REPORT OF THE STOCK IDENTIFICATION
METHODS WORKING GROUP (SIMWG)

BY CORRESPONDENCE

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Contents

Executive summary

The Stock Identification Methods Working Group met by correspondence in 2004-2005. The Working Group's volume on Stock Identification Methods was published, and a theme session on stock identification methods was convened by the Working Group at the 2004 Annual Science Conference. SIMWG liaised with the Study Group on Stock Identity and Management Units of Whiting, reviewed the SGSIMUW report, and concluded that the report proposes a coordinated effort to address the Study Group's terms of reference. SIMWG members were also involved in various ICES work related to SIMWG tasks. SIMWG proposes S. Mariani (Ireland) as a new Co-Chair.

1   Main tasks and participants

At its 2004 Annual Science Conference, ICES resolved that a Working Group on Stock Identification Methods would meet by correspondence under the Chairmanship of S. Cadrin (USA) and J. Waldman (USA). The terms of reference indicated that the Working Group would advise on the need for future meetings of the SIMWG and liaise with SGSIMUW on developments in stock identity studies in North Sea whiting (Annex 1).

The Working Group met by correspondence in 2004–2005 to discuss SIMWG tasks re-affirm membership, propose new members, and recommend a new Co-Chair to replace K. Friedland (who stepped down from the position of Co-Chair). SIMWG membership, including proposals for outside experts, is listed in Annex 2. SIMWG recommended that Dr. Stefano Mariani of the University College Dublin School of Biological and Environmental Science be appointed Co-Chair. Dr. Mariani's experience in multidisciplinary stock identification, expertise in genetic analysis and familiarity with the fishery resources advised by ICES would complement the abilities of the current Co-Chairs. He was an active participant in the SIMWG theme session and subsequent correspondence, and is willing to accept the position of SIMWG Co-Chair.

SIMWG members were also involved in various ICES work related to SIMWG tasks. The Stock Identification Methods theme session of the 2004 Annual Science Conference was convened and is described in section 2. The Chairs of SIMWG and SGSIMUW corresponded on developments in stock identity studies in North Sea whiting. A report of the Study Group (ICES, 2005a) was reviewed by SIMWG, described in Section 3. S. Cadrin, SIMWG Co-Chair, served as a reviewer of the Study Group on Stock Identity and Management Units of Redfish (ICES, 2004) for a review group that reported to ACFM at its October meeting. Several SIMWG members submitted abstracts to the "Multidisciplinary Approaches to the Identification of Stock Structure of Small Pelagics: Implications for Assessment and Sustainable Management" theme session at the 2005 Annual Science Conference proposed and convened by E. Hatfield, a SIMWG member. Another ICES Working Group that has overlapping membership and related work SIMWG is the WG on the Application of Genetics in Fisheries and Mariculture, which met from the 3–6 May 2005 in Denmark (ICES, 2005b). Of particular interest are two sections of the report related to tasks b and c: "Evaluate methods and provide recommendations on the application of mixed stock and assignment analysis to elucidate stock components, with an emphasis on marine fishes and fisheries" and "Synthesize the evidence and methods for detecting local (genetic) adaptation in marine fishes."

2   Stock identification methodology

The Working Group's volume on Stock Identification Methods (Cadrin *et al.*, 2005) was published by Elsevier Academic Press, chapter authors received copies, and 10 copies were sent

to ICES. A theme session on stock identification methods was convened by SIMWG (the abstractsa are available on the ICES CM 2004 Documents CD-ROM and also on the ICES website at: http://www.ices.dk/products/CMdocs/2004/CM2004.pdf). The Theme Session was proposed by SIMWG and served as an unofficial meeting of SIMWG members. The session report (below) also serves as technical minutes.

<u>Theme Session EE Stock Identification Methods</u>

Convener: Steve Cadrin (USA)

Background

Stock identification is an interdisciplinary field that involves the recognition of self-sustaining components within natural populations. Stock identification remains a central theme in fisheries science and management. Indeed, the reliability of stock assessments and therefore the effectiveness of fishery management are severely limited for many principal fishery resources, because stock structure and delineation are uncertain. Despite its importance, stock identification remains one of the most confusing subjects in fisheries science for non-specialists.

The ICES Stock Identification Methods Working Group was established to review methodologies of stock identification and develop a protocol for the application of stock identification results. The Group was organized in an open format to invite a wide participation of experts on stock identification to summarize the various approaches. Over the last decade, the Group compiled a volume of contributions aimed at synthesizing the many disciplines involved in stock identification and focusing on the application of results to fishery science and management (Cadrin *et al.,* 2005). Contributors to the publication and other researchers or managers with expertise in stock identification approaches were invited to present case studies or reviews relevant to stock identification for the theme session.

Summary of presentations

Presentations were organized by methodological topic. The session began with an introductory section, including an overview by the convener and case studies on using multiple approaches to stock identification for anglerfish and horse mackerel. The second section was related to phenotypic variation, consisting of a general description of phenotypic characters, a group of presentations on morphometrics and meristics (including case studies for hake, anchovy and anglerfish), spacing patterns of circuli (with a blue whiting example), microchemistry of whiting otoliths, parasites (including a case study on herring) and fatty acids. A section on applied marks included a review of conventional tagging methods for stock identification and some case studies that considered mark-recapture data with genetics information in the Baltic. The section on genetics included a general introduction and case studies on blue whiting allozymes, and microsatellites of Atlantic salmon and herring. The section on data analysis had a description of neural network analysis of horse mackerel data and a review of maximum likelihood methods for stock composition analysis. The final section was on the use of stock identification information for resource management, with presentations on forming fishery management advice and case studies for Baltic herring and cod.

Discussion - Several aspects of stock identification were discussed. Participants noted the challenge of accurately classifying samples to many groups, and the subjectivity involved in deciding how many groups to consider. Two general approaches to the problem were proposed: Exploratory analyses (e.g., PCA, k-groups cluster analysis) can be conducted to determine how many groups are illustrated by patterns of variance in the data; however, a more holistic approach would be to consider information from other stock identification disciplines to determine the number of putative stocks in the sample.

The difficulty in concluding genetic homogeneity was discussed, because of the issue of negative results. The consensus solution was to explore as many genetic characters as possible. Al-

ternatively, it was noted that false differences in genetics characters is also a potential problem if sampling is not representative.

During a scheduled break in the second day of the session, two topics were raised for discussion by the session convener:

The prospect of continuing SIMWG was discussed. The main objective of SIMWG, completing a volume of methodological protocols, has been completed. Other objectives, like advising on specific issues concerning stock identification may be best addressed by other specific study groups. For example, the Study Group on Stock Identity and Management Units of Redfishes conducted a review of stock structure for *Sebastes mentella* (ICES, 2004). Similarly, stock identification questions for Baltic herring were addressed by the Study Group on Herring Assessment Units in the Baltic (ICES, 2001). Participants voiced their opinions that SIMWG should continue to serve its original purpose in the ICES community. As new methods continue to be developed, ICES will need them to be evaluated in the context of other approaches. Furthermore, the group felt that SIMWG provides a forum for discussing the implications of new methods. Perhaps the best way to proceed for SIMWG is to adopt its earlier approach to documenting methodological protocols, in which new methods are reviewed in the annual SIMWG report, and successive reports may eventually form material for an updated volume.

A theme session for the 2005 Annual Science Conference is being proposed by Emma Hatfield and Doug Hay titled "Theme Session on Multidisciplinary Approaches to the Identification of Stock Structure of Small Pelagics: Implications for Assessment and Sustainable Management Applications." Although there was one chapter in the SIMWG book on management applications (Hammer and Zimmermann, 2005), the topic deserves more attention. There were mixed feelings in the group on limiting the scope to small pelagics or including demersal stocks as well. Certainly, pelagic species present particular difficulties with delineating stocks and mixed-stock fisheries, and four EU projects are currently funded for small pelagic (HOMSIR, HERGEN, WESTHER, and SARDYN). However, many interesting implications of demersal stock structure would also be worth considering. Perhaps the conveners can request papers on the implications of stock structure research, with preference for small pelagic applications, and use their discretion in acceptance of papers for theme session.

Conclusions

One theme that emerged throughout the development of SIMWG and the theme session is the strength of interdisciplinary analyses. Over the history of stock identification, new methods were developed and promoted as better ways to approach stock identification, often leading to equivocal information from competing methodological camps. However, when results from each approach are viewed in the context of what precise aspect of stock structure they reveal, a more holistic view with multiple perspectives is possible, providing more reliable information for resource management. As new methods continue to emerge, their results should be considered by SIMWG along with those from traditional approaches to improve our ability to study stock structure.

3   Review of 2005 SGSIMUW Report

SGSIMUW met from 15–17 March 2005 in Aberdeen to coordinate and initiate a study on the stock identity and management units of whiting in the North Sea. The report includes descriptions of fishery distribution, the physical environment, and a review of information on whiting stock structure, spawning areas, and spatial patterns of survey data.

The description of physical attributes of the North Sea provides a meaningful context in which to interpret results of previous studies and spatial patterns of fishery and survey data. The report offers compelling evidence that the "strong temperature front separating the mixed and

stratified areas in summer and autumn along the 50 m depth contour to the north of the Dogger Bank" forms a putative boundary between northern and southern components of the North Sea whiting resource.

The review of previous evaluations of North Sea whiting stock structure supports the putative boundary formed by the temperature front. Although genetic studies do not indicate distinct populations in the North Sea, results from other disciplines (tagging, parasites, meristics) suggest limited movements across the boundary. The group concluded that background information supports the hypothesis of separate northern and southern groups, but they may not be genetically distinct, and available information is insufficient to delineate the two groups. Information on ichthyoplankton distribution (expected later in 2005), a new tagging project, and an analysis of microsatellites from whiting sampled on spawning grounds should help to address the degree of reproductive isolation between the two putative stocks.

New results provided by SGSIMUW analyses indicate strong spatiotemporal patterns in survey abundance and mortality, in which temporal patterns of abundance and mortality are strongly correlated within the putative stock areas, and remote areas in different stocks are uncorrelated (or negatively correlated). However, some adjacent areas in different stock areas had correlated patterns, indicating they may be transitional areas. SGSIMUW offered these results as example analyses and plans a more comprehensive analysis with the goal of delineating stock areas.

In summary, SIMWG applauds the multidisciplinary approach taken by SGSIMUW and concludes that the report proposes a coordinated effort to address its terms of reference. SIMWG looks forward to liaise with SGSIMUW and to review new information as it becomes available.

4   Future meeting

The WG 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.

5   Recommendation

The Working Group recommends:

The Stock Identification Methods Working Group [SIMWG] Co-Chairs Dr. S. Cadrin (USA), Dr. J. Waldman (USA), and Dr. S. Mariani* (Ireland) work by correspondence in 2005/2006 to:

a) liaise with ICES working groups and study groups dealing with stock identification issues;

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 2006 Annual Science Conference.

6   References

Cadrin, S.X., K.D. Friedland and J.R. Waldman, editors. 2005. Stock Identification Methods: Applications in Fishery Science. Elsevier Academic Press, Amsterdam. 718p.

Hammer, C., and Zimmermann, C. 2005. The role of stock identification in formulating fishery management advice, *In*: Stock Identification Methods: Applications in Fishery Sci-

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ICES. 2001. Report of the Study Group on the Herring Assessment Units in the Baltic Sea. ICES CM 2001/ACFM:10.

ICES. 2004. Report of the Study Group on Stock Identity and Management Units of Redfishes. ICES CM 2004/ACFM:10.

ICES. 2005a. Report of the Study Group on Stock Identity and Management Units of Whiting. ICES CM 2005/G:03.

ICES. 2005b. Report of the Working Group on the Application of Genetics in Fisheries and Mariculture. ICES CM 2005/F:01.

Annex 1: Terms of Reference for 2005

The **Stock Identification Methods Working Group** [SIMWG] (Co-Chairs S. Cadrin, USA, and J. Waldman, USA) will work by correspondence in 2005 to:

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

b) liaise with SGSIMUW on developments in stock identity studies in North Sea whiting.

SIMWG will report by 31 May, 2005 for the attention of the Living Resource Committee.

Supporting Information

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 and relation to Action Plan:	Action Plan No 1 – Action 1.2.1: Understand and quantify stock structure of commercially and ecologically important species. [LRC] Stock structure and stock identification have been identified as part of the work programme of the Living Resources Committee. 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.
Resource Requirements:	Research programs for this work are already committed and nearly completed. Additional resources required are negligible.
Participants:	41
Secretariat Facilities:	None
Financial:	No financial implications
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. ACFM will review the problem of *Sebastes mentella* stock identification in the North Atlantic with consideration of SIMWG protocols.
Linkages to other Organisations	There are no direct linkages to other organizations.
Cost Share	ICES: 100%

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