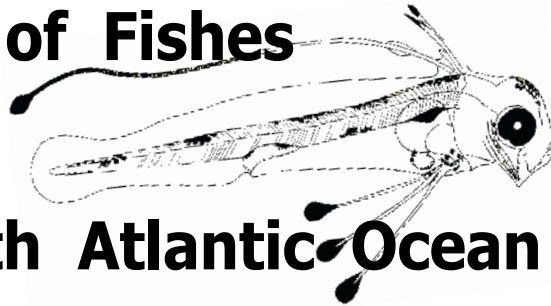










# Early Stages of Fishes in the Western North Atlantic Ocean



by Michael P. Fahay

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This comprehensive scientific publication is the only up-to-date textbook providing detailed descriptions and accurate drawings of the early life-history stages of the fishes from the Northwest Atlantic Ocean north of 35°N and west of 40°W. The region covers the world's most famous fishing grounds and includes the Davis Strait, southern Greenland, Flemish Cap, Georges Bank, northern Sargasso Sea and Middle Atlantic Bight to Cape Hatteras. This beautifully produced and published work includes:

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## Review of Michael Fahay's 2007 monograph "Early Stages of Fishes in the Western North Atlantic Ocean"



### THE HISTORY

In the 1880s, naturalists such as Goode and Bean in the NW Atlantic, and Dannevig, Hjort, Schmidt, McIntosh and Prince in European waters, began to unravel the mysteries of the early development of fishes. There was ongoing conjecture surrounding the survival processes operating during the planktonic phase that generate the enormous and unpredictable variability in year-class strength. In 1914 Johan Hjort introduced the concept of the 'critical phase' in the early life history of fishes. Interest has inevitably surrounded the commercial species and it was as long ago as 1882 that fishermen joined the debate. The Scottish marine biologist William McIntosh was commissioned to study the effects of bottom trawling on the livelihoods of line fishermen. He incubated the reproductive products of captive fish and discovered that the young stages of fish, such as cod, haddock, whiting and lemon sole, were planktonic and hence not threatened by bottom trawling. This enraged the Scottish line fishermen who demonstrated outside his home and burned his effigy! Their actions heralded the first major confrontation between the fishing industry and scientists. For over a century, popular interest and scientific debate have embraced this fascinating world of the ichthyoplankton. In more recent times, fish quotas, growth and recruitment overfishing, species recovery programmes and global warming, have made the study of fish ontogeny even more relevant to our needs.

Survival of the early life history stages of fish and the subsequent strength of each year-class is fundamental knowledge in the management of commercial fish species. As a consequence, understanding the mechanisms which generate annual variability has attracted a considerable body of scientific investigation. Underpinning the biological and physiological research, is a comprehensive knowledge of their ontogeny. Accumulation of such knowledge has progressed steadily on both sides of the Atlantic to the point where the development of most of the commercially important species, plus many others, is now fairly well described. In 1976, F. S. Russell produced the first comprehensive work on the early life history of fishes in NW European waters for nearly seventy years. In 1978, a six volume monograph on the Fishes of the Mid Atlantic Bight was produced containing descriptions of the egg, larval and juvenile stages of over 300 species. In 1983, Michael Fahay published his monograph on the ontogeny of 255 fish species in the western North Atlantic from Cape Hatteras to the Scotian Shelf.

*Michael Fahay's professional interest in the early life histories of fishes started in 1965. He published an illustrated atlas of fish eggs and larvae in 1983, and recently spent three years expanding and updating this classic work. Michael retired in June 2006 and is currently co-authoring a book on temperate estuarine fishes.*

### THE REVIEW

Michael Fahay's current contribution represents a further major step forward in synthesising all our current knowledge of fish ontogeny in the western North Atlantic. It is a superbly presented monograph in two large volumes but it still comes as a surprise that the 760 species from 196 families described only represents about 70% of the adult species known to occur in the area. Since his original monograph, the study area has been extended and now covers the area from the Northern Sargasso Sea to the Davis Strait and east to 40° W. The work represents many hours of painstaking research and meticulous attention to illustrative detail. Michael generously acknowledges the help, in various ways, of his colleagues and in particular the skills of the larval fish illustrators whose descriptions of various stages he has been able to use. Those acknowledgements in no way detract from the huge contribution of the author in bringing together all of this information in such a readily accessible and usable form. I found that the summary information, on the essential characteristics of each order of fishes, including meristic characters, presented in tables, to be particularly valuable. The glossary of terms used is extensive and well complemented by clear explanatory figures. The individual species descriptions are a pleasure to read with relevant, useful and consistently clearly presented information. As he rightly points out, the proper identification and description of larval fishes is dependant on ontogenetic series rather than characteristics of individual specimens. It is particularly valuable to be given the full distribution range of each species ensuring that this work has relevance to researchers outside the specific study area. In this context there are many species, particularly deeper water *Alepocephalus*, *Argentina*, *Argyropelecus*, *Mauroliticus*, Myctophids, Macrourids, and many others, which occur on both sides of the North Atlantic.

These two excellent volumes are a 'must' on the book shelves of all professional marine biologists on both sides of the North Atlantic. They will also prove to be of great interest to all keen amateurs who have the good fortune to be able to dip into the fascinating world of plankton and in particular ichthyoplankton.

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*John Nichols, former head of the Plankton Laboratory, Directorate of Fisheries Research, MAFF, Lowestoft, England, undertook this review. John retired recently with 42 years of ichthyoplankton research experience and sat on numerous ICES working and study groups. He is currently a certification assessor for the Marine Stewardship Council and a Justice of the Peace for the Country of Suffolk.*

## Scientific Publications of the Northwest Atlantic Fisheries Organization

### Journal of Northwest Atlantic Fishery Science

The Journal provides an international forum for the primary publication of original research papers on fisheries science in the Northwest Atlantic, with emphasis on environmental, biological, ecological and fishery aspects of the living marine resources and ecosystems. (Scientific publications during ICNAF times during 1949–79 are available at the Secretariat).

- Vol. 1 – Miscellaneous papers, (10), December 1980, 112 pp.
- Vol. 2 – Miscellaneous papers, (10), October 1981, 76 pp.
- Vol. 3, No. 1, 2 – Miscellaneous papers, (17), May and December 1982, 180 pp.
- Vol. 4 – Special issue *Guide to the Early Stages of Marine Fishes Occurring in the Western North Atlantic Ocean, Cape Hatteras to the Southern Scotian Shelf*, July 1983, 424 pp.
- Vol. 5, No. 1, 2 – Miscellaneous papers, (26), January and November 1984, 224 pp.
- Vol. 6, No. 1, 2 – Miscellaneous papers, (17), June and December 1985, 179 pp.
- Vol. 7, No. 1, 2 – Miscellaneous papers, (18), December 1986 and December 1987, 177 pp.
- Vol. 8 – Miscellaneous papers, (7), December 1988, 88 pp.
- Vol. 9 – Miscellaneous papers, (13), September and December 1989, 159 pp.
- Vol. 10 – Special issue, (1), *The Delimitation of Fishing Areas in the Northwest Atlantic*, December 1990, 57 pp.
- Vol. 11 – Miscellaneous papers, (7), February 1991, 80 pp.
- Vol. 12 – Miscellaneous papers, (7), January 1992, 84 pp.
- Vol. 13 – Miscellaneous papers, (7), December 1992, 114 pp.
- Vol. 14 – Symposium papers, (12), on *Changes in Biomass, Production and Species Composition of the Fish Populations in the Northwest Atlantic over the Last 30 Years, and Their Possible Causes*, December 1992, 160 pp.
- Vol. 15 – Special issue, (1), *Decapod Crustacean Larvae from Ungava Bay*, December 1993, 170 pp.
- Vol. 16 – Miscellaneous papers, (7), July 1994, 100 pp.
- Vol. 17 – Miscellaneous papers, (6), October 1994, 78 pp.
- Vol. 18 – Miscellaneous papers, (6) (1 Note), April 1996, 115 pp.
- Vol. 19 – Symposium papers, (11), on *Gear Selectivity/Technical Interactions in Mixed Species Fisheries*, September 1996, 145 pp.
- Vol. 20 – Special issue, (1), *North Atlantic Fishery Management Systems: A Comparison of Management Methods and Resource Trends*, September 1996, 143 pp.
- Vol. 21 – Miscellaneous papers, (5), April 1997, 83 pp.
- Vol. 22 – Symposium papers, (25) (1 Note), on *The Role of Marine Mammals in the Ecosystem*, December 1997, 387 pp.
- Vol. 23 – Symposium papers, (16), *What Future for Capture Fisheries*, October 1998, 277 pp.
- Vol. 24 – Miscellaneous papers, (4), November, 1998, 97 pp.
- Vol. 25 – Symposium papers, (17), (2 Notes), on "*Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish*", October 1999, 233 pp.
- Vol. 26 – Miscellaneous papers, (6), December 2000, 145 pp.
- Vol. 27 – Symposium papers (22) (1 Note), *Pandalid Shrimp Fisheries – Science and Management at the Millennium*, December 2000, 289 pp.
- Vol. 28 – Special issue, (1), *A Review of the Cod Fisheries at Greenland, 1910–1995*, December 2000, 121 pp.
- Vol. 29 – Miscellaneous papers, (5), December, 2001, 99 pp.
- Vol. 30 – Miscellaneous papers, (5), December, 2002, 91 pp.
- Vol. 31 – Symposium papers, (34) (1 Abstract), October, 2003, 496 pp.
- Vol. 32 – Miscellaneous papers, (4), December, 2003, 72 pp.
- Vol. 33 – Symposium papers, (9), *Reproductive Potential of Fish Populations of the North Atlantic*, December 2003, 214 pp.
- Vol. 34 – Mini-symposium papers, (7), *Hydrographic Variability in NAFO Waters for the Decade 1991–2000 in Relation to Past Decades*, March, 2004, 120 pp.
- Vol. 35 – Symposium papers, (43), *Elasmobranch Fisheries: Managing for Sustainable Use and Biodiversity Conservation*, 11–13 September 2001, 544 pp.
- Vol. 36 – Miscellaneous papers, (10), December, 2006, 152 pp.
- Vol. 37 – Symposium Papers, (14), *Flemish Cap*, April, 2007, 189 pp.
- Vol. 38 – Miscellaneous Papers, (7), January, 2008, 81 pp.
- Vol. 39 – Symposium Papers, (8), *Environmental and Ecosystem Histories in the Northwest Atlantic – What Influences Living Marine Resources?*, March, 2008, 154 pp.

**NAFO Scientific Council Studies**

This publication includes papers of topical interest and importance to the current and future activities of the Scientific Council.

- No. 1 – Miscellaneous papers, (11), March 1981, 101 pp.
- No. 2 – Manual on *Groundfish Surveys*, December 1981, 56 pp.
- No. 3 – Miscellaneous papers, (8), April 1982, 82 pp.
- No. 4 – Special Session papers, (12), on *Remote-Sensing Applications to Fishery Science*, September 1982, 98 pp.
- No. 5 – Symposium papers, (12), on *Environmental Conditions in 1970–79*, December 1982, 114 pp.
- No. 6 – Miscellaneous papers, (8), December 1983, 104 pp.
- No. 7 – Miscellaneous papers, (9), August 1984, 98 pp.
- No. 8 – Miscellaneous papers, (12), April 1985, 96 pp.
- No. 9 – Special Session papers, (17), on *Squids*, November 1985, 180 pp.
- No. 10 – Miscellaneous papers, (9), August 1986, 112 pp.
- No. 11 – Miscellaneous papers, (11), March 1987, 127 pp.
- No. 12 – Miscellaneous papers, (8), March 1988, 90 pp.
- No. 13 – Miscellaneous papers, (5), November 1989, 82 pp.
- No. 14 – Miscellaneous papers, (6), May 1990, 74 pp.
- No. 15 – Miscellaneous papers, (7), May 1991, 68 pp.
- No. 16 – Special Session papers, (22), on *Management Under Uncertainties*, November 1991, 190 pp.
- No. 17 – Workbook on *Introduction to Sequential Population Analysis*, February 1993, 98 pp.
- No. 18 – Symposium papers, (18), on *Changes in Abundance and Biology of Cod Stocks and Their Possible Causes*, July 1993, 110 pp.
- No. 19 – Miscellaneous papers, (8), October 1993, 98 pp.
- No. 20 – Miscellaneous papers, (7), February 1994, 114 pp.
- No. 21 – Collections of Papers, (10), Related to *Northern Cod and Seals in NAFO Divisions 2J and 3KL*, December 1994, 165 pp.
- No. 22 – Miscellaneous papers, (6), May 1995, 95 pp.
- No. 23 – Miscellaneous papers, (5), September 1995, 95 pp.
- No. 24 – Symposium papers, (12), on *Impact of Anomalous Oceanographic Conditions at the Beginning of the 1990s in the Northwest Atlantic on the Distribution and Behaviour of Marine Life*, September 1994, 155 pp.
- No. 25 – Collection of Papers, (5), *Flemish Cap Selected Environmental and Other Papers*, July 1996, 91 pp.
- No. 26 – Selected Papers, (11), (2 Notes), on *Harp and Hooded Seals*, December 1996, 129 pp.
- No. 27 – Miscellaneous papers, (5), (1 Note), December 1996, 81 pp.
- No. 28 – Special Session papers, (6), on *Assessment of Groundfish Stocks Based on Bottom Trawl Survey Results*, December 1996, 105 pp.
- No. 29 – Selected Papers, (11), *Selected Studies Related to Assessment of Cod in NAFO Divisions 2J+3KL*, May 1997, 125 pp.
- No. 30 – Miscellaneous papers, (9), December 1997, 117 pp.
- No. 31 – Miscellaneous papers, (8), December 1998, 165 pp.
- No. 32 – Miscellaneous papers, (8), April 1999, 133 pp.
- No. 33 – Miscellaneous papers, (7), May 2000, 135 pp.
- No. 34 – Miscellaneous papers, (3), October, 2001, 91 pp.
- No. 35 – Workshop: *The Canada-United States Yellowtail Flounder Age Reading*, December 2002, 68 pp.
- No. 36 – Workshop on Assessment Methods, May 2003, 320 pp.
- No. 37 – Working Group on Reproductive Potential, August 2003, 378 pp.
- No. 38 – Yellowtail Flounder Ageing Manual, May 2005, 54 pp.
- No. 39 – Workshop on Mapping and Geostatistical Methods for Fisheries Stock Assessment, May 2005, 50 pp.
- No. 40 – NAFO Hake, Rockling and Wolffish Guide, January 2008, 4 pp.

**NAFO Scientific Council Reports**

This publication contains reports of Scientific Council Meetings held through each year since NAFO replaced ICNAF. (The comparable publication during ICNAF was called the *Redbook*).

- 1980 – Reports of seven meetings in 1979 and 1980, Published December 1980, 190 pp.
- 1981 – Reports of four meetings in 1981, Published December 1981, 148 pp.
- 1982 – Reports of two meetings in 1982, Published December 1982, 110 pp.
- 1983 – Reports of three meetings in 1983, Published December 1983, 152 pp.
- 1984 – Reports of three meetings in 1984, Published December 1984, 126 pp.
- 1985 – Reports of three meetings in 1985, Published December 1985, 146 pp.

**NAFO Scientific Council Reports (Continued)**

- 1986 – Reports of three meetings in 1986, Published December 1986, 156 pp.
- 1987 – Reports of three meetings in 1987, Published December 1987, 138 pp.
- 1988 – Reports of two meetings in 1988, Published December 1988, 150 pp.
- 1989 – Reports of two meetings in 1989, Published December 1989, 180 pp.
- 1990 – Reports of two meetings in 1990, Published December 1990, 188 pp.
- 1991 – Reports of two meetings in 1991, Published December 1991, 164 pp.
- 1992 – Reports of four meetings in 1992, Published December 1992, 212 pp.
- 1993 – Reports of three meetings in 1993, Published January 1994, 234 pp.
- 1994 – Reports of four meetings in 1994, Published January 1995, 234 pp.
- 1994 – Reports of four meetings in 1994, Published January 1995, 234 pp.
- 1995 – Reports of three meetings in 1995, Published January 1996, 244 pp.
- 1996 – Reports of three meetings in 1996, Published January 1997, 226 pp.
- 1997 – Reports of three meetings in 1997, Published January 1998, 274 pp.
- 1998 – Reports of three meetings in 1998, Published January 1999, 257 pp.
- 1999 – Report of four meetings in 1999, Published January 2000, 327 pp.
- 2000 – Report of four meetings in 2000, Published January 2001, 303 pp.
- 2001 – Report of three meetings in 2001, Published January 2002, 339 pp.
- 2002 – Report of three meetings in 2002, Published January 2003, 323 pp.
- 2002/2003 – Report of four meetings in 2002-03, Published August 2003, 383 pp.
- 2003 – Report of two meetings in 2003, Published January 2004, 104 pp.
- (Supplement)
- 2004 – Report of three meetings in 2004, Published January 2005, 298 pp.
- 2005 – Report of three meetings in 2005, Published May 2006, 359 pp.
- 2006 – Report of four meetings in 2006, Published February 2007, 311 pp.
- 2007 – Report of four meetings in 2006, Published March 2008, 279 pp.

**NAFO Statistical Bulletin**

This publication replaced *ICNAF Statistical Bulletin* which terminated with Vol. 28 (revised). The volume numbering continues the series as the *NAFO Statistical Bulletin*.

- Vol. 29 – Fishery statistics for 1979, Originally published July 1981; revised edition published November 1984, 290 pp.
- Vol. 30 – Fishery statistics for 1980, Originally published August 1982; revised edition published October 1984, 280 pp.
- Vol. 31 – Fishery statistics for 1981, Originally published September 1983; revised edition published March 1985, 276 pp.
- Vol. 32 – Fishery statistics for 1982, Published December 1984, 284 pp.
- Vol. 33 – Fishery statistics for 1983, Published December 1985, 280 pp.
- Vol. 34 – Fishery statistics for 1984, Published December 1986, 304 pp.
- Vol. 35 – Fishery statistics for 1985, Published December 1987, 322 pp.
- Vol. 36 – Fishery statistics for 1986, Published October 1989, 304 pp.
- Vol. 37 – Fishery statistics for 1987, Published April 1990, 295 pp.
- Vol. 38 – Fishery statistics for 1988, Published February 1991, 307 pp.
- Vol. 39 – Fishery statistics for 1989, Published February 1993, 300 pp.
- Vol. 40 – Fishery statistics for 1990, Published February 1994, 309 pp.
- Vol. 41 – Fishery statistics for 1991, Published February 1995, 318 pp.
- Statistical Bulletin Supplementary Issue, 1960–90, (statistics) Published April 1995, 156 pp.
- Vol. 42 – Fishery statistics for 1992, Published October 1995, 310 pp.
- Vol. 43 – Fishery statistics for 1993, Published December 1997, 329 pp.
- Vol. 44 – Fishery statistics for 1994, Published December 2000, 201 pp.
- Vol. 45 – Fishery statistics for 1995, Published October 2001, 207 pp.
- Vol. 46 – Fishery statistics for 1996, Published November 2001, 214 pp.
- Vol. 47 – Fishery statistics for 1997, Published November 2001, 216 pp.
- Vol. 48 – Fishery statistics for 1998, Published November 2001, 210 pp.
- Vol. 49 – Fishery statistics for 1999, Published January 2002, 210 pp.

**Inventory of Sampling Data**

This publication replaced *ICNAF Inventory of Sampling Data 1967–1978* which was completed in 1986.

- Inventory of Sampling Data 1979–1984, Published April 1989, 250 pp.
- Inventory of Sampling Data 1985–1989, Published March 1993, 265 pp.
- Inventory of Sampling Data 1990–1994, Published October 1999, 287 pp.
- Inventory of Sampling Data 1995–1999, Published November 2002, 142 pp.

**NAFO Index of Meeting Documents**

This publication contains lists of all documents along with a subject and author index of the NAFO Scientific Council documents issued during 5-year periods.

- 1979–84 – Index of Meeting Documents, Published March 1985, 146 pp.
  - 1985–89 – Index of Meeting Documents, Published December 1990, 116 pp.
  - 1990–94 – Index of Meeting Documents, Published November 1995, 139 pp.
  - 1995–99 – Index of Meeting Documents, Published December 2000, 141 pp.
-

## Information for Preparing Manuscripts for NAFO Scientific Publications

### Journal of Northwest Atlantic Fishery Science

The Journal is for the primary publication of original practical and theoretical research that is unpublished and is not being submitted for publication elsewhere. While it is intended to be regional in scope, papers of general applicability and methodology may be considered. Space is also provided for notes, letters to the editor and notices. Each paper is assigned to an Associate Editor of the Journal's Editorial Board, and is normally reviewed by two referees regarding suitability as a primary publication.

### NAFO Scientific Council Studies

The Studies publishes papers which are of topical interest and importance to the current and future activities of the Scientific Council, but which do not meet the high standards or general applicability required by the Journal. Such papers have usually been presented as research documents at Scientific Council meetings and nominated for publication by the Standing Committee on Publications. Studies papers are not peer reviewed.

### Content of Paper

The paper should be in English. The sequence should be: Title, Abstract, Text, References, Tables and Figures.

#### Title

The paper should start with the title, followed by the name(s), address(es) and emails of the author(s) including professional affiliation, and any related footnotes.

#### Abstract

An informative concise abstract should be provided along with key words listed alphabetically.

#### Text

In general, the text should be organized into Introduction, Materials and Methods, Results, Discussion, and Acknowledgements. Authors should be guided by the organization of papers that have been published in the NAFO Journal or Studies.

**Introduction** should be limited to the purpose and rationale of the study.

**Materials and Methods** should describe in sufficient detail the materials and methods used, so as to enable other scientists to evaluate or replicate the work.

**Results** should answer the questions evolving from the purpose of the study in a comprehensive manner and in an orderly and coherent sequence, with supporting tables and figures.

**Discussion** should explain the main contributions from the study, with appropriate interpretation of the results focusing

on the problem or hypothesis. Comparisons with other studies should be included here.

**Acknowledgements** should be limited to the names of individuals who provided significant scientific and technical support, including reviewers, during the preparation of the paper, and the names of agencies which provided financial support.

#### References

The references cited in the text should be listed alphabetically. References should be mainly restricted to significant published literature. Unpublished documents and data, papers in preparation, and papers awaiting acceptance to other journals, may be cited with full contact addresses as unpublished or personal communications.

#### Examples:

KING, M. 1995. Fisheries biology, assessment and management. Fishing News Books, UK, 341 p.

CROWDER, L. B., and S. A. MURAWSKI. 1998. Fisheries by-catch: implications for management. *Fisheries*, **23**: 8–16. doi:10.1577/1548-8446(1998)023<0008:FBIFM>2.0.CO;2

ÁVILA DE MELO, A. M., D. POWER, and R. ALPOIM. MS 2005. An assessment of the status of the redfish in NAFO Division 3LN, *NAFO SCR Doc.*, No. 52, Serial No. 5138, 19 p.

Text citations of the above would be (King, 1995; Crowder and Murawski, 1998; Ávila de Melo *et al.*, MS 2005). The surnames of two authors may be used in a citation, but *et al.* should be used for more than two authors. The citation of mimeographed reports and meeting documents should contain the abbreviation "MS". Abbreviations of periodicals can be found [ftp://ftp.fao.org/fi/asfa/Monitoring\\_List/MASTER.txt](ftp://ftp.fao.org/fi/asfa/Monitoring_List/MASTER.txt). The Digital Object Identifier (doi) should be included if available. <http://www.crossref.org/freeTextQuery/> can be used to check this.

#### Tables and Figures

All Tables and Figures must be cited in the text. Tables and Figures must be numbered consecutively and correspond with the order of presentation in the text. Figure captions should be included as a separate page. Each table and figure should have a complete concise descriptive caption. Figures should always be submitted in black and white. Colour plots and photographs are acceptable only if colour is essential to the content. Preferably, all figures should be submitted as separate files in .eps or .ps format. Photographs, maps and contour plots can also be submitted in high quality .jpg format.

#### Paper Submission

Papers should be submitted by email to Dr. A.B. Thompson, General Editor, at [journal@nafo.int](mailto:journal@nafo.int).