Report to CIE on ICCAT Assessment Meeting
Madrid, Spain 22-30 July 2002

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Executive Summary.

The ICCAT Assessment Meeting for bluefin tuna met in Madrid July 22-30, 2002. The resource is divided into eastern and western stocks for the purpose of assessment and for most of the meeting parallel sessions were held. As one of three CIE reviewers, I was assigned to work with the western sub-group and my comments are restricted to western stock. The reviewer's role was to aid in preparation and review during the meeting rather than the more traditional technical analysis. The analysis was an age structured cohort approach and assumed two stocks. This VPA approach is weakened by the underlying data on stock structure, difficulties in ageing (approximated by cohort slicing) and lack of fishery independent abundance data. The VPA model has a large plus group which is estimated by assuming a constrained ratio in the fishing mortality between this group and the next younger age; a model assumption which makes the analysis 'stiff' which in turn affects the analysis. The stiffness, and the low power in the abundance data, was evident when the F-ratio constraint was relaxed and very divergent stock trajectories were produced. Furthermore, the projections use two stock-recruit models, neither of which fit the data well. The assessment and projections should receive further analysis with alternative models.

History of events.

Upon receipt of background materials, they were reviewed.

Sunday, July 21 – Arrived in Madrid

Monday, July 22 – Dr. Sissenwine met with the three CIE reviewers and outlined his expectations regarding our participation. He emphasized the importance of participation during the meeting rather than an analysis of the meeting and the resultant assessment.

- The participants were divided into eastern and western bluefin stock components; I joined the western Atlantic group.

- I was assigned to compile (with Dr. Murdoch McAllister) the results section for the western stock.

Thursday, July 26 – Data were compiled and first assessment results were made available for diagnosis and sensitivity runs

Monday, July 29 – Western group was convened to review western text in Executive Summary

Tuesday, July 30 – Entire group was reconvened as single body to review Executive Summary for both areas.

Findings and recommendations.

This summary will be partitioned into two sections using the headings from the terms of reference (See Statement of Work in Appendix A), the first will deal with the conduct of the meeting and how it might be improved, and it is labeled procedural summary. The second covers technical aspects of the review and reviews the analysis and resultant advice. By necessity, some issues pertain to both categories. The Statement of Work requested a list of the documents presented, and it is provided in Appendix B.

Procedural summary.

The meeting was well chaired and a great deal of work was produced and investigated in a short time. The requirements to get consensus and an Executive Summary dominated the meeting. There was barely time for a single pass at results and diagnostics and then compiling a detailed report. Thus, there was little time to review results, let alone stepping back and re-visiting technical issues. As the panel was broken into western and eastern fishery contingents, about half of the report was not seen by other half until the last night of the meeting. This means that for many issues the level of peer review was restricted, and in general less than say that of a SARC. While intersessional work and methods meetings could particularly technical issues, some time at the assessment meeting should be set aside for looking at the context, approach and implications of the assessment.

Numerical discussion dominated biological issues. Of the time used for technical discussion, a fair bit was devoted to variance estimation, weighting schemes in the VPA, and chi-square distributions. With the exception of questions as to whether the catch data represented stocks, the fundamental issues of whether the data (either catch or abundance) supported a VPA-based analysis that assumes the ability to age and identify cohorts were not broached. Neither did the other VPA underpinnings of natural mortality rates, growth rates and maturity ogives receive attention. The related question of to what degree the data and models could be credibly projected for over two decades was addressed only by bootstrapping, which is predicated on the concept that the model (VPA) adequately describes the resource's dynamics.

Because of the lack of time to get familiar with the data, I prepared and distributed a manuscript (Appendix C) to help the attendees, who such as myself, were not well acquainted with the underlying data. The second purpose of the manuscript was to make available summarized data for comparison to model results and their implications.

Technical summary.

This summary will be portioned into point form to discuss four technical issues: VPA formulation; model selection; implications of stock structure; and other models.

VPA formulation

This section will cover both the VPA formulation and stock projections.

The VPA model for the western fishery is fairly stiff, in that it cannot react easily to changes in the data. The stiffness is a result of two attributes of the VPA formulation, the constrained F-ratio and the explicit plus group. The inclusion of an explicit plus group means that any divergences in that group are accumulated back in time. In simulations, explicit plus groups did not perform well and the usual way around this is to tune to the oldest age and then apply (perhaps with a time variable F-ratio) the F on this group to the catch in the plus group. This accounts for the catch but does not allow the build up of older fish. Formulations of this type should be re-considered. The formulation was very sensitive to the 'F-ratio', which linked the age 10+ fish to the age 9. This parameter was heavily constrained for the period since 1982. In one trial when this constraint was relaxed to a looser constraint (a random walk) on biomass, estimates of spawning stock biomass (SSB) were 2-3 times higher. In a second trial in which catch from a larger area was added in, the F-ratio caused counter-intuitive lower SSB estimates. And finally, the uncertainty from bootstrap replicates is atypically, relatively high in the earliest years where the VPA is generally converged.

In order to carry out projections two stock-recruit relationships were fit to the output from the VPA. Two models were fit, called high recruitment (HR) and low recruitment (LR). The former fit the data with a Beverton-Holt curve, which was influenced by the high recruitment estimated for the 1970s. The LR fit two straight lines through the data, a hockey-stick model. Neither of these fit the data very well, especially the recent years, which are most important in projections. An anomaly of these models is that the low recruitment scenario has higher recruitment over a range of SSBs. The projections used three sorts of estimates of cohort strength. The older ones were estimated directly in the VPA, those slightly younger were fit by model assumptions about the partial recruitment of the youngest fish in the terminal year, and those not yet born were estimated from one of the stock-recruit relationships. More of the uncertainty in this process needs to be considered; the current bootstrapping is inadequate. Although quantification is not possible, alternative scenarios to address model uncertainty and exploration of estimation with an operational model would be useful.

Model selection

The western group adopted the AICc as a statistical basis for model selection. Weight was also given to keeping the model quite similar to those of previous assessments to aid in comparisons. The related question of model acceptability was also addressed, but time did not allow for a complete investigation. The validity of the assessment would seem to hinge on having a credible model. This age-based assessment suffers from poorer data than most, and model validation should be given priority.

The related question of data selection for the abundance indices was also discussed. A sensitivity run was performed in which two indices that had correlated residuals were dropped. Although their inclusion had little effect (this in some degree shows again the stiffness of the system) they do open more fundamental questions as to what they are measuring. Perhaps when the underlying spatial/temporal stock dynamics are better understood, these indices, and others, will fit together better.

Implications of stock structure

Although a poll was not taken, the impression I had was that no one in room believed that the western stock catch, and hence its assessment, was composed exclusively of, or in many of the expressed opinions, even dominated by western born fish. Tagging data showed a great deal of movement, even of young fish. A two stock analysis was investigated and spatial models having

six sub-areas were presented. A simpler model having three areas, with two spawning sites, Gulf of Mexico and Mediterranean, and a mixed Atlantic might be considered as an alternative depiction. This approach would not have much more data requirements than the present two single stock and two stock models, but it is more in step with the tagging observations and stated hypotheses concerning stock structure.

Other models

In addition to some of the suggestions above, three sorts of models should be considered. The first consists of simple models that are essentially data descriptions. Perhaps management should be considered which uses trends in data and more qualitative considerations rather than a stock reconstruction via VPA.

The other extreme in terms of complexity is an operational model. Such a model could include spatial heterogeneity, multiple fleets, environmental forcing, etc., and it could be used to test the analytical models. The age-structured, six-box model that was presented had potential to be developed into an operational model. Similarly, some of the larger modeling undertakings, like Iceland's BORMICON, could be adapted for use.

A third class of models would be the highly parameterized models, often based on AD Model Builder that would use the same data as the current assessments. The highly parameterized models make many of the implicit assumptions explicit, and due to because of their diagnostics, they permit insights into the current analysis used in assessments. The contributions of individual data sources, such as catch at length, CPUE or tagging can be explicitly explored. Also, the development of such alternatively parameterized models expands the understanding of base model in a sensitivity analysis sense.

Appendix A. Statement of Work

STATEMENT OF WORK

Consulting Agreement between the University of Miami and Dr. Robert Mohn

Background

Atlantic bluefin tunas are a valuable commercial and recreational fishery resource. The fishery takes place throughout the North Atlantic Ocean and the Mediterranean Sea. Many countries from Europe, North America, Asia, Africa, South America and the Caribbean participate in the fishery.

The fishery is subject to international management by the International Commission for Conservation of Atlantic Tunas (ICCAT). The ICCAT convention establishes Maximum Sustainable Yield as the objective for management. Scientific advice for fisheries management is prepared by ICCAT's Scientific Committee on Research and Statistics (SCRS). ICCAT manages Atlantic bluefin tuna as two separate management units for the Western Atlantic and Eastern Atlantic (including the Mediterranean Sea). The Western Atlantic bluefin tuna population has been sharply reduced in abundance from the 1970s. ICCAT adopted a rebuilding plan for the Western Atlantic fishery in 1998, which is still in force. Overfishing is now occurring in the Eastern Atlantic, with the catch far exceeding estimates of the yield that can be sustained.

Management of bluefin tuna, particularly for the Western Atlantic management unit, has been controversial for decades. The fishing industries (both commercial and recreational) believe the stock has not declines as seriously as indicated by ICCAT assessments, and that more recover has occurred in recent years. Environmentalists have argued that the Western Atlantic bluefin tuna fishery is an extreme example of overfishing, and that the rebuilding process has just begun, at best. Part of the controversy over bluefin tuna is related to ICCAT's use of two management units. It has always been known that there is some migration across the management unit boundary, but recent evidence indicates the mixing between Western and Eastern Atlantic management units could be quite important from a management perspective.

More detailed background can be found on the ICCAT web site at www.iccat.es by clicking on "Download Reports, Regulations, etc.", and then clicking on:

- "Executive Summaries of Species Status, Oct. 2001- Bluefin": For the most recent management advice;
- "Last Detailed Species Assessment Report-Bluefin": For details on the most recent assessment which was conducted in 2000;
- "Other Reports of 2001- Bluefin Mixing Meeting": For a description of recent information on mixing and its implications; and
- "Work plans for Species Working Groups- Bluefin": For the work plan for the 2002 assessment meeting for bluefin.

These four documents will also be sent electronically (see Appendix I for a tentative list of submissions to the ICCAT bluefin tuna session).

Role of the Consultant

The consultant is to participate as an objective scientific expert member of the US Delegation to the ICCAT bluefin tuna assessment meeting, 22-30 July 2002 at ICCAT Headquarters in Madrid. The US Delegation will be composed of scientists funded by the fishing industry and environmental interests, as well as US government scientists. In the past, the diversity of perspectives of the scientists within the US delegation has made it difficult to reach consensus on assessment results and management advice. The participation of independent experts from the Center for Independent Experts (CIE) is intended to add expertise, help reach a balanced consensus, and lend credibility to the outcome.

The last "bulleted" document (work plan) above gives a description of the work to be carried out during the assessment meeting. The second "bulleted" document (Detailed Assessment) describes the statistical methods used to calculate abundance indices (i.e., general linear models), preparation of catch at age matrices (by cohort slicing), the assessment methodology (a version of ADAPT), and other models (e.g., Age Structured Production Models). The consultants must have the expertise and experience to understand these methods and models and to help guide the assessment meeting to use them properly from a scientific perspective.

In addition to participating in the ICCAT meeting for nine days, the consultant will be expected to spend five days preparing for the meeting (reviewing past assessments and documents submitted to the current meeting), and two days following the meeting preparing a report. The consultant's duties will not exceed a total of 19 days.

Specific Responsibilities of the Consultant

Specific tasks and timings are itemized below:

1. Read and become familiar with the four documents noted above listed in the Background session of this SOW, SCRS documents submission to the assessment meeting provided to the consultants in advance of the meeting (a list of expected submissions is attached), and other relevant documents;

2. Participate in the entire ICCAT assessment meeting of 22-30 July 2002;

3. As a participant in the meeting, conduct analyses and prepare portions of the meeting report as assigned by the head of the US Delegation for the Western Atlantic bluefin tuna assessment;

4. Prepare a report addressing the following points:

    - Highlighting impressions of the conduct of the meeting and how it might be improved in the future;

    - Discussing strengths and weaknesses in the analyses and advice resulting from the assessment meeting; and

    - If, and only if, the assessment meeting fails to provide unambiguous advice by consensus, the individual consultants will provide their own expert advice within the context of work plan and requirements of the ICCAT rebuilding plan for Western Atlantic bluefin tuna. Specifically, they should advise on the appropriate total allowable catch level consistent with the rebuilding plan, and on management units (i.e., should ICCAT change from its current two management units, and if so, how?).

5. No later than August 9, 2002, submit the written report[1] (see Appendix II) addressed to the "University of Miami Independent System for Peer Review," and sent to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu.

NAME_____ DATE_____

[1] The written report will undergo an internal CIE review before it is considered final. After completion, the CIE will create a PDF version of the written report that will be submitted to NMFS and the consultant.

ANNEX I: TENTATIVE LIST OF SUBMISSIONS FOR THE ICCAT BLUEFIN TUNA SESSION

Specifications and clarifications regarding the ADAPT VPA assessment/projection computations carried out during the September 2000 ICCAT West Atlantic bluefin tuna stock assessment session - Punt, A E and Butterworth, D S - SCRS/02/086

An initial application of the spatial structure framework for North Atlantic bluefin developed at the September 2001 bluefin mixing workshop using simple age-aggregated models - Punt, A E and Butterworth, D S - SCRS/02/087

A scenario-based framework for the stock assessment of North Atlantic bluefin tuna taking into account trans-Atlantic movement, stock mixing and multiple fleets - P. Apostolaki , M. McAllister and E. A. Babcock - SCRS/02/088

Standardized catch rates of bluefin tuna, thunnus thynnus, from the rod and reel/handline fishery off the northeast United States during 1980-2001 - Craig A. Brown - SCRS/02/089

Standardized catch rates for large bluefin tuna, thunnus thynnus, from the U.S. pelagic longline fishery in the gulf of Mexico and off the florida east coast. - Jean Cramer - SCRS/02/090

Updated index of bluefin tuna (thunnus thynnus) spawning biomass From Gulf of Mexico ichthyoplankton surveys - Gerald P. Scott and Stephen C. Turner - SCRS/02/091

Updated information on electronic tag results from bluefin tuna tagged in the western Atlantic Ocean - Barbara A. Block and Andre Boustany - SCRS/02/092

Atlantic bluefin tuna: additional considerations on mixing on the feeding grounds - Frank Hester - SCRS/02/093

ANNEX II: REPORT GENERATION AND PROCEDURAL ITEMS

1. The report should be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the report should consist of a background, description of review activities, summary of findings, conclusions/recommendations, and references.

3. The report should also include as separate appendices the bibliography of all materials provided and a copy of the statement of work.

Appendix B. Submitted and key reference documents.

SCRS/01/020	ICCAT Workshop on Bluefin Mixing. Anon.
SCRS/02/010	GFCM-ICCAT Meeting Report. Anon.
SCRS/02/036	General review of bluefin tuna farming in the Mediterranean area. Miyake, P.M., J.M. de la Serna, A. di Natale, A. Farrugia, N. Miyabe, V. Ticina.
SCRS/02/081	Updated standardized CPUE indices for Canadian bluefin tuna fisheries based on commercial catch rates. Porter, J.M., M. Ortiz, and S.D. Paul.
	SCRS/02/085 Preliminary results of aerial surveys of bluefin tuna in the western Mediterranean sea. Jean-Marc Fromentin, Henri Farrugio, Michele Deflorio and Gregorio De Metrio.
SCRS/02/086	Specifications and clarifications regarding the ADAPT VPA assessment projection computations carried out during the September 2000 ICCAT west Atlantic bluefin tuna stock assessment session. Punt, A.E. and D.S. Butterworth.
SCRS/02/089	Standardized catch rates of bluefin tuna, thunnus thynnus, from the rod and reel/handline fishery off the northeast United States during 1980-2001. Brown, C.
SCRS/02/090	Standardized catch rates for large bluefin tuna, thunnus thynnus, from the U.S. pelagic longline fishery in the gulf of Mexico and off the Florida east coast. Cramer, J.
SCRS/02/091	Updated index of bluefin tuna (thunnus thynnus) spawning biomass From Gulf of Mexico ichthyoplankton surveys. Scott, G., and S.C. Turner.
SCRS/02/092	Distribution of western-tagged Atlantic bluefin tuna determined from implantable archival and pop-up satellite archival tags. Block, B., et al.
SCRS/02/093	Atlantic bluefin tuna: additional considerations on mixing on the feeding grounds. Hester, F.
SCRS/02/094	Sex-ratio by length-class of bluefin tuna (Thunnus thynnus L.) caught by Maltese longliners. Farrugia, A.
SCRS/02/095	Description of Maltese bluefin tuna (Thunnus thynnus L.) fisheries. Farrugia, A.
SCRS/02/096	Revision of historical catches of bluefin tuna made by Maltese longliners. Farrugia, A.
SCRS/02/097	Historical catch of bluefin tuna (Thunnus Thynnus) and little tuna (E. Alletteratus) from a Libyan trap net. Tawil, M.Y.
SCRS/02/101	Update of bluefin tuna catch-at-size database. Kebe, P., C Palma, J Cheatle.
SCRS/02/102	Catch, effort and standardized catch per unit effort for the eastern Mediterranean bluefin tuna stock caught by Taiwanese longline fishery up to 2001. Hsu, C. and H. Lee.
SCRS/02/103	Standardized bluefin CPUE from the Japanese longline fishery in the Atlantic including those for mixing studies. Miyabe, N. and Y. Takeuchi.
SCRS/02/104	Long term fluctuations in bluefin tuna trap catches: Are they environmentally driven? Ravier-Mailly, C. and J.M. Fromentin.
SCRS/02/107	New tendencies in the Turkish bluefin tuna fishery in 2001 and 2002. Oray,I.K. and F.S. Karakulak.
SCRS/02/109	Updated Standardized Catch Rates for bluefin tuna from the trap fishery in the straits of Gibraltar. Ortiz de Urbina, J. and J.M. de la Serna.
MS/2002	Bluefin tuna CPUE standardization of the baitboat fishery in the Bay of Biscay. Ortiz,M., E. Rodriguez-Marin, H. Arrizabalaga, G. Moreno, C. Rodriguez-Caballo, M. Ruiz, J. Pereira, J.L. Cort. Col.Vol,Sci.Pap. ICCAT, 54(2):574-610 (2002)

MS/2002 Influence of the improved Spanish baitboat abundance index on the VPA calibration for the East Atlantic and Mediterranean bluefin stock. Kell, L.T., M. Oritz, H. Arrizabalaga, E. Rodriguez-Marin, G. Moreno. Col.Vol,Sci.Pap. ICCAT, 54(2):611-619 (2002)

Appendix C. Manuscript distributed at ICCAT Meeting

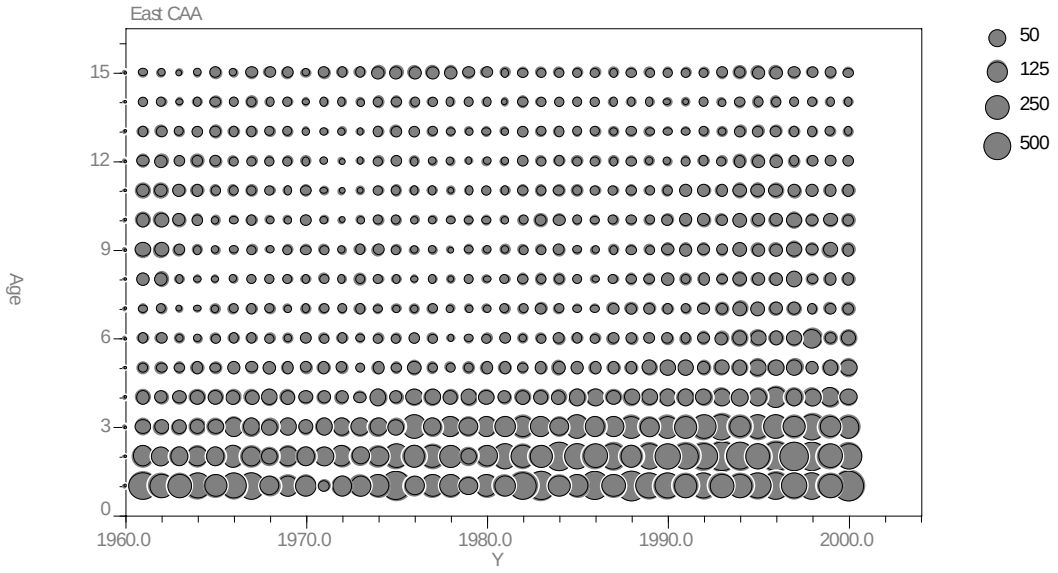
Simple Graphical Data Summaries to Aid New Players in BFT Mohn

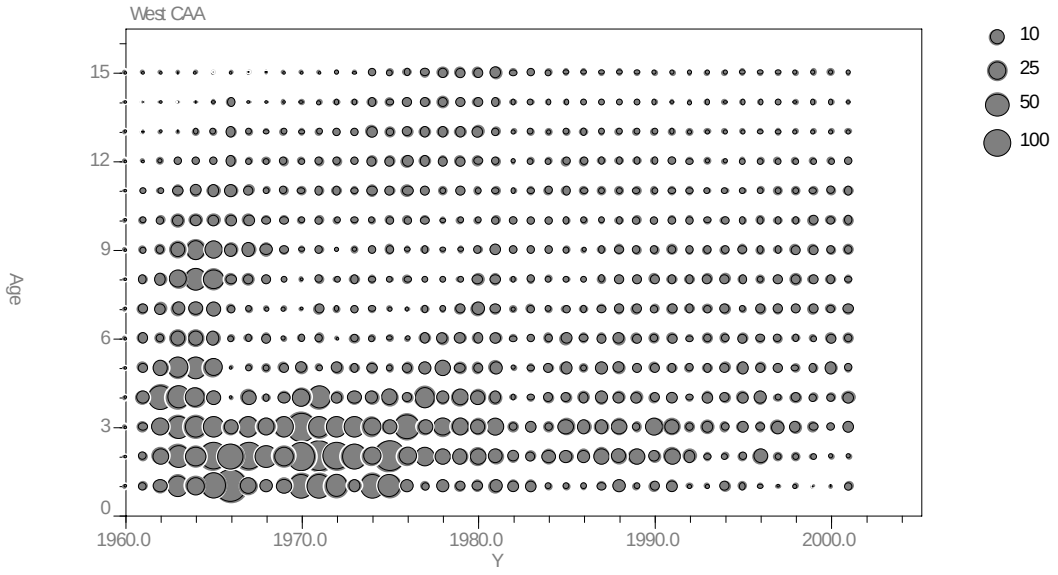
To help get acquainted with the BFT fishery and assessment, several of the principle data types have been plotted. These visual summaries are intended only to aid in orientation. As I am not familiar with this resource, if they are in variance to other depictions, they are presumed to be wrong. In all cases, the text precedes (is this 'follows' or 'precedes'?) the figure.

1. Catch at age.

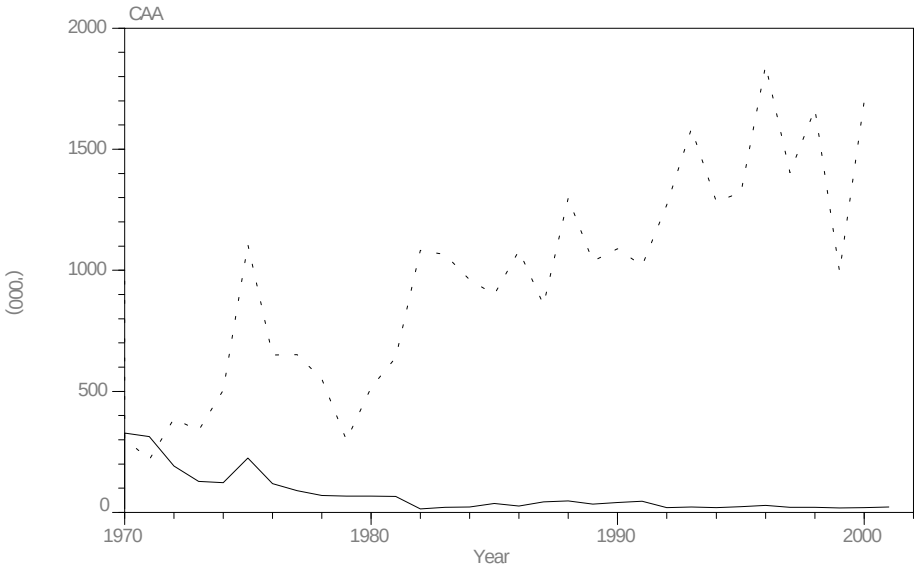
The catch at age (in numbers) for each region is summarized below in a bubble plot. For each panel, a key is given for the approximate value of the symbols, in thousands of fish. The upper panel is for the East and is seen to be dominated by young fish. No cohort structure can be seen (diagonal patterns), but year effects are visible. In the West, the early period had a large contribution from fish less than ?years old. In this period, the 1973 cohort can be seen in the data. A temporal discontinuity is seen in 1982, where catches across all ages are suddenly reduced. There is some evidence of cohort structure in the younger ages post-1982.

Expanded symbol display of catch at age for East and West fisheries.

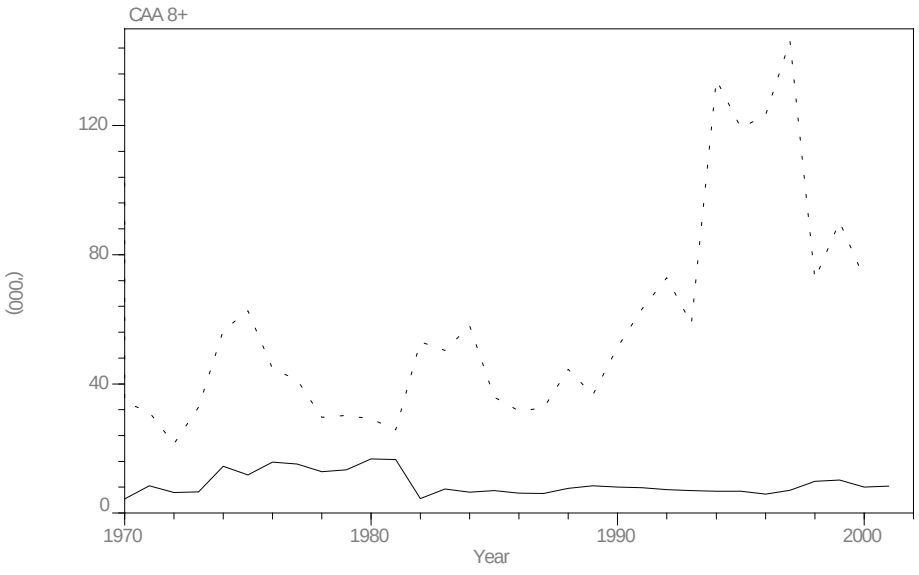




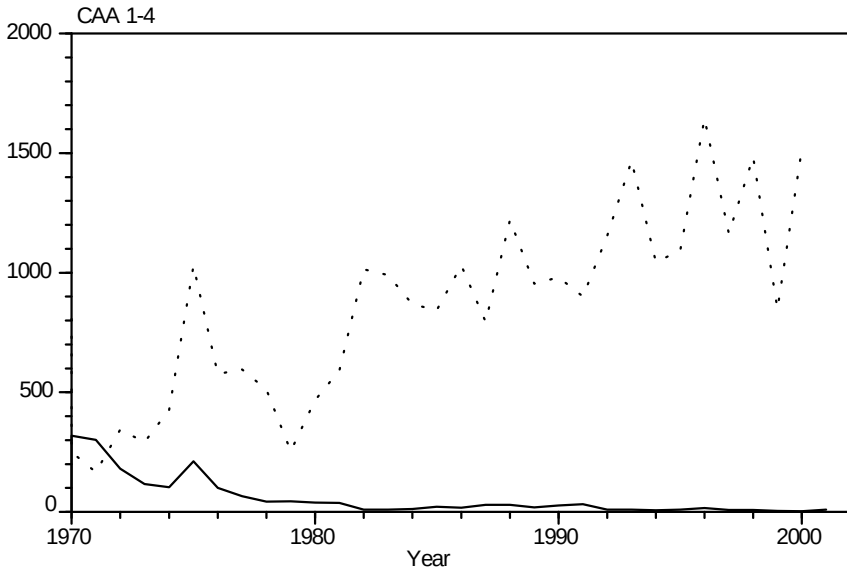
Conventional plots of the catch at age follow. The first is just the total numbers caught. The East is the dashed line. The west has a declining trend with the 1982 discontinuity visible. The East has a rising trend, which peaked in the late 1990s.



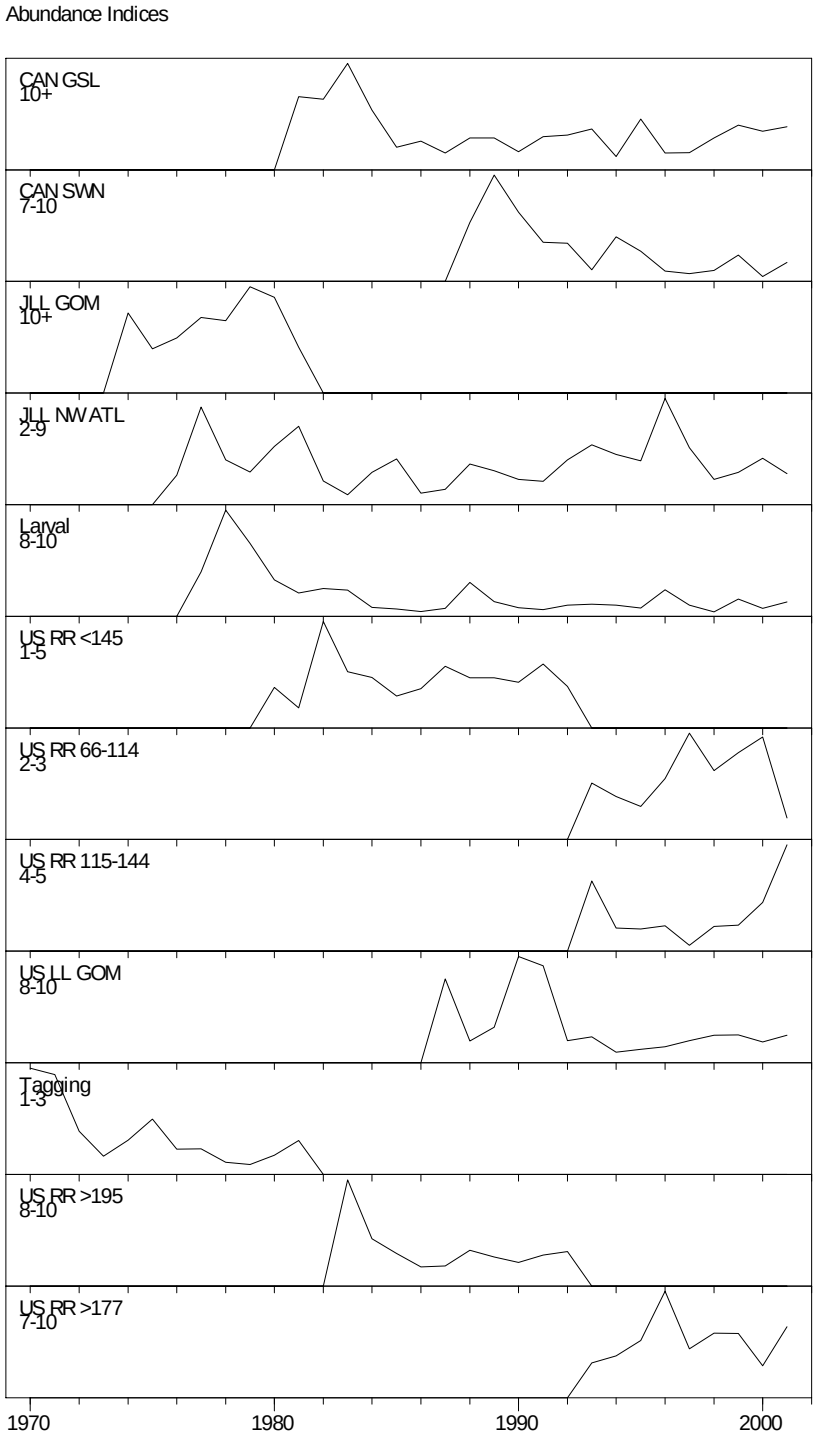
The trends are similar for the removals from the spawning stock (8+). Again the two periods are clear in the West (solid line). The East's pattern for 8+ appears more episodic than for the total catch.(OK-RM)



And finally, the catches of ages 1-4 to the total. Ages 1-4 were chosen arbitrarily.



The survey indices are shown as a stack plot. In each panel the series identification and age range are given in the upper left corner. Some fudging was done to these data to bridge gaps in the surveys, so they did not look like zero results for these years.



Finally, the residuals from the base run are shown in a bubble plot. The residuals are taken from the 3rd column of the standard output tables. The residuals have been arranged in the approximate order of the ages they represent. Positive residuals are filled circles, negative are unfilled. Temporal patterns can be seen in individual indices (e.g. JLL GOM) of among groups of indices over a range of similar ages of influence; for example, US RR 66-144, US RR 115-144, JLL NW ATL, and CAN SWNS have a preponderance of negative residuals in recent years. (OK-RM)