**REPORT OF THE**

# Stock Identification Methods Working Group

**By Correspondence**

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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# 1       MAIN TASKS AND PARTICIPANTS

At its 2001 Annual Science Conference, ICES resolved that a Working Group on Stock Identification Methods will meet by correspondence under the chairmanship of Dr. K. Friedland (USA), Dr. J. Waldman (USA), and Mr. S. Cadrin. The terms of reference indicated that the Working Group would continue to develop the Stock Identification Methodology and advise on future meetings of the Working Group (Appendix 1).

The Working Group participants in 2001-2002 were as follows, with addresses given in Appendix 2.

## 1.1       Participants

| | |
|---|---|
| S. Cadrin (Co-Chair) | USA |
| K. Friedland (Co-Chair) | USA |
| J. Waldman (Co-Chair) | USA |

# 2       STOCK IDENTIFICATION METHODOLOGY

The Working Group continued work on producing a publication on Stock Identification Methodology. A publication agreement was made with Academic Press to publish the volume. Editorial reviews were sent to Chapter authors with a request to revise and resubmit drafts by January 2003. The revised Table of Contents can be found in appendix 3, with notes on authorship and chapter status. Co-chairs are actively soliciting authors for the few remaining chapters.

# 3       FUTURE MEETING

The Working Group did not identify the need for a meeting at this time, but would recommend that the subject remain on the terms of reference for future consideration.

# 4       RECOMMENDATION

The Working Group recommends:

The Stock Identification Methods Working Group [SIMWG] (Co-Chairs Dr. K.D. Friedland, Dr. J. Waldman, and S. Cadrin, USA) work by correspondence in 2003 to:

a) prepare a complete draft of the Stock Identification Methodology publication;

b) advise on the need for future meetings of the SIMWG, and prepare appropriate Terms of Reference if required.

SIMWG should report on progress to the Living Resources Committee at the 2003 Annual Science Conference.

SIMWG proposes that the contributions of SIMWG be presented at the 2004 Annual Science Conference as a theme session, entitled "Stock Identification Methods."

The **Stock Identification Methods Working Group** [SIMWG] (Co-Chairs K.D. Friedland, USA, J. Waldman, USA, and S. Cadrin, USA) will work by correspondence in 2002 to:

a) prepare a complete draft of the Stock Identification Methodology publication;

b) advise on the need for future meetings of the SIMWG, and prepare appropriate Terms of Reference if required.

SIMWG will report by 31 May, 2003 for the attention of the Living Resource Committee.

**Supporting Information**

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|---|---|
| Priority: | Essential. Stock structure is a fundamental requirement before any assessment or modelling on a stock level can be contemplated. Publication of a Stock Identification Methods, a compilation of methodological reviews, is the main initiative of the SIMWG and is nearing completion. The SIMWG wants to continue with this initiative and will seek the few remaining contributions to the Methodology in the coming year. |
| Scientific Justification: | SIMWG continues to make progress on the development of its Stock Identification Methodology. A publication agreement has been reached, contributors have agreed to produce final drafts. |
| Relation to Strategic Plan: | Stock structure and stock identification have been identified as part of the work programme of the Living Resources Committee. |
| Resource Requirements: | |
| Participants: | 35 |
| Secretariat Facilities: | |
| Financial: | |
| Linkages to Advisory Committees: | ACFM |
| Linkages to other Committees or Groups: | WGAGFM - Chairs of these two Working Groups corresponding to ensure that there is no unnecessary overlap in their work |
| | ACFM's response to the special request by IBFSC on a Research Plan for Central Baltic Herring advised that protocols detailed in the SIMWG publication should be applied. |
| Linkages to other Organisations | |
| Cost Share | ICES: 100% |

**APPENDIX 2: 2001-2002 PARTICIPANTS**

| Name | Address | Phone | Fax | e-mail |
|---|---|---|---|---|
| Steve Cadrin | National marine Fisheries Service<br>166 Water Street<br>Woods Hole, MA 02543 USA | 508-495-2335 | 508-495-2393 | scadrin@whsun1.wh.whoi.edu |
| Kevin Friedland | UMass/NOAA CMER Program<br>Blaisdell House<br>University of Massachusetts<br>Amherst, MA 01003-0040 USA | 413-545-2842 | 413-545-2304 | friedlandk@forwild.umass.edu |
| John Waldman | Hudson River Foundation<br>40 West 20th Street<br>Ninth Floor<br>New York, NY 10011  USA | 212-924-8290 | 212-924-8325 | john@hudsonriver.org |

## I   Introduction

Overview – by S. Cadrin (National Marine Fisheries Service, USA), K. Friedland (Univ. Massachusetts, USA), J. Waldman (Hudson River Foundation, USA)

A brief introduction to stock identification, including the historical development of the ICES Study Group.

Definition of Management Units, Stock Units, and Populations – by J. Waldman (Hudson River Foundation, USA)

A more detailed introduction to the field, including technical definitions.

Environmental versus Genetic Influence on Identification Characters – by D. Swain (Canada Dept. of Fisheries & Oceans, New Brunswick)

An overview on the major categories of stock identification approaches and their relative strengths for identifying stocks.

## II          LIFE HISTORY TRAITS

Distribution of Life Stages – by J. Hare (National Marine Fisheries Service, USA) and G. Begg (James Cook Univ., Australia)

A description of methods that examine geographic range and distribution during early life history, including planktonic stages, as well as juvenile and adult stages.

Growth and Reproductive Characteristics – by J. Hare (National Marine Fisheries Service, USA) and G. Begg (James Cook Univ., Australia)

A review and critique of approaches that use differences in ontogenetic rates to distinguish stocks.

Life History Parameters in Fish Stock Identification – by G. Begg (James Cook Univ., Australia) and by J. Hare (National Marine Fisheries Service, USA)

A protocol for estimating and comparing life history parameters among putative stocks with illustrative examples.

## III          NATURAL MARKS-MORPHOLOGICAL ANALYSES

Outline Methods – by K. Friedland (Univ. Massachusetts, USA)

A review and critique of methods that describe shape of outlines for structures such as scales and otoliths, and how methods are used to distinguish individuals with differently shaped features.

Landmark Methods – by S. Cadrin (National Marine Fisheries Service, USA)

A description of techniques used to measure and analyze general morphometry, including traditional multivariate morphometrics and more advance geometric analyses.

Texture Methods – by K. Friedland (Univ. Massachusetts, USA)

A review of methods used to analyze spacing patterns of circuli on scales, otoliths, and vertebrae through image analysis, including digital photomicrograph examples.

Meristics – by J. Waldman (Hudson River Foundation, USA)

An evaluation of using the number of discrete morphological elements (e.g., number of vertebrae, fin rays) for identifying stocks, with illustrative examples.

## IV        NATURAL MARKS-ENVIRONMENTAL SIGNALS

Parasites as Biological Tags – by K. MacKenzie (Aberdeen Marine Lab, Scotland) and P. Abuanza (Instituto Oceanografia, Spain)

A summary of how parasitological analysis has been used to discriminate stocks.

Elemental Composition of Body Parts – by S. Campana (Canada Dept. Fisheries & Oceans, Nova Scotia)

A review of rapidly developing techniques that use chemical composition of secreted hard parts to identify environmental differences and individuals that inhabited different habitats throughout their life history.

Fatty Acid Profiles – by O. Grahl-Nielson (Univ. Bergen, Norway)

A description of a relatively new method for determining different populations according to fatty acids in tissues, with demonstrations on finfish and marine mammals.

## V        NATURAL MARKS-GENETIC ANALYSES

Chromosome Morphology – by R. Phillips (Univ. Wisconsin-Milwaukee, USA)

A review and critique of techniques for detecting differences among stocks through inspection of chromosome form, including several example photomicrographs.

Allozymes – by M.-L. Koljonen (Fisheries Research Inst., Finland)

A description of traditional electrophoretic methods with many examples of stock identification applications.

Mitochondrial DNA – by A. Magoulas (Inst. Of Marine Biology of Crete, Greece)

A comprehensive review and protocol for detecting mitochondrial genetic characters and analyzing stock differences.

Nuclear DNA – by I. Wirgin (New York Univ. Medical Center, USA) and J. Waldman (Hudson River Foundation, USA)

A review and critique of methods using single copy, coding and noncoding, repetitive nuclear DNA for stock identification.

Random Amplified Polymorphic DNA (RAPD) – by P. Smith (National Inst. Water & Atmospheric Research, New Zealand)

A review of polymerase chain reaction and RAPD techniques, which have had a rapidly increased application for stock identification in recent years.

Amplified Length Polymorphic DNA (AFLP) – by J. Liu (Auburn Univ., USA)

A description of a relatively new technique with great potential for stock identification, including a comparative review with other genetic approaches.

# VI        APPLIED MARKS

Pigments, Dyes, and Brands – by S. Schroeder and C. Knudsen (Washington Dept. of Fish & Wildlife, USA)

A review of diverse applications that use external applied marks for stock identification.

Internal and External Tags – author(s) to be solicited

A summary and critique of conventional tagging methods and their application for identifying stocks.

Electronic Tags – by M. Bain (New York Cooperative Fish & Wildlife Research Unit, USA)

A description of rapidly developing techniques involving telemetry and archival tags.

Otolith Thermal Marking – by E. Volk, S. Schroeder, and J. Grim (Washington Dept. of Fish & Wildlife, USA)

A description of relatively new methods involving thermal signatures on fish otoliths with photomicrographs illustrating their application for stock identification.

# VII        STOCK IDENTIFICATION DATA ANALYSIS

Stock Identification Data Requirements in Quantitative Assessments – by M. Fabrizio (National Marine Fisheries Service, USA)

A protocol for sampling and a description of how sampling issues affect precision and accuracy of stock composition analyses.

Exploratory Analyses of Stock Identification Data – by S. Cadrin (National Marine Fisheries Service, USA)

A review of statistical methods commonly used for stock identification with protocols for appropriate quality control and accurate interpretation.

Statistical Algorithms for Stock Composition Analysis – by M. Prager (National Marine Fisheries Service, USA)

An evaluation of methods used to determine the contributions of different stocks in mixed-stock samples.

Discriminant Function Analysis – author(s) to be solicited

A description of linear discriminant analysis with focus on stock identification applications.

Neural Networks in Classifying Biological Populations – by S. Saila (Univ. Rhode Island, USA)

An introduction to a relatively new method of data analysis with illustrative examples for identifying stocks.

Maximum Likelihood Estimators of Stock Composition – by J. Brodziak (National Marine Fisheries Service, USA)

A review of stock identification applications using maximum likelihood to estimate contributions of different stocks in mixed-stock samples.

Non-parametric Methods of Estimating Classification Variability – author(s) to be solicited
A description of methods that can be used for stock identification when data do not conform to parametric assumptions.

Analysis of Outlines and Profiles – by T. Ong and S. Saila (Univ. Rhode Island, USA)

A review of statistical methods used to analyze outline and texture data for stock identification.

Analysis of Tagging Data – author(s) to be solicited

A description of analytical methods used to examine mark-recapture data for identifying stocks and quantifying interchange rates among stocks.

## VIII APPLICATION OF STOCK IDENTIFICATION DATA IN RESOURCE MANAGEMENT

Application of Stock Identification Data in Resource Management – author(s) to be solicited

A summary of how information on stock structure is used in resource management decisions.

The Role of Stock Identification Data in Formulating Fishery Management Advice - by C. Hammer and C. Zimmermann (Inst. Sea Fisheries, Germany).

A description of how information on stock structure is considered in advice on stock status and management alternatives.

Identifying Fish Farm Escapees – author(s) to be solicited

A review of the issue of escaped fish from aquaculture operations and a protocol for monitoring methods.

Real Time Application of Stock Identification Information – author(s) to be solicited

A description of how stock identification data can be used in real time resource science and management applications.