

# NORTHWEST ATLANTIC FISHERIES ORGANIZATION



## Scientific Council Studies Number 37

Working Group on Reproductive Potential

The presentation of material in this publication does not imply the expression of any opinion on the part of the Secretariat of the Northwest Atlantic Fisheries Organization (NAFO) concerning the legal national or international issues of any Contracting Party of NAFO or any country mentioned in this publication.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the NAFO Secretariat. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Executive Secretary, Northwest Atlantic Fisheries Organization.

Northwest Atlantic Fisheries Organization  
2 Morris Drive, P. O. Box 638  
Dartmouth, Nova Scotia, Canada B2Y 3Y9  
Tel.: (902) 468-5590 • Fax: (902) 468-5538  
E-mail: [info@nafo.int](mailto:info@nafo.int) • Website: [www.nafo.int](http://www.nafo.int)

# NORTHWEST ATLANTIC FISHERIES ORGANIZATION



## Scientific Council Studies Number 37

### Working Group on Reproductive Potential

Printed and Distributed by:  
Northwest Atlantic Fisheries Organization  
P. O. Box 638, Dartmouth, Nova Scotia  
Canada B2Y 3Y9

August, 2003



## 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. Each year since 1981, the Scientific Council has held at least one Special Session on a topic of particular interest, and many of the contributions to those sessions have been published in one of these NAFO publications.

The Scientific Council Special Session, the Symposium on *Variations in Maturation, Growth, Condition and Spawning Biomass Production in Groundfish* held at the Altis Hotel in Lisbon Portugal during 9–11 September 1998 in conjunction with the 20<sup>th</sup> NAFO Annual Meeting, resulted with the Scientific Council establishing the *Working Group on Reproductive Potential*. The Working Group (Chair E. Trippel) through its deliberations concerning fish stocks in the North Atlantic recommended to the Scientific Council that

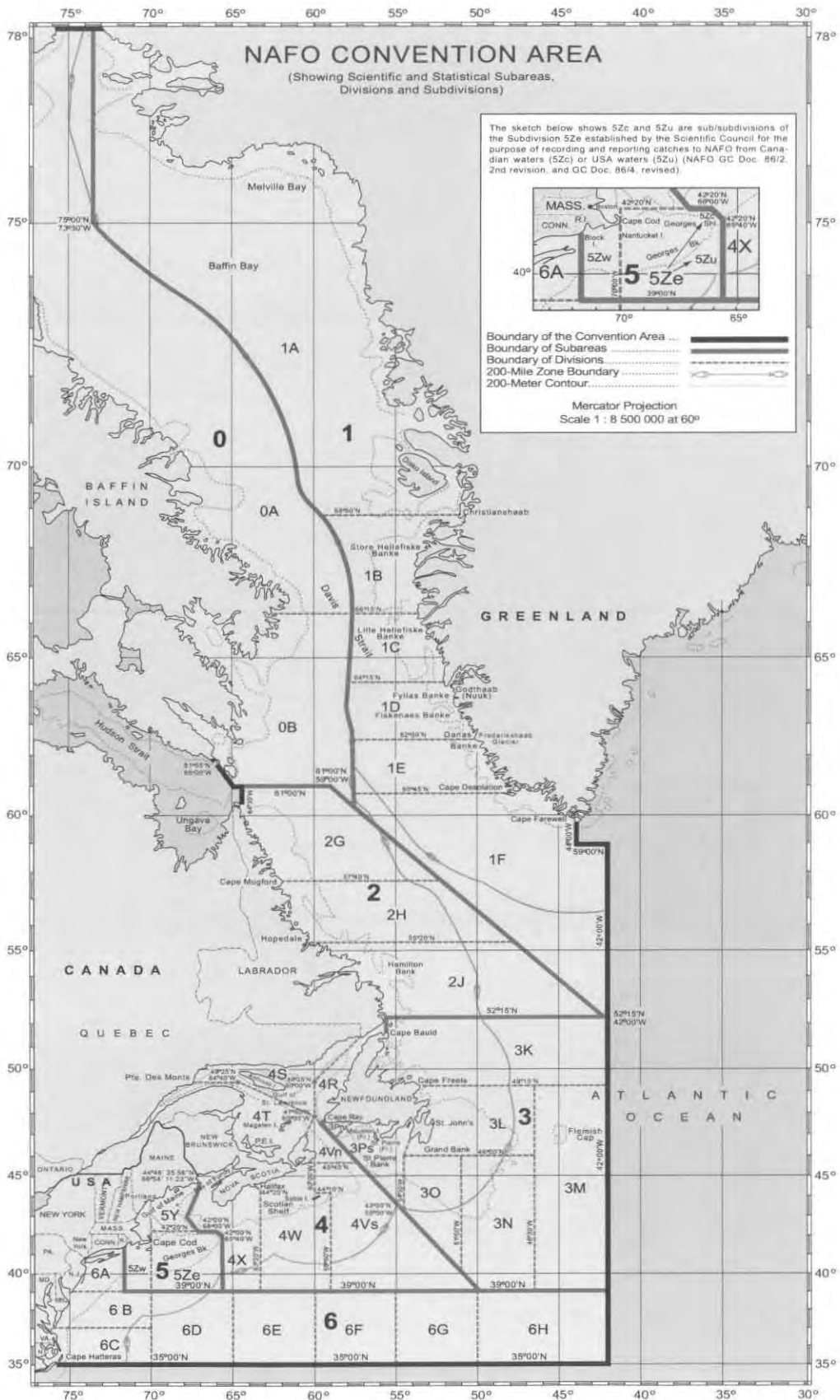
- i) a complete collection of scientific papers relating to the subject be peer reviewed and considered for publication in the *Journal of Northwest Atlantic Fishery Science*, and
- ii) a compilation of available data for those stocks be published in the *Scientific Council Studies*.

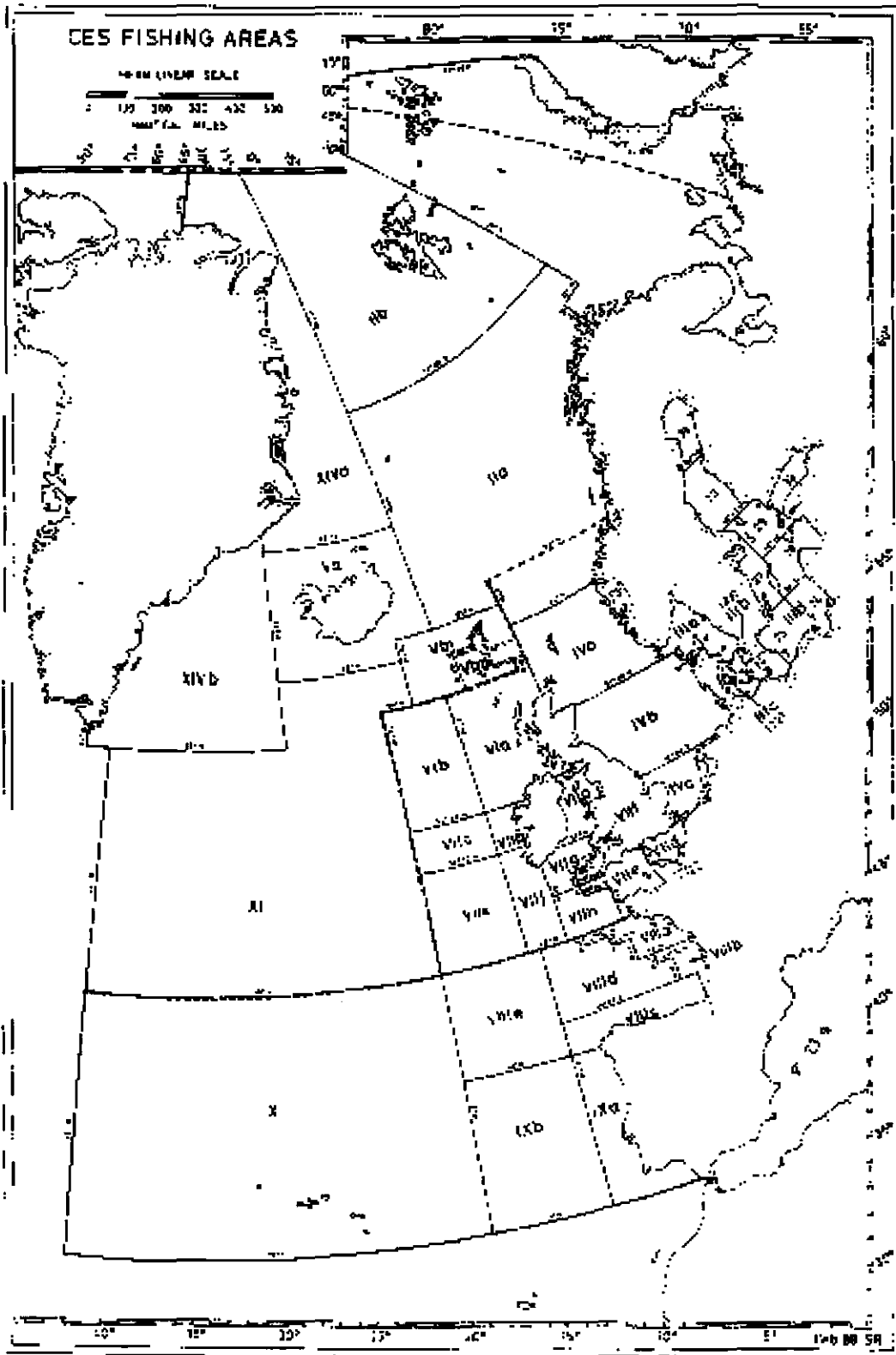
The Scientific Council endorsed the recommendation, and this issue of the *Scientific Council Studies* series is dedicated to the compilation regarding the available data. Many members of the Working Group and scientists both within the Scientific Council circles and outside these circles have spent a great deal of time and effort collecting, collating and refining the information base. The comprehensive coverage achieved in this publication is timely and important for scientists dealing with fish stocks and stock complexes in the North Atlantic, particularly in the NAFO and ICES areas.

May 2003

Tissa Amaratunga, Editor  
NAFO Scientific Council Studies  
Northwest Atlantic Fisheries Organization  
P. O. Box 638  
Dartmouth, Nova Scotia  
Canada B2Y 3Y9









# Contents

Introduction .....	1
Guide to the Tables .....	2
Acknowledgements .....	3
List of Stocks Included in this Volume .....	5
Atlantic Cod in NAFO Div. 3M .....	7
Atlantic Cod in NAFO Div. 2J+3KL .....	15
Atlantic Cod in NAFO Div. 3NO .....	21
Atlantic Cod in NAFO Subdiv. 3Ps .....	29
Atlantic Cod in NAFO Subdiv. 3Pn+Div. 4RS .....	37
Atlantic Cod in NAFO Div. 4T+Subdiv. 4Vn (January–April) .....	45
Atlantic Cod in NAFO Subdiv. 4Vs+Div. 4W .....	53
Atlantic Cod in NAFO Div. 4X .....	61
Atlantic Cod in NAFO Div. 5Z+Subarea 6 .....	69
Atlantic Cod in NAFO Div. 5Y .....	77
Atlantic Cod in ICES Area IV .....	85
Atlantic Cod in ICES SD 25–32 .....	93
Atlantic Cod in ICES Areas I and II .....	111
Atlantic Cod in ICES Div. Va .....	121
Haddock in NAFO Div. 4TVW .....	129
Haddock in NAFO Div. 4X .....	135
Haddock in NAFO Div. 5Z+Subarea 6 .....	143
Haddock in ICES Area IV .....	151
Pollock in NAFO Div. 4VWX+5Zc .....	159
White hake in NAFO Subareas 5+6 .....	165
American plaice in NAFO Div. 3M .....	171
American plaice in NAFO Subarea 2+Div. 3K .....	175
American plaice in NAFO Div. 3LNO .....	181
American plaice in NAFO Subdiv. 3Ps .....	187
American plaice in NAFO Subarea 5 .....	193
Greenland halibut in NAFO Subarea 2+Div. 3KLMNO .....	199
Witch flounder in NAFO Div. 2J+3KL .....	207
Witch flounder in NAFO Div. 3NO .....	213
Witch flounder in NAFO Subdiv. 3Ps .....	219
Witch flounder in NAFO Subareas 5+6 .....	225
Yellowtail flounder in NAFO Div. 3LNO .....	231
Yellowtail flounder in NAFO Subdiv. 5Ze .....	237
Yellowtail flounder in NAFO Subdiv. 5Zw .....	243
Yellowtail flounder in US Statistical Areas 514 and 521 .....	249
Winter flounder in NAFO Div. 5Z .....	255
Winter flounder in NAFO Subareas 5+6 .....	261

**Contents (Cont'd)**

Summer flounder in NAFO Subareas 5+6 .....	269
Acadian redfish in NAFO Div. 3M .....	275
Golden redfish in NAFO Div. 3M .....	281
Deep-sea redfish in NAFO Div. 3M .....	287
Redfish in NAFO Div. 3M .....	293
Redfish in NAFO Subarea 2+Div. 3K .....	299
Redfish in NAFO Div. 3LN .....	305
Redfish in NAFO Div. 3O .....	311
Redfish in Unit 2 NAFO Subdiv. 3Ps 4Vs 4Wfgj+3Pn 4Vn (Jun–Dec) .....	317
Acadian redfish in NAFO Subarea 5 .....	323
Roughhead grenadier in NAFO Subareas 2+3 .....	329
Roundnose grenadier in NAFO Subareas 2+3 .....	335
Atlantic herring in NAFO Subareas 5+6 .....	341
Atlantic mackerel in NAFO Subareas 2–6 .....	347
Bluefish in NAFO Subareas 5+6 .....	353
Striped bass in Subareas 5+6 .....	359
Thorny skate in Div. 3M .....	367
<b>Notices</b> .....	371
<b>Scientific Publications of NAFO</b> .....	375

# **The Availability of Data for Estimating Reproductive Potential for Selected Stocks in the North Atlantic**

by

**M. J. Morgan**

Dept. of Fisheries and Oceans  
P.O. Box 5667, St. John's, NL A1C 5X1, Canada

**J. Burnett**

Northeast Fisheries Science Center  
166 Water Street, Woods Hole, MA 02543, USA

**J. Tomkiewicz**

Danish Institute for Fisheries Research,  
Kavalergaarden 6, 2920 Charlottenlund, Denmark

and

**F. Saborido-Rey**

Instituto de Investigaciones Marinas  
Eduardo Cabello, 6, 36208 Vigo, Spain

## **Abstract**

Information was collected on the availability of data to estimate reproductive potential on fish stocks in the north Atlantic. Information was collected on a total of 53 stocks or stock complexes from both the Northeast and Northwest Atlantic. A series of tables was compiled that provide an overview of the availability of basic information, evaluate the quality of the information and provide references to this information. The tables were not designed to include actual data, but rather to reference existing data and studies published in journals, reports, etc., or to identify persons who might provide information regarding data which may exist in national laboratories but have not been analysed or published. The tables provide an overview of the years for which basic data are available, details on the collection and quality of the data, the existence of studies that estimate reproductive potential or evaluate stock-recruitment relations and references to the data and studies.

*Keywords:* data availability, data quality, reproductive potential

## **Introduction**

The importance of estimating the reproductive potential of a fish stock, rather than just spawning stock biomass is becoming widely accepted. However, little is known about the general availability of data required to produce such estimates. This gap in information was recognized in the first Term of Reference of the NAFO Working Group on reproductive potential which was: explore and review availability of information and existing data on reproductive potential by areas and species. To address this question information was collected on the availability of data to estimate reproductive potential on fish stocks in the north Atlantic. A series of tables was compiled that provide an overview of the availability of basic information, evaluate the quality of the information and provide references to this information. The purpose of the tables was to provide an overview of available information and existing data that can be applied to estimate stock reproductive potential. Unpublished as well as published data may be available for this purpose and, by recording identified stock characteristics (e.g. stock size, maturity, fecundity, etc.) and data sources in a systematic fashion, the potential for estimating the total, realised or viable egg and larval production can be evaluated for different stocks.

The tables were not designed to include actual data, but rather to reference existing data and studies published in journals, reports, etc. or to identify persons who might provide information relative to data which

may exist in national laboratories but have not been analysed or published. Four tables were developed: 1) Available Data; 2) Data Basis, Format and Quality; 3) Studies of Reproductive Potential; and 4) Data Sources. The first table provides an overview of the availability of basic information to estimate the reproductive potential of a given stock. The table is on a yearly scale and includes basic variables only. Table 2 provides more details about the available data and adds information about compatibility of different data sets (e.g. age-based versus length-based data) and their quality (e.g. differences in accuracy due to differences in methodology, sampling intensity, experimental design, etc.). This table includes more variables than Table 1, and some variables have been divided into sub-levels to specify different data types. Table 3 refers to existing studies that estimate reproductive potential or evaluate stock-recruitment relations. In both Tables 2 and 3, a reference number links the identified data and studies with their sources in Table 4. Table 4 provides the full reference to journals, reports etc. or the address of persons and laboratories is given.

The listed variables are intended to primarily cover aspects related to maternal and paternal influences on the reproductive potential, i.e. at the basic level estimating the total egg production, to the ultimate level of estimating the viable larvae production. The influences of the ambient environment on egg and larval survival during the recruitment process have had a lower priority but may be very important to stock-recruitment relations; options to record information of this type exist in both Tables 2 and 3.

The availability of data and information to estimate reproductive potential varies tremendously, from hardly any data existing for some species or stocks to those that are data-rich with studies of reproductive potential and recruitment processes at an advanced level. However, tables recording data-poor stocks may prove to be as valuable as data-rich as they may draw attention to specific variables and research fields where information is needed in order to estimate the stock reproductive potential. The availability of data has thus not been a criterion in the selection of species to be included.

In total tables were completed for 53 stocks or stock complexes in the north Atlantic. There were a total of 20 species and although most (15) were demersal teleosts, other groups were included. The Working Group focused on the Northwest Atlantic in the NAFO area but, 5 stocks are included from the ICES area. A list of people who contributed tables or who reviewed tables is given in the Acknowledgements.

### **Guide to the Tables**

The tables consist of text and form fields indicated by shading. Only the form fields could be filled in. There were two types of form fields, text and drop-down form fields. Numbers or text of variable length could be filled in the text fields with standard formats. The drop-down fields offered different choices, but no text could be added. A help function providing an explanatory text was available for each form field. The help function generally contained both an explanation and an example.

#### **Table 1**

The form fields in the header of Table 1 specify the fish species, area and stock. The latter two were applied as headers in subsequent tables.

The person(s) initially reviewing the literature and creating the table is referenced in the lower header of Table 1, and the date of submission of data to the NAFO Working Group is included. If the tables are updated later, the name of the person(s) providing new data or reviewing the tables as well as the date is recorded in addition.

The review of a specific stock attempted to encompass all data and information that can be used to quantify the total or realised egg production and potentially estimate the viable egg and larvae production. This implies that highest priority should be given to inclusion of quantitative measures or relationships that can be used as parameter estimates. The review extended as far back in time as possible.

In this overview table, three different options existed in the drop-down form fields: Option 1:  $\surd$  is selected if quantitative estimates about a given variable is available. Option 2: ( $\surd$ ) is chosen if for example no applicable estimates are available but basic data or information exists although not analysed or published. The reason for choosing option 2 should be specified under comments in Table 2. The default, Option 3: blank, indicates that no information is available. The availability of data or information about the specific variables is recorded on a yearly basis back to 1960. If information before 1960 exists, particular years are included to record specific information about variables.

#### **Table 2**

The text fields in the header to be filled in include information about Reproductive Strategy, Timing of Spawning, and Optimal Time for Maturity Sampling as well as their references. This information is intended to provide the reader with some criteria to evaluate the data quality. The data types and analytical methods needed to estimate the total egg production depend on the type of reproductive strategy. The timing of spawning is important in relation to the timing of fecundity sampling for the given species and stock. The optimal time for maturity sampling is normally during the pre-spawning period when fish that will participate in spawning will have initiated the gonadal maturation process, but before for example spawning migration has started.

The table Data Basis, Format and Quality provides the opportunity to enter more detailed information about data or studies for specific variables. The variable column lists different categories and sub-categories, which may be utilised in the estimation of the reproductive potential of a stock. The list is not meant to be all encompassing, but to specify the data basis, format and quality of important variables making an evaluation of the compatibility and applicability of data possible as well as identifying data sets potentially complementing each other. In the event that the listed categories do not suffice, information could be added under 'Other factors and parameters' at the end of the table, specifying under 'Notes' the kind of information; if sub-categories are not comprehensive, the information is similarly entered under 'Other'. For each data source, the following information is entered: the year range, the data basis, data origin, sampling frequency and the reference number referring to the source of the study (should be given in full in Table 4). Under 'Notes on data, methods and contents', additional information about the particular data source can be added.

#### **Table 3**

In some cases, studies of the reproductive potential of the stock may have been performed and for example estimates of egg or larvae production may be available. This information should be included in Table 3. The table lists different subject-related categories to include information about the reproductive potential as well as about processes affecting stock reproduction. For each study, a brief description of its focus is filled in as well as the year range covered and the reference number referring to its source.

#### **Table 4**

This table references the sources of data or other information referenced in Tables 2 and 3. The reference numbers applying to the proceeding tables as well as the data sources should be filled in, i.e. full literature reference or the name and postal address of contact persons.

### **Acknowledgements**

Many people other than the authors contributed to the compilation of the tables in this volume. We thank them for their efforts. They are: R. Bowering, J. Brattey, G. Chouinard, A. Frechet, G. Kraus, Y. Lambert, G. Lilly, T. Marshall, G. Marteinsdottir, H. Murua, L. O'Brien, D. Power, C. Schmitz, G. Shepherd, D. Stansbury, E. Trippel, S. Walsh, P. Wright, N. Yaragina.

## List of Stocks

## List of stocks included in this volume.

Species	Common Name	Stock name	NAFO or ICES area
<b>Gadidae</b>			
<i>Gadus morhua</i>	Atlantic cod	Flemish Cap Northern Grand Bank Southern Grand Bank Newfoundland South Coast Northern Gulf of St. Lawrence Southern Gulf of St. Lawrence Eastern Scotian Shelf Bay of Fundy/Western Scotian Shelf Georges Bank Gulf of Maine North Sea Baltic Sea Northeast Arctic Icelandic	NAFO Div. 3M NAFO Div. 2J+3KL NAFO Div. 3NO NAFO Subdiv. 3Ps NAFO Subdiv. 3Pn+Div. 4RS NAFO Div. 4T+Subdiv. 4Vn (J-A) NAFO Subdiv. 4Vs+Div. 4W NAFO Div. 4X NAFO Div. 5Z+Subarea 6 NAFO Div. 5Y ICES IV ICES SD 25-32 ICES t+2 ICES Va
<i>Melanogrammus aeglefinus</i>	Haddock	Eastern Scotian Shelf  Bay of Fundy/Western Scotian Shelf Georges Bank North Sea	NAFO Div. 4TVW  NAFO Div. 4X NAFO Div. 5Z+Subarea 6 ICES IV
<i>Pollachius virens</i>	Pollock	Scotian Shelf/Bay of Fundy/Georges Bank	NAFO Div. 4VWX+5Zc
<i>Urophycis tenuis</i>	White hake	Gulf of Maine/Georges Bank	NAFO Subareas 5+6
<b>Pleuronectiformes</b>			
<b>Pleuronectidae</b>			
<i>Hippoglossoides platessoides</i>	American plaice	Flemish Cap  Labrador and Northeast Newfoundland Grand Bank Newfoundland South Coast Gulf of Maine/Mid Atlantic	NAFO Div. 3M  NAFO Subarea 2+Div. 3K NAFO Div. 3LNO NAFO Subdiv. 3Ps NAFO Subarea 5
<i>Reinhardtius hippoglossoides</i>	Greenland halibut	Labrador/Eastern Newfoundland	NAFO Subarea 2+Div. 3KLMNO
<i>Glyptocephalus cynoglossus</i>	Witch flounder	Labrador and Northeast Newfoundland  Southern Grand Bank Newfoundland South Coast Gulf of Maine/Georges Bank	NAFO Div. 2J+3KL  NAFO Div. 3NO NAFO Div. 3Ps NAFO Div. 5+6
<i>Limanda ferruginea</i>	Yellowtail flounder	Grand Bank Georges Bank Southern New England Cape Cod	NAFO Div. 3LNO NAFO Div. 5Ze NAFO Div. 5Zw US Statistical areas 514 and 521
<i>Pseudopleuronectes americanus</i>	Winter flounder	Georges Bank  Coastal - Southern New England/Mid-Atlantic	NAFO Div. 5Z NAFO Subarea 5+6
<b>Bothidae</b>			
<i>Paralichthys dentatus</i>	Summer flounder	Mid Atlantic/Georges Bank	NAFO Subarea 5+6
<b>Scorpaenidae</b>			
<i>Sebastes fasciatus</i> <i>Sebastes marinus</i> <i>Sebastes mentella</i> <i>Sebastes spp.</i>	Red fish	Flemish Cap Flemish Cap Flemish Cap Flemish Cap	NAFO Div. 3M NAFO Div. 3M NAFO Div. 3M NAFO Div. 3M

TABLE 1 (Cont'd). List of stocks included in this volume.

Species	Common Name	Stock name	NAFO or ICES area
Scorpaenidae (Cont'd)	Redfish	Labrador/Northeast Newfoundland Eastern Grand Bank Southwestern Grand Bank Unit 2 (Canadian coastal)  Gulf of Maine/Georges Bank	NAFO Div. 2+3K NAFO Div. 3LN NAFO Div. 3O NAFO Div. 3Ps 4Vs 4Wfgj+ 3Pn 4Vn (Jun-Dec) NAFO Div. 5
Macrouridae			
<i>Macrourus berglax</i>	Roughhead grenadier	Labrador/Eastern Newfoundland	NAFO Subarea 2+3
<i>Coryphaenoides rupestris</i>	Roundnose grenadier	Labrador/Eastern Newfoundland	NAFO Subarea 2+3
Clupeidae			
<i>Clupea harengus</i>	Herring	Mid-Atlantic/Gulf of Maine Coastal Complex and Georges Bank	NAFO Subarea 5+6
Scombridae			
<i>Scomber scombrus</i>	Mackerel	Northwest Atlantic	NAFO Subarea 2+6
Pomatomidae			
<i>Pomatomus saltatrix</i>	Bluefish	Mid-Atlantic/Gulf of Maine	NAFO Subarea 5+6
Percichthyidae			
<i>Morone saxatilis</i>	Striped Bass	Coastal-Mid-Atlantic/Gulf of Maine	NAFO Subarea 5+6
Rajidae			
<i>Raja radiata</i>	Thorny skate	Flemish Cap	NAFO Div. 3M

