Northwest Atlantic Fisheries Organization

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SCIENTIFIC COUNCIL MEETING – NOVEMBER 2001

REPORT OF THE 2ND MEETING OF THE WORKING GROUP ON REPRODUCTIVE POTENTIAL

NAFO Scientific Council Working Group on Reproductive Potential
Hosted by the State Research and Design Institute for Fishing Fleet (Giprorybflot),
St. Petersburg, Russia
23-26 October 2001

OPENING

The 2nd meeting of the NAFO Scientific Council Working Group on Reproductive Potential was held during 23-26 October 2001 at the State Research and Design Institute for Fishing Fleet (Giprorybflot), St. Petersburg, Russia. There were 10 participants from Canada, Germany, Norway, Russia, Spain, United Kingdom, and United States of America.

The Meeting was opened by E. Trippel (Canada), Chairman of the Working Group, who on behalf of the Scientific Council welcomed participants to St. Petersburg, and presented an overview of the Working Group's Terms of Reference, activities completed, and those tasks remaining. The Institute Director, Prof. Dr. V. Romanov also welcomed Working Group members, provided a brief overview of the Institute's scientific mandate, and wished the WG success during its stay in St. Petersburg. Excellent co-ordination of local arrangements were made throughout the meeting by N. Yaragina (PINRO, Russia) and L. Zaslavskaya (Giprorybflot, Russia).

INTRODUCTION

The establishment of the Working Group on Reproductive Potential followed a recommendation of the *Symposium on Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish* hosted by the NAFO Scientific Council in Lisbon, Portugal, September 1998. Terms of Reference were assigned to the Working Group by NAFO Scientific Council in 1999. The 1st Working Group Meeting was held at the Aquarium, San Sebastian, Spain (AZTI) in October 2000 and led to the synthesis of significant progress. Annual progress reports have been made by the Chairman at the June 2000 and 2001 NAFO Scientific Council meetings in Dartmouth, Nova Scotia and received endorsement and favourable comments. The Working Group plans to make 2 publications as special volumes: one in the *NAFO Scientific Council Studies* and the other in the *Journal of Northwest Atlantic Fishery Science*. Editorial work will be handled by the Chairman.

The 2nd Working Group Meeting in St. Petersburg focused on preparation of manuscripts for these publications, including (i) their presentation to WG members, (ii) preparation of unwritten material, (iii) co-ordination among co-authors, and (iv) assignment of tasks for their completion. The meeting was organized into three parts. Terms of Reference (TOR) Co-Leaders first presented their achievements to date and received feedback. The second part was more informal, during which four TOR groups were formed to discuss future work activities and the status of manuscripts specific to a TOR's goals as initiated during the previous meeting 10-13 October 2000 in San Sebastian, Spain. The third part provided a synthesis of TOR group discussions to inform the Chairman and other participants on updated TOR member responsibilities and deadlines. At the conclusion of the meeting, it was clear that the set of published papers will form an important contribution to the methodology and application of reproductive biology to fish stock assessment.

The following is a summary of progress made and the status of manuscripts.

TOR 1 Co-Leaders: J. Tomkiewicz (Denmark) and J. Burnett (USA)

Explore and review availability of information and existing data on reproductive potential by area and species.

Co-Leaders were not present at the meeting, hence, the Chairman presented an updated version of the four level tables designed for the inventory of data on reproductive potential of marine fish stocks. TOR 1 has been successful in assembling reproductive data on 51 fish stocks of the North Atlantic and Baltic Sea. The four tables comprise (i) status of available data for a specific stock, (ii) information on data format and quality, (iii) reference to studies conducted on reproductive potential, and (iv) data sources. A large number of investigators assisted with this impressive effort. Species encompass gadoids, pleuronectoids, *Sebastes* sp. and others. F. Saborido-Rey (Spain) was recruited to assist with the preparation of the *Sebastes* sp. overview. It was recommended that data also be assembled for North Sea plaice.

A scoring-system is in the process of being developed and plans include the evaluation of data quality and quantity of each of the 51 stocks. These summary statistics will be used to define data poor, medium and rich stocks. Preliminary results indicate that NAFO stocks are primarily data poor, whereas the selected ICES stocks could be referred to as data medium or rich. Tabular format provides a uniform method of data recording and permits rapid assessment of where one may look to find data on a particular aspect needed to measure fish reproductive potential. The tables, when edited, will be published in the *NAFO Scientific Council Studies* series as well as be listed on the NAFO website. The contribution is expected to be about 250 pages. Discussion was made on reference style and recommendations were made that should keep the contribution to within this size.

The second manuscript of this TOR will summarize the scores of each of the 51 stocks, describe the patterns of data quality, and outline requirements for more basic or applied research for the various species and stocks. This manuscript (along with all others referred to below) will collectively be published as a special volume of the *Journal of Northwest Atlantic Fishery Science* and will represent the Working Group's Report in fulfilment of its Terms of Reference (in combination with the separate publication of the reproductive data tables).

TOR 2 Co-Leaders: H. Murua (Spain) and A. Thorsen (Norway)

Explore possibilities to develop standard internationally coordinated research protocols to estimate egg and larval production.

Co-Leaders updated WG members on the progress made on 5 planned manuscripts that deal with procedures used to estimate egg, sperm and larval production of fish stocks. H. Murua (Spain) referring to the first manuscript provided the establishment of categories of reproductive biology of various species and indicated that different fecundity estimating procedures may be required for determinate and indeterminate spawners. In the second manuscript, H. Murua indicated that appropriate fecundity estimating methods of wild fish will be given in detail for each species. This will include preserving of gonads, subsampling, and dealing with oocyte atresia. The methods will account for multiple-batch and single-batch spawning. Specific methods will be recommended, though the choice will remain with the end user. Each study and institution may have specific constraints and cannot always adopt a specialized method easily.

A. Thorsen (Norway) will lead the third manuscript on estimating fecundity of captive females of a variety of species. Captive female studies have expanded considerably over the past 10 years. Different institutions have adapted slightly different systems for assessment of egg production, viability and larval quality for fish of different species, reproductive history and nutritional status. Maintaining animals in captivity and attempting to breed them is a difficult task while establishing, as much as possible, environmental factors and diet that reflect natural conditions. Description of how to undertake these studies will be made in detail. Methods to measure fertilization rates, hatching rates and fecundity will be given. Greatest importance is placed on gadoids, particularly cod, though methodology on flatfishes is also provided.

E. Trippel (Canada) will lead a manuscript on male reproductive potential. This manuscript was not originally planned and is considered an additional product of the WG. Male fish represent ~50% of breeders of a population, but only limited attention has been given to their influence on fertilization success, hatchability, offspring quality and recruitment. Male gametes are tiny compared to eggs and thus at first glance are not considered important. However, differences exist in embryo and early life performance as a result of sire input. The male effect is presumably a result of inherited metabolic processes from the male genome and may be correlated with adult male

attributes (e.g., condition factor). Recommendations on how to assess sperm quality and estimate annual sperm production of a stock are provided. The manuscript is nearly completed.

Y. Lambert (Canada) will lead the fifth manuscript of this TOR, which will provide an evaluation of which species are more adaptive to captive spawning experiments than others. The number of batches spawned, spawning duration, inter-batch intervals are examples of information that cannot easily be obtained from wild ovary samples. Furthermore, seasonal egg size and quality changes cannot be readily obtained in the field and related back to parental fish. Captive studies permit the tracking of individual fish and potentially enable the measurement of these reproductive variables permitting a better portrayal of stock reproductive potential. Unfortunately, experience has shown that some species are not as suitable as others for captive research. Stress symptoms are more readily apparent for some species (and some individuals within species), though special handling techniques can sometimes overcome these shortcomings. Discussion is made of the advantages and disadvantages of captive studies and their integration with wild studies.

TOR3 Co-Leaders: Y. Lambert (Canada) and N. Yaragina (Russia)

Explore and evaluate alternative methods to estimate reproductive potential annually or part of routine in monitoring and sampling schemes (such as HSI).

It was previously recommended that a wide variety of body metrics be explored and a select few priorized and recommended for standard practices in estimating a stock's reproductive potential. This manuscript led by Y. Lambert (Canada) is an extensive undertaking and deals with the process of reviewing the results to date of the great majority of fish reproductive studies of North Atlantic species. Cod is the most frequently studied species and further detailed examination of cod data was made. The ability of maternal length, reproductive history and condition factor (Fulton's, HSI) to predict fecundity, egg size, quality, fertilization, hatching and larval production is reviewed.

A second manuscript of TOR 3 that evaluates the applicability of proxies to develop estimates of stock reproductive potential is listed as a tentative contribution. It would proceed to build on the information in the preceding manuscript by involving case studies that show how time series of stock reproductive potential can be constructed using various predictive equations. Discussion focussed on the manuscript's potential contents and various work assignments were given to co-authors, but it was unsure whether the manuscript could be completed in time for inclusion in the special volume.

TOR 4 Co-Leaders: T. Marshall (Norway) and G. Marteinsdottir (Iceland)

Review possibilities to develop methods and opportunities to estimate stock reproductive potential for assessment and management.

T. Marshall (Norway) provided an update of efforts to date and presented a first version of a case study approach to describe ways to improve on fisheries management advice. Improvements include having authors of stock survey reports/assessments provide current estimate's of a stock's reproductive potential (e.g., in addition to maturity, weight or SSB). New biological reference points could then be developed if the reconstructed stock-recruitment relationship explains more of the variation in recruitment. The stocks proposed for case studies include those in NAFO and ICES jurisdictions and differ in data quality (poor, moderate and rich). A comparison of the relative merit of using different proxies to estimate reproductive potential is planned especially as some data requirements are less tedious yet produce good predictive power for some stocks.

L. O'Brien (USA) presented a nearly completed manuscript on a case study using the MARMAP pelagic egg survey data for Georges Bank cod. A lengthy time series exists and it provides a classic integration of stock assessment data with planktonic egg survey data. The modelling results demonstrate the poor ability of first-time spawning cod to impact egg abundance at various developmental stages. Spawning stock biomass-per-recruit analyses for Georges Bank cod is thus in need of improvement. The existing SSB-based approach does not discount the effectiveness of first-time spawners, and consequently predicts fishing mortality rates that are not supported by the spawning potential of the stock.

F. Saborido-Rey (Spain) is leading a manuscript on temporal changes in population structure of Flemish Cap cod. Severe shifts in age and size at sexual maturity and size-specific fecundity have occurred for this stock in

recent years. Integration of both Spanish and Canadian data are being made for the first time and reveal the heavily exploited state of the stock.

P. Wright (UK) suggested he might be able to produce an additional manuscript that was not previously planned. This manuscript would examine the relationship between the contribution of first and repeat spawners and recruitment variability in North Sea haddock. His work has already demonstrated low survivorship from the period when haddock spawn for the first time, based on otolith microstructure studies. This temporal spawning dimension is difficult to quantify, but likely plays a key role in recruitment.

CONCLUSION

It was recommended that TOR Co-Leaders arrange with their participants the finalization of material for primary publication as a special volume of the *Journal of Northwest Atlantic Fishery Science*. Co-Leaders of TOR 1 will also publish the comprehensive set of tables in the *NAFO Scientific Council Studies*. A 3rd Working Group Meeting to discuss the applicability of the achieved results to fishery management has been proposed for autumn 2002 (date and location to be decided). In the mean time, the Working Group will work by correspondence to finalize the manuscripts in order to meet the deadline set by the Chairman of February 28, 2002.

E. Trippel (Canada) closed the meeting by thanking the Co-Leaders and participants for their excellent contributions and energy shown in their activities to date. All members of the Working Group expressed their appreciation for the great hospitality shown by the State Research and Design Institute for Fishing Fleet (Giprorybflot) during the meeting, which created an enjoyable and productive experience.

Participants present at the 2nd Meeting of the Working Group on Reproductive Potential, State Research and Design Institute for Fishing Fleet (Giprorybflot), St. Petersburg, Russia:

(Left to Right): L. O'Brien (U.S.A.), P. Wright (United Kingdom), N. Yaragina (Russia), H. Murua (Spain), T. Marshall (Norway), G. Kraus (Germany), Y. Lambert (Canada), A. Thorsen (Norway), F. Saborido-Rey (Spain), and E. Trippel (Canada).

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