurred in the winter spring of 1992, and may have had an impact on gadoid recruitment processes. The four papers on the oceanographic conditions within the NAFO area provided an excellent framework within which to summarize the degree to which the past several years had been anomalous. In the summary discussion it was concluded that on a time scale of interest to fisheries management (i.e. years to decades) the early-1990s had been very cold for most of the NAFO area.

Four papers (SCR Doc. 94/64, 66, 67 and 73) evaluated trends in spawning stock biomass (SSB), recruitment, survival rate (i.e. recruitment over SSB), and growth of fish as a function of changing environmental conditions and fishing pressure. It was concluded that survival rate had been relatively low during the past decade. Also weight-at-age and growth rates had been low for several cod stocks, but not all. To a certain degree the recent patterns in growth rate changes and weight-at-age follow the broad patterns in changes in environmental conditions. Weights-at-age for Div. 2J+3KL cod, Div. 4T cod, Div. 4VsW cod and annual growth rate for Div. 2J+3KL cod had been declining during the cool

period. In contrast growth rates for Icelandic and Arcto-Norwegian cod, and weights-at-age for the Gulf of Maine area cod (Div. 4X and 5Z) had either been stable or high during the respective average and warm periods. It was also noted that fishing mortality had been increasing during the time period of stock declines in many areas. Thus fishing had contributed to the rate of decline of the stocks during a time period which had been poor for fish production over a large part of the NAFO area. There was some evidence that cod recruitment variability off West Greenland was associated with increased advection of warm oceanic waters and that temperature and current strength off Atlantic Canada influenced recruitment for a range of fish species (groundfish and pelagic).

Four papers (SCR Doc. 94/63, 65, 68 and 74) addressed changes in distribution of fish species in response to the cool period of the last several years. There was strong evidence that capelin and Greenland halibut had expanded their distribution to the Scotian Shelf in parallel with the declining temperatures on the eastern shelf. Spawning times of capelin have been 4–6 weeks later since 1991. Capelin have also appeared on Flemish Cap in recent years. American plaice were observed more frequently in deeper water within Div. 3LNO than had been the case prior to the 1990s. Silver hake were shown to be associated with the shelf/slope front off the Scotian Shelf. On short time scales (weeks), silver hake were observed to change their distribution in relation to shifts in the position of the front.

During a general discussion, it was **recommended** that *long-term monitoring of oceanographic properties (including plankton), as well as of fish distributions and abundance be given high priority within the NAFO area to allow interpretation of fish population fluctuations*. The consensus of the participants was to publish the papers and the discussion from the symposium in a special publication. The co-conveners thanked the Secretariat for their help in the preparation of the papers and their support at the meeting.

### Schedule

#### 15 and 16

#### September 1994: NAFO Symposium

(Note: these are revised dates, initial announcement was 14–16 September)

#### Thursday, 15 September

- 0900–0930 – Registration (at NAFO Headquarters)
- 0930–1800 – Presentation of papers and discussions.

1. DRINKWATER, K. Decadal overview of environmental conditions.
2. STEIN, M. Environmental overview in the Northern Atlantic area.
3. SINCLAIR, A. Decadal trends in stock abundances in the Northwest Atlantic.
4. BOCHKOV, Yu. A., and F. M. TROYANOVSKY. Contemporary long-term oscillations of atmospheric and oceanic processes in the Labrador and Barents Seas and their biological consequences. (NOT PRESENTED)
5. FRANK, K. T., J. SIMON, and J. E. CARSCADDEN. Unusual distribution of capelin (*Mallotus villosus*) in the Northwest Atlantic during the late-1980s and early-1990s.
6. NAKASHIMA, B. S., G. H. WINTERS, and G. MERTZ. The effect of oceanographic conditions on spawning behaviour and early life history of capelin and their impact on traditional inshore indices of abundance.
7. MALMBERG, SVEND-AAGE, and HÉOINN VALDIMARSSON. Hydrographic conditions in Icelandic waters in relation to the sub-polar Gyre.
8. STEIN, M. Stability of water masses – Impact on cod recruitment off West Greenland?

#### Friday, 16 September

- 0930–1300 – Presentation of papers and discussions.
1. SIGAEV, IGOR K., and VLADIMIR A. RIKHTER. On relation of some commercial fish species year-classes abundance and hydrological conditions in the Northwest Atlantic.
  2. IGLESIAS, SERGIO, ENRIQUE DE CARDENAS, and JAVIER PAZ. Presence of American plaice (*Hippoglossoides platessoides*) at non-habitual depths in the Northwest Atlantic.
  3. DE CARDENAS, ENRIQUE. Some considerations about annual growth rate variations in cod stocks.

- |  |           |   |
|--|-----------|---|
| 4. GERASIMOVA, O. V., V. M. KISELEVA, and S. A. KUZMIN. Long-term variations on cod distribution and space structure of their trophic relations over the Newfoundland Shelf in spring. (NOT PRESENTED) |           | Shelf. (NOT PRESENTED)  |
| 5. CLARK, D. S., and F. H. PAGE. Influence of water temperatures on distribution of cold water fish fauna on the eastern Scotian   | 1430–1800 | –   |
|  |           | 6. SIGAEV, I. K. Ecological conditions of silver hake concentrations in the Scotian Shelf area. |
|  |           | 7. MANNING, J. Oceanographic conditions of the Georges Bank spawning grounds, 1992–94.          |
|  |           | Review and discussions followed by concluding session.  |
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