FIRST MEETING OF THE WORKING GROUP OF FISHERIES MANAGERS AND SCIENTISTS IN SUPPORT OF THE WESTERN ATLANTIC BLUEFIN TUNA STOCK ASSESSMENT

(Montreal, Canada – June 26-28, 2013)

1. Opening of the meeting

In the absence of the Panel 2 Chair, Mr. Masanori Miyahara, Chairman of the Commission, opened the meeting, welcomed participants, and thanked Canada for hosting. A List of Participants is included in **Appendix 2** [WBFT-002].

2. Election of Chair

It was agreed that Ms. Sylvie Lapointe (Canada) and Dr. Josu Santiago (SCRS Chairman), would serve as Co-Chairs for the meeting.

3. Adoption of Agenda and meeting arrangements

The Tentative Agenda [WBFT-001] was developed based on the terms of reference for the Working Group, as appended to ICCAT Recommendation 12-02. The Co-Chairs reviewed the terms of reference for the meeting and reiterated that the goals of the meeting are to enhance the dialogue between scientists, managers and stakeholders, and consider how the work plans of the SCRS can best support the needs of the Commission. The Agenda was adopted without change and is attached as **Appendix 1**.

4. Nomination of rapporteur

Ms. Rachel O'Malley (United States) was nominated to serve as Rapporteur.

5. History of the science advice and management of the western Atlantic bluefin tuna

Dr. Santiago introduced Dr. Clay Porch, Rapporteur of the SCRS Western Bluefin Tuna Species Group, and explained that Dr. Porch would make several presentations to guide the discussion under each Agenda item. Dr. Porch began with a presentation on the "History of the Science Advice and Management of Western Atlantic Bluefin Tuna".

There was a question regarding the origin of the low recruitment scenario, and whether the weight of scientific evidence more strongly supports either the low-recruitment or the high recruitment scenario. Dr. Porch explained that the two-line model emerged in 1994 to help support short-term projections; it was based on assumptions that average recent levels of recruitment would best predict recruitment over the next few years. At this time, there is no clear scientific evidence that favors either the low-recruitment or the high-recruitment scenario. It was noted that change in the growth curve, which was first used in the 2010 assessment, impacted the perception of the status of the stock.

One party requested further explanation of the SCRS decision to begin conducting separate assessments of the eastern and western stocks. Dr. Porch confirmed that as far back as 1974, the SCRS recommended conducting separate eastern and western assessments. The first assessment of the western stock was conducted in 1978. The decision to conduct separate assessments was based on the

distribution of catches, the existence of two distinct spawning grounds, and tagging data which showed limited exchange between the eastern and western Atlantic.

There were some questions concerning why productivity is thought to be so different for the eastern and western stocks. Dr. Porch confirmed that there are no scientific studies that conclusively explain differences in productivity. The Mediterranean could be a more productive environment for larvae, but this has not been definitively established. Work is underway by national scientists to study the spatial extent and quality of larval habitat. In addition, studies on age at first maturity and fecundity are being undertaken. Previous studies suggest that relative to western bluefin, eastern bluefin produce a similar number of eggs at size, but that they mature earlier. It is not clear what fraction of eastern or western bluefin at each age are actually going to the spawning grounds. This is a complicated issue that is not yet fully understood, but relevant new information is expected to emerge between now and 2015.

The Working Group recalled paragraph 17 of Recommendation 12-02, which asked the *SCRS to conduct a review of the evidence that initially was used to support each recruitment scenario, as well as any additional information as a means of informing the Commission on which scenario is more likely to reflect the current stock recruitment potential*. Dr. Porch's presentation highlighted some possible approaches to this question (for example, the risk analysis/decision tables), and it was agreed that this would help to describe the potential risks of operating according to one scenario when another is more accurate. Dr. Santiago requested that the Commission provide further clarification on paragraph 17 at the 2013 annual meeting.

In Dr. Porch's presentation on the evolution of the scientific advice, he noted that the two recruitment scenarios were presented by the SCRS for the 1998 rebuilding program, and that while there was no explicit adoption of the low recruitment scenario, the Commission chose to set a total allowable catch (TAC) level consistent with the scientific advice offered under the low recruitment scenario. However, it was noted that the western Atlantic bluefin rebuilding program was constructed in a way to be flexible and responsive to both the low recruitment scenario and the high recruitment scenario, which is why it did not specify a numerical value for the MSY target and provided that the TAC, the MSY target, and the rebuilding period could be changed in line with scientific advice.

The observer from Pew expressed appreciation for the opportunity to discuss uncertainties at this meeting and consider how best to apply precautionary management measures. She asked whether low biomass of the western stock could help to explain low productivity of the western stock. Dr. Porch responded that this could explain some of the difference between the apparent productivities of the two stocks, although it does not appear that the western stock was ever as large as the eastern stock.

The Secretariat presented a document on the "History of ICCAT Management of West Atlantic Bluefin Tuna" [WBFT-004] (attached as **Appendix 3**).

Japan presented a "History of Management of Atlantic Bluefin Tuna" [WBFT-005] (attached as **Appendix 4**). The delegate of Japan noted that, in the past, Japan had accepted a significant reduction in its share of the quota in recognition that the United States and Canada, as coastal States, did not have access to alternative fishing grounds. He noted that Japan accepted this disproportionate sacrifice when the TAC was reduced, with the understanding that Japan's share would be increased after the stock is rebuilt to allow a TAC increase to greater than 2660 t. The delegate of Japan explained that the percentages presented in its aforementioned document [WBFT-005] correspond not to the Recommendation texts, but to actual shares (i.e., the percentage shares indicated in Japan's table are inclusive of by-catch allocations and allocations to minor harvesters that are taken off the top).

One party indicated that there seemed to be some inconsistencies between the presentations made by the Secretariat, Japan, and the SCRS. Given that these were working documents, resolving these discrepancies may not be necessary.

6. Review the current knowledge of population mixing between West and East/Mediterranean stocks and implications for stock assessment methods

Dr. Porch gave a presentation on stock mixing, on behalf of the SCRS. Estimates of the status of the western Atlantic bluefin tuna stock are sensitive to mixing, and the fishery in the eastern Atlantic potentially has an important impact on the western Atlantic. Analyses of mixing are not yet reliable enough to serve as the basis for advice on rebuilding programs. However, progress has been made in terms of available information (such as conventional tagging, electronic tagging, otolith stable isotope chemistry, and genetics) and models (VPA, MAST). Dr. Porch emphasized that it is important to get the mixing assumptions right. Invalid assumptions about mixing can result in even greater bias in the results than if there is no consideration of mixing.

Additional information was requested on the evolution of mixing models, dating back to the early 1990s. Initially, the SCRS used a diffusion model to describe mixing (i.e., the chance of movement depends on current location). This model assumes that once a fish moves from east to west, it behaves just like a fish of western origin. Under the diffusion model, the assessment results were very sensitive to movement, leading to extremely different projections regarding the status of the stock. The diffusion model was criticized by the SCRS as not consistent with observed bluefin behavior: migrations related to feeding, but fish tended to return home to spawn. The overlap model was developed to better reflect what is known about bluefin mixing at different life stages (i.e., some probability of mixing coupled with natal site fidelity). Assessment outcomes are not as sensitive to mixing under the overlap model.

One party asked about the availability of information on the origin of small fish (1-3 years old) in the western Atlantic. Some samples have been collected recently and there should be information soon regarding what fraction of these fish is of eastern or western origin. In general, not many western bluefin are caught at age 1, so it may be difficult to draw definitive conclusions.

In response to a question, Dr. Porch confirmed that there have been discussions within the SCRS regarding whether to include fish caught off Brazil in the eastern or western assessments. He noted that in previous analyses, the inclusion of the Brazilian fish in the eastern stock did not make a large difference in the outcome of the eastern stock assessment. Based on tagging data and the distribution of Japanese longline catches, the prevailing wisdom is that the Brazilian population came from the west. The SCRS Chair added that one document to be published soon also suggests that Brazilian bluefin of the 1960s were of western origin.

There were several questions related to the origin of the 2003 year class in western catches. Reference points used to distinguish western from eastern origin fish were refined earlier this year (Secor, et al), and the samples have been reclassified. The findings indicate so far that the 2003 year class remains very prominent in western catches and that over 90% of the 2003 year class caught in the west during 2011 and 2012 was of western origin. (Earlier results suggested that a higher proportion of the 2003 year class came from the east, possibly reflecting movements of a similarly strong year class in the east). Researchers have expanded their sample size from hundreds to thousands of otoliths, and microconstituent analysis is ongoing. Similar efforts are underway in the east.

7. Review of the biological and life-history parameters (natural mortality rates, age at first maturity, growth and length parameters, etc.)

Dr. Porch presented information related to the review of biological and life history parameters. At the 2013 Bluefin Meeting on Biological Parameters Review (Tenerife, May 2013), the Group considered approaches for evaluating population structure based on this information, as well as possible approaches for evaluating movements and mixing. At its 2013 Stock Assessment Methods Meeting in July, the SCRS will discuss how to incorporate emerging information in stock assessment models and management strategy evaluations. There was one question concerning the new natural mortality curve

to be used in 2015, and how it might affect the assessment. Dr. Porch replied that it is difficult to predict, as the stock could appear more or less productive depending on what new information is obtained (i.e., from estimates of longevity or tagging studies).

8. Review of basis for current assumptions concerning spawning stock biomass and recruitment

Dr. Porch presented information to the Working Group to explain the basis of assumptions concerning spawning stock biomass and recruitment. At the conclusion of the presentation, he offered some ways forward for the SCRS. With the use of new assessment methods, scientists can explore ways to use qualitatively different data, extending data back at least to the 1960s. Additional research on the effect of environmental cues on recruitment could help to support or reject the low recruitment scenario. Finally, he suggested that the SCRS could consider combining the low recruitment scenario and high recruitment scenario with other plausible recruitment hypotheses, possibly weighting them by how well they fit the data. Additionally, he noted that the SCRS could develop alternative methodologies (e.g., decision tables) to present the consequences of managing based on one recruitment scenario when the other is true.

Next, Dr. Porch proposed some possible ways forward for managers. One way to discriminate between the alternative recruitment scenarios is to allow the SSB to increase substantially. Allowing the 2003 year class to survive and contribute to spawning stock would help to determine if there is an associated increase in recruitment.

There was some discussion of how we could get closer to determining the best possible fit to a recruitment scenario (e.g., by increasing biomass), how long would it take and at what level, in order to help us answer this question. Dr. Porch replied that the time necessary would depend on how quickly the stock is allowed to grow. He noted that an analysis of the time it would take – and at what levels of TAC– to test the high recruitment scenario would be performed at the SCRS Western Bluefin Tuna Species Group meeting in September 2013, and he welcomed suggestions as to how the SCRS could best present this information.

There was a question about when research on the effect of environmental cues on recruitment might yield preliminary findings regarding whether there has been a change in the potential productivity of the stock since the 1970s. Information regarding the identification of suitable larval habitat (in the Gulf of Mexico and the Mediterranean) might be available within the next few years, although it is hard to specify a timeline. If there were not enough samples from the spawning grounds, there would be significant variability, and many more years of sampling would be required to determine a cause and effect relationship. These studies may provide insight into what environmental factors contribute to strong year classes, but other factors (e.g., predation) are also involved.

There was strong interest in the ongoing efforts of the SCRS to explore new models as an alternative to the high recruitment scenario and the low recruitment scenario. Dr. Santiago confirmed that the SCRS intends to integrate all available information in the 2015 assessment. Current hypotheses will be considered, as well as other plausible alternatives. A management strategy evaluation framework is one way the SCRS can investigate the effect of plausible scenarios so that optimal scenarios can be identified. Dr. Santiago highlighted that external consultants will be required to develop a management strategy evaluation.

9. Other relevant issues relating to science and management of western Atlantic bluefin tuna

Japan presented a “Research Proposal to Improve Stock Abundance Indices for Western Stock of Atlantic Bluefin Tuna” [WBFT-006] (attached as **Appendix** 5). The paper expressed concerns regarding existing abundance indices; some indices have been based on quite a small part of catch data, for example in rod & reel indices of the USA; some indices are not considering changes of

fishery operational pattern, for example in Gulf of St. Lawrence fishery; and there are some life stages lacking an abundance index, for example, in young-of-the-year. Therefore, this document proposed some possible ways to further strengthen data collection from the western Atlantic spawning stock, including starting a longline research survey in the Gulf of Mexico for spawning fish, starting recruitment monitoring research for 0-1 year old fish, through fishery-independent surveys similar to those undertaken to monitor Southern bluefin, improvement of rod & reel data collection in the USA, and starting fishery independent research which lasts for sufficient durations in the Gulf of St. Lawrence, Canada. Japan proposed that the CPCs should look for ways to improve existing indices of abundance and develop new ones for the stock assessment.

One party asked whether the SCRS had identified particular areas of deficiency in the indices or biological sampling. The party also asked how the proposal would improve management.

Another party asked if recruitment can be understood only in the model or can be gauged through direct observation. Dr. Porch replied that the SCRS does not have a direct estimate of age 1 fish. Dr. Santiago thanked Japan for the presentation and indicated that the SCRS would be pleased to analyze and consider these ideas.

There was some discussion of the "emergency clause" in paragraph 5 of Recommendation 12-02 and whether there are adequate indicators to detect a stock collapse if one were to occur. Existing U.S. surveys that monitor the school fishery offer one tool to detect changes in recruitment at a later stage - for example, the strength of the 2003 year class was detected through these surveys from a young age. It was suggested that the SCRS should explore other possible indicators, such as a survey of spawning biomass.

Canada presented an "Overview of Key Uncertainties in the Western Atlantic Bluefin Tuna Stock Assessment" [WBFT-007], which outlined some considerations for the 2015 assessment (attached as **Appendix 6**). There was general recognition that options for improving data collection to help resolve these sources of uncertainty should continue to be explored within the SCRS. It was noted that the growth curve for the western stock has been recently updated, and now is almost identical to that of the eastern stock. Taking note of the uncertainties highlighted in the Canadian presentation, a party suggested the need for a precautionary approach. Dr. Santiago indicated that Canada's document [WBFT-007], and the questions in the paper, will be considered by the SCRS in its preparations for the 2015 assessment.

Dr. Santiago presented the 2013 Work Plan of the SCRS as it relates to western bluefin. He reiterated that the key sources of uncertainty elaborated in the various presentations and discussions this week are all well known to the SCRS. These concerns have informed the existing work plan of the SCRS. He emphasized that intense collaboration at a scientific level is producing major results; if possible, the parties should put greater emphasis on electronic tagging, and urged parties to do what they could to provide all available data from such programs. At the upcoming meeting on Stock Assessment Methods in Boston, the SCRS will explore possible new modeling approaches to determine which are best equipped to handle the current uncertainties and new scientific information, and prioritize its tasks in preparation for the 2015 assessment.

There was a question concerning the degree of interaction between the assessment work done for eastern and western stocks, and whether this interaction needed to be enhanced. The SCRS Chair assured the Working Group that although an update to the eastern assessment is scheduled for 2014, the work of the SCRS relating to both the eastern and western stocks is well coordinated.

There was general acknowledgement of the many efforts that are underway within the SCRS, but it was also noted that it will take time for these new inputs and approaches to be applied. Until the results of the 2015 assessment are available, managers will need to make decisions based on available scientific information, and meeting participants discussed possible tools to ensure that the best scientific advice informs the short-term management of this stock.

It was agreed that expanded otolith sampling could be helpful in addressing uncertainty. The SCRS Chair advised that ideally the sampling of hard parts should be representative of catches, and the development of proportional sampling distributions (taking into account areas, gear types, and seasons) should be considered. There could be particular emphasis on geographic areas and for size classes that are known to have high rates of mixing. It was suggested that it would be helpful for managers to know the specific fisheries where further otolith sampling is needed, and the SCRS was requested to provide that information.

One party suggested that given the uncertainty associated with long-term forecasts for this stock, the Commission could consider requesting short-term projections to inform management advice, keeping in mind that a precautionary approach to management would still be needed. The SCRS Chair noted that a new assessment would need to be conducted in 2013 in order to fulfill such a request.

The United States provided some additional reactions to Japan's research proposal [WBFT-006] and Canada's paper [WBFT-007]. While noting the value to managers and scientists of considering the issues raised in both documents, concerns were expressed about some of the information, assertions, conclusions, and proposed actions in those documents. As it had done in several previous ICCAT related meetings, the United States provided information on the monitoring of its recreational fishery as well as on its work to collect and analyze otoliths and other biological samples. Given the highly technical nature of the documents, the United States stressed that evaluation of the contents and recommendations in the papers was most appropriately considered by the SCRS prior to any decisions for implementation by CPCs. Japan and Canada requested that the United States provide comments regarding both proposals in writing.

The "Chair's Paper" [WBFT-009], captured a number of possible recommendations from the Working Group, both looking ahead to the 2013 annual meeting and over the medium to long-term. The Working Group discussed this document with the proposed changes, the document was recirculated [WBFT-009A] and agreed, with additional changes [WBFT-009B] (attached as **Appendix 7)**.

10. Other matters

No other matters were discussed.

11. Adoption of report and adjournment

The report of the meeting was adopted. The Chair adjourned the meeting.

Appendix 1

AGENDA [WBFT-001]

1. Opening of the meeting
2. Election of Chair
3. Adoption of Agenda and meeting arrangements
4. Nomination of rapporteur
5. History of the science advice and management of the western Atlantic bluefin tuna
6. Review the current knowledge of population mixing between east/west/Mediterranean stocks and implications for stock assessment methods
7. Review of the biological and life-history parameters (natural mortality rates, age at first maturity, growth and length parameters, etc...)
8. Review of basis for current assumptions concerning spawning stock biomass and recruitment
9. Other relevant issues relating to science and management of western Atlantic bluefin tuna
10. Other matters
11. Adoption of Report and adjournment

Appendix 2

LIST OF PARTICIPANTS

ICCAT Chairman
Miyahara, Masanori
Deputy Director-General, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries1-2-1 Kasumigaseki, Chiyoda-Ku, Tokyo 100-8907
Tel: +81 3 3591 2045, Fax: +81 3 3502 0571, E-Mail: masanori_miyahara1@nm.maff.go.jp

SCRS Chairman
Santiago Burrutxaga, Josu
Head of Tuna Research Area, AZTI-Tecnalia, Txatxarramendi z/g, 48395 Sukarrieta, Bizkaia, Spain
Tel: +34 94 6574000 (Ext. 497); 664303631, Fax: +34 94 6572555, E-Mail: jsantiago@azti.es

WBFT Rapporteur
Porch, Clarence E.
Chief, Sustainable Fisheries Division, Southeast Fisheries Science Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 361 4232, Fax: +1 305 361 4219, E-Mail: clay.porch@noaa.gov

CANADA
Scattolon, Faith [*]
Regional Director-General, Maritimes Region, Department of Fisheries & Oceans 176 Portland Street, Dartmouth, Nova Scotia B2Y 1J3
Tel: +1 902 426 2581, Fax: +1 902 426 5034, E-Mail: scattolonf@dfo-mpo.gc.ca

Lapointe, Sylvie
Associate Director General, International Affairs Directorate, Department of Fisheries & Oceans200 Kent Street, Ottawa, Ontario K1A 0E6
Tel: + 1 613 993 6853, Fax: + 1 613 993 5995, E-Mail: sylvie.lapointe@dfo-mpo.gc.ca

[*]Head Delegate.

Atkinson, Troy
Industry Commissioner, 155 Chain Lake Drive, Suite #9, Halifax Nova Scotia B3S 1B3
Tel: +1 902 457 4968, Fax: +1 902 457 4990, E-Mail: hiliner@ns.sympatico.ca

Donihee, Lauren
International Affairs Directorate, Department of Fisheries & Oceans200 Kent Street, Ottawa, Ontario K1A 0E6
Tel: + 1 613 949 7507; E-mail: lauren.donihee@dfo-mpo.gc.ca

Fraser, Douglas
Industry Commissioner, Huntley R.R. #2 - Alberton, Prince Edward Island
Tel: +1 902 853 2793; E-mail: Doug.Fraser@Bellaliant.com

Elsworth, Samuel G.
South West Nova Tuna Association, 228 Empire Street, Bridgewater, Nova Scotia B4V 2M5
Tel: +1 902 456 1760, Fax: +1 902 543 7157, E-Mail: sam.fish@ns.sympatico.ca

Melvin, Gary
Biological Station - Fisheries and Oceans Canada, 531 Brandy Cove Road, St. Andrews, New Brunswick E5B 2L9
Tel: +1 506 529 5874, Fax: +1 506 529 5862, E-Mail: gary.melvin@dfo-mpo.gc.ca

Norton, Brett
International Fisheries Advisor, International Affairs Directorate, Fisheries and Oceans Canada200 rue Kent St., Ottawa, Ontario K1A 0E6
Tel: +1 613 993 1860, Fax: +1 613 993 5995, E-Mail: Brett.Norton@dfo-mpo.gc.ca

Turple, Justin
International Affairs Directorate, Fisheries and Oceans Canada200 rue Kent St., Ottawa, Ontario K1A 0E6
Tel: +1 613 809 3181; E-mail: Justin.turple@dfo-mpo.gc.ca

Walsh, Ray
Resource Management Officer, Newfoundland and Labrador Region, Fisheries and Oceans Canada P.O. Box 5667, St. John's, Newfoundland A1C 5X1
Tel: +1 709 772 4472, Fax: +1 709 772 3628, E-Mail: ray.walsh@dfo-mpo.gc.ca

EUROPEAN UNION
D'Ambrosio, Marco
European Commission, DG MARE-B1, Rue Joseph II - 99; 03/66, 1049 Brussels, Belgium
Tel: +322 299 3765, Fax: +322 295 5700, E-Mail: Marco.DAMBROSIO@ec.europa.eu

Daniel, Patrick
Commission européenne - DG Mare Unité - B3, J-99 02/53, 1000 Bruxelles, Belgium
Tel: +322 229 554 58, Fax: E-Mail: patrick.daniel@ec.europa.eu

JAPAN
Ota, Shingo
Director of Ecosystem Conservation Office, Resources and Environment Research Division, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries1-2-1 Kasumigaseki, Chiyoda-Ku, Tokyo 100-8907
Tel: +81 3 3502 0736, Fax: +81 3 3502 1682, E-Mail: shingo_oota@nm.maff.go.jp

Kaneko, Morio
Assistant Director, International Affairs Division, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries1-2-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8907
Tel: +81 3 3502 8460, Fax: +81 3 3504 2649, E-Mail: morio_kaneko@nm.maff.go.jp

Itoh, Tomoyuki
Chief Scientist, National Research Institute of Far Seas Fisheries, 5-7-1 Orido Shimizu, Shizuoka 424-8633
Tel: +81 543 36 6036, Fax: +81 543 35 9642, E-Mail: itou@fra.affrc.go.jp

Kimoto, Ai
Scientifist, National Research Institute of Far Seas Fisheries, 5-7-1 Orido, Shimizu Shizuoka 424-8633
Tel: +81 543 36 6036, Fax: +81 543 35 9642, E-Mail: aikimoto@affrc.go.jp

Suzuki, Ziro
Visiting Scientist, National Research Institute of Far Seas Fisheries, 5-7-1 Orido, Shimizu Shizuoka 424-8633
Tel: +81 543 36 6036, Fax: +81 543 35 9642, E-Mail: zsuzuki@fra.affrc.go.jp

Uozumi, Yuji
Visiting Scientist, National Research Institute of Far Seas Fisheries, 5-7-1 Orido, Shimizu Shizuoka 424-8633
Tel: +81 543 36 6037, Fax: +81 543 35 9642, E-Mail: uozumi@fra.affrc.go.jp

UNITED STATES

Smith, Russell*****
Deputy Assistant Secretary for International Fisheries, Office of the Under-Secretary, Room 6224, National Oceanic and Atmospheric Administration; U.S. Department of Commerce, 14th and Constitution Avenue, N.W., Washington, DC. 20503
Tel: +1 202 482 5682, Fax: +1 202 482 4307, E-Mail: russell.smith@noaa.gov

Blankenbeker, Kimberly
Foreign Affairs Specialist, Office of International Affairs, National Marine Fisheries Service1315 East West Highway, Silver Spring, Maryland 20910
Tel: +1 301 427 8350, Fax: +1 301 713 2313, E-Mail: kimberly.blankenbeker@noaa.gov

Brown, Craig A.
NOAA Fisheries Southeast Fisheries Center, Sustainable Fisheries Division75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 586 6589, Fax: +1 305 361 4562, E-Mail: Craig.brown@noaa.gov

Devnew, Jack
Director Marine Division, Maury, Donnelly & Parr, Inc, 201 E. City Hall Ave. Suite 700, Norfolk ,Virginia 23510
Tel: +1 757 641 7830, Fax: +1 757 458379, E-Mail: jdevnew@mdpins.com

Díaz, Guillermo
NOAA-Fisheries, Southeast Fisheries Science Center, 1315 East-West Highway # 13562, Silver Spring Maryland 20910
Tel: +1 301 427 8589, Fax: +1 301 713 1875, E-Mail: guillermo.diaz@noaa.gov

Graves, John E.
Professor of Marine Science, Virginia Institute of Marine Science - College of William and Mary, P.O. Box 1346, Gloucester Point, Virginia 23062
Tel: +1 804 684 7352, Fax: +1 804 684 7157, E-Mail: graves@vims.edu

McLaughlin, Sarah
Fishery Management Specialist, National Marine Fisheries Services, Highly Migratory Species Management Division55 Great Republic Drive, Gloucester, Massachusetts 01930
Tel: +978 281 9279, Fax: +978 281 9340, E-Mail: sarah.mclaughlin@noaa.gov

O'Malley, Rachel
Office of International Affairs, National Marine Fisheries Service, 1315 East-West Highway - Room 12622, Silver Spring, Maryland 20910
Tel: +1 301 427 8373, Fax: +1 301 713 2313, E-Mail: rachel.o'malley@noaa.gov

Piñeiro-Soler, Eugenio
P.O. Box 723, 1353 Vigoreaux Ave., Guaynabo, Puerto Rico 000966
Tel: + 1 787 234 8304; E-mail: epsfish@yahoo.com

Schulze-Haugen, Margo
Chief, Highly Migratory Species Division, Office of Sustainable Fisheries, U.S. National Marine Fisheries Service, 1315 East-West Highway, Rm. 13458, Silver Spring Maryland 20910
Tel: +1 301 427 8503, Fax: +1 301 713 1917, E-Mail: margo.schulze-haugen@noaa.gov

Warner-Kramer, Deirdre
Senior Foreign Affairs Officer, Office of Marine Conservation (OES/OMC), U.S. Department of State, Rm. 2758, 2201 C Street, NW, Washington, D.C. 20520-7878
Tel: +1 202 647 2883, Fax: +1 202 736 7350, E-Mail: warner-kramerdm@state.gov

OBSERVERS

BLUE WATER FISHERMEN'S ASSOCIATION
Delaney, Glenn
601 Pennsylvania Avenue NW, Suite 900, South Building, Washington, DC 20004 United States
Tel: +1 202 434 8220, Fax: +1 202 639 8817, E-Mail: grdelaney@aol.com

AMERICAN BLUEFIN TUNA ASSOCIATION (ABTA)
Cadrin, Steven
American Bluefin Tuna Association (ABTA), University of Massachusetts
Tel: +1 774 238 6819; E-mail: scadrin@umassd.edu

Golet, Walter
American Bluefin Tuna Association (ABTA), University of Maine, 350 Commercial Street, Portland, Maine 04101 United States
Tel: +1 207 228 1628; E-mail: wsalter.golet@maine.edu

Ruais, Richard P.
American Bluefin Tuna Association (ABTA), 28 Zion Hill Road, Salem, New Hampshire 3079 United States
Tel: +1 603 898 8862, Fax: +1 603 898 2026, E-Mail: rruais@aol.com

DAVID SUZUKI FOUNDATION
Wallace, Scott
Senior Research Scientist, David Suzuki Foundation, 219-2211 West 4th Avenue, Vancouver, BC V6K 4S2, Canada
Tel: +1 604 732 4228, E-Mail: swallace@davidsuzuki.org

ECOLOGY ACTION CENTRE (EAC)
Fuller, Susanna
Ecology Action Center, 2705 Fern Lane, Halifax, Nova Scotia B3K 4L3, Canada
Tel: +1 902 446 4840, Fax: +1 902 405 3716, E-Mail: marine@ecologyaction.ca

Schleit, Kathryn
Ecology Action Center, 2705 Fern Lane, Halifax, Nova Scotia B3K 4L3, Canada
Tel: +1 902 488 4078, E-Mail: kschleit@gmail.com

PEW ENVIRONMENT GROUP
Miller, Shana
Pew Charitable Trusts, 901 E Street, NW, Washington, DC 20004, United States
Tel: +1 631 671 1530, Fax: E-Mail: smiller-consultant@pewtrusts.org

Nickson, Amanda
Pew Charitable Trusts, 901 E Street, NW, Washington, DC 20004, United States
Tel: 1 202 540 6528 12026; E-mail: anickson@pewtrusts.org

ICCAT SECRETARIAT
C/ Corazón de María, 8 - 6 Planta, 28002 Madrid, Spain
Tel: + 34 91 416 5600Fax: +34 91 415 2612, E-Mail: info@iccat.int

Meski, Driss
Pallarés, Pilar
García-Orad, María José
Peyre, Christine
Seidita, Philomena

Interpreters

Arias, Jordán
Bret, Justine
Daguerre, Christine
Dubois, Emmanuelle
Fulton, Janet
McNeely, Catherine
Roy, Francine
Sugden, Don
Venegas, Pilar

Appendix 3

HISTORY OF ICCAT MANAGEMENT OF WEST ATLANTIC BLUEFIN TUNA [WBFT-004]

ICCAT Secretariat

Background

While total Atlantic bluefin tuna catches have represented a relatively small proportion of the total catches of tuna and tuna-like species over the years since the 1960s (**Figure 1**) (a total of 7.5% of the accumulated catches of major species 1950-20011, and western bluefin tuna (BFT-W) totalling less than 1% of catches of major tuna species in the Convention area), the economic and ecological importance of this species, together with the sudden growth in catches, have identified it as one of the species requiring study from the outset of ICCAT.

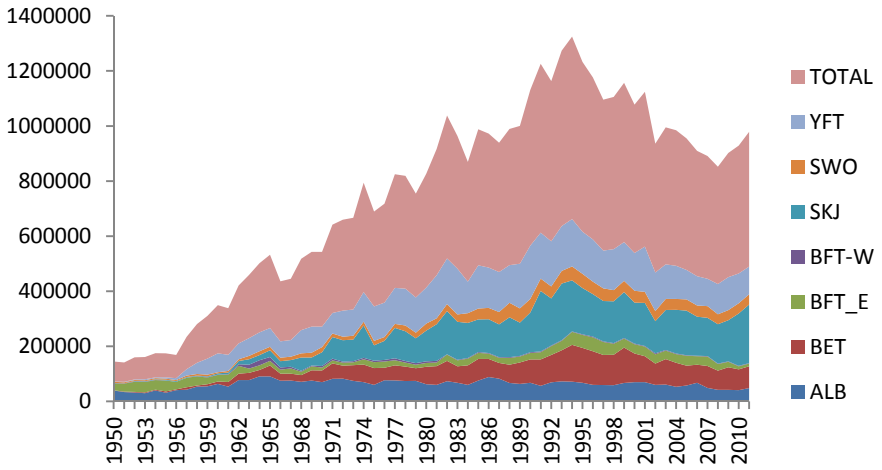


Figure 1. Total catches of major tuna and tuna-like species 1950-2011.

At the first meeting of the Commission held in December 1969, no management measures were adopted on bluefin tuna due to uncertain data and insufficient information. At the second meeting of the Standing Committee on Research and Statistics (SCRS), bluefin tuna was discussed, and the scientists concurred at that time with the view that capture of fish less than 9.8 kg could cause a loss in sustained yield, but that further study was needed before minimum size limits could be established.

The Secretariat was established in Madrid, Spain, in 1971, and was charged *inter alia* with the task of developing a system for the collection and analyses of data and the administration of the research programs required for the Standing Committee on Research and Statistics to assess the stocks of tuna and tuna-like species and provide advice to the Commission on the basis of which management decisions could be taken.

In 1971, the Sub-Committee on Stock Assessment recommended a minimum size limit for bluefin tuna; the need for a statistical reporting system providing the Commission with much more up-to date information on catches, and noted that the "the striking feature of the fisheries on large tuna has been the very sharp decline in catches since about 1960".[1] In 1972, the SCRS identified bluefin tuna as one of the three major species requiring study, while the Commission agreed that no decision on regulation of the fisheries could be made due to lack of concrete evidence.
The first Recommendation adopted by the Commission on bluefin tuna was the 1974 *Recommendation by ICCAT Concerning a Limit on Bluefin Tuna Size and Fishing Mortality* [74-01], establishing a minimum size for bluefin tuna and requiring Contracting Parties to take necessary measures to limit the fishing mortality of bluefin tuna to recent levels. This Recommendation was effective for the entire Atlantic Ocean.

[1] ICCAT, 1972. Report for the Biennial Period 1970-1971, Part 3 (1971), p. 95.

Atlantic bluefin tuna was originally considered a single stock (SCRS Report 1973, p. 96), although there was recognition that there could be more than one stock. This was first discussed in depth by SCRS in 1976, and the two-stock hypothesis put forward to Commission for consideration in 1978. It was adopted in 1981 by majority vote through the *Recommendation by ICCAT on Bluefin Management Measures* [81-01], as shown in **Figure 2**.

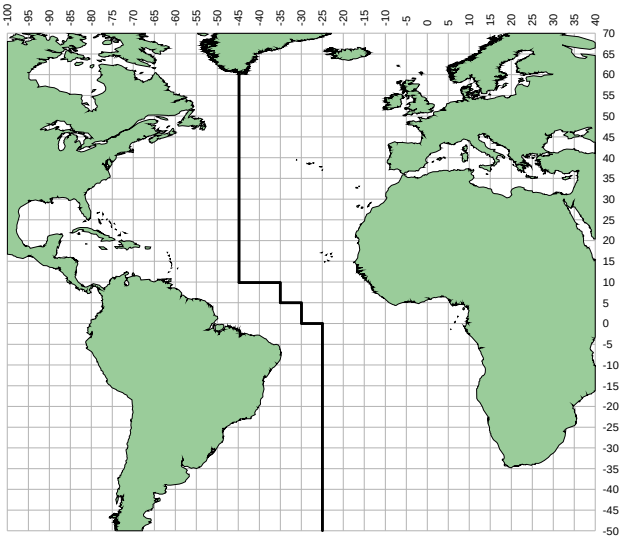


Figure 2. East-west bluefin tuna stock areas

ICCAT measures taken for the West Atlantic

While some of the initial concerns which had led to the creation of ICCAT stemmed from the eastern Atlantic, it was the western stock on which management measures were first concentrated, where longline and purse seine catches had increased from around 100 t each in the late 1950s to 12,000 t and 5,000t respectively in 1964, as can be seen in **Figure 3**).

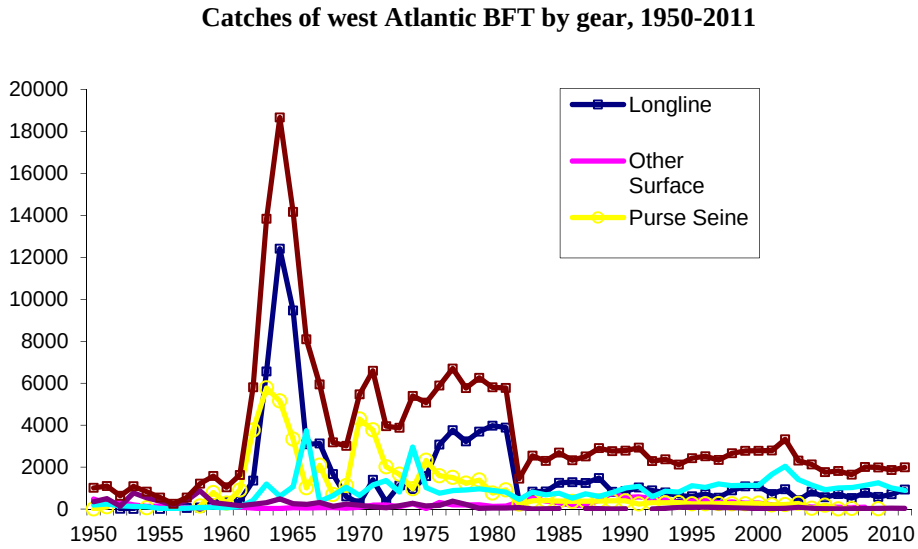


Figure 3. Catches of western Atlantic BFT 1950-2011.

The 1981 Recommendation [Rec. 81-01] set out specific requirements for the western Atlantic bluefin stock, including a total allowable catch limit, and continuing the 1974 size limit for all bluefin tuna. *New Regulations for the Atlantic Bluefin Tuna Catch* [1983] [82-01], pertaining again mainly to the western Atlantic stock were adopted in 1982, and were continued, with gradual refinements, up to 1986, by which time the measures included a closure of the fishery during the spawning season in the Gulf of Mexico and additional requirements in relation to minimum size. This measure was extended annually by the Commission until 1990.

In 1991, the Commission adopted the *Recommendation by ICCAT for the Enhancement of the Current Management of Western Atlantic Bluefin Tuna* [91-01], which specified the individual catch limits in the body of the text for the first time. Prior to that, the TAC had been distributed in accordance with an arrangement agreed at an inter-sessional meeting by the parties involved in the fisheries (*Record of the Meeting on the Western Atlantic Bluefin Management Measures* (ICCAT 1982[2]). Similar allocations were made through the *Recommendations for the 1992-1993 Management of Western Atlantic Bluefin Tuna* [92-04], which in fact extended the allocations up to 1994, although these were revised upwards through the *Recommendation by ICCAT on the Management of Bluefin Tuna Fishing in the Western Atlantic* [93-05], in accordance with the conclusions of the Management Review Committee for West Atlantic Bluefin Tuna[3] held in Tokyo, Japan 1992. It was also agreed during the meeting of this Committee that the three main harvesters of western bluefin tuna would require their fishermen to tag all Atlantic bluefin tuna harvested and available for sale and implement a system whereby import of all bluefin tuna be accompanied by a certificate of origin (see Statistical Document Programme below).

Recommendation by ICCAT for the Management of Bluefin Tuna Fishing in the Western Atlantic Ocean [94-12] set individual quotas for west Atlantic bluefin tuna, which continued, with an increase in the TAC of 300 t, through the *Recommendation by ICCAT to Establish a Scientific Monitoring Quota For Bluefin Tuna in the Western Atlantic for 1997-1998* [96-04].

In 1998, recognising that the western stock of bluefin tuna was over-exploited, the Commission adopted a twenty year rebuilding plan through the *Recommendation by ICCAT to Establish a Rebuilding Program for Western Atlantic Bluefin Tuna* [98-07], modified in 2002, 2003, 2004 and 2006 (*Recommendation by ICCAT concerning conservation of western Atlantic bluefin tuna* [02-07]; *Recommendation by ICCAT concerning the stock assessment schedule for western Atlantic bluefin tuna* [03-08]); *Recommendation by ICCAT concerning the western Atlantic bluefin tuna rebuilding program and the conservation and management measures for bluefin tuna in the eastern Atlantic and Mediterranean* [04-05] and the *Supplemental Recommendation by ICCAT Concerning the Western Atlantic Bluefin Tuna Rebuilding Program* [06-06]. This plan set a TAC, modifiable in accordance with scientific advice, a closed area during the spawning season in the Gulf of Mexico and a sharing arrangement based on percentage shares of the TAC. *Additional Supplemental Recommendations by ICCAT Concerning the Western Atlantic Bluefin Tuna Rebuilding Program* [Rec. 08-04], [Rec. 10-03] and [12-02] have since been adopted, with revision of the TACs as well as a ban on at-sea transhipment and monthly catch reporting requirements.

Measures for western bluefin tuna have been in place for over twenty-five years, and the rebuilding plan for ten years, and in recent years, catches have been well below the TAC in a consistent manner for the first time, (**Figure 4**).

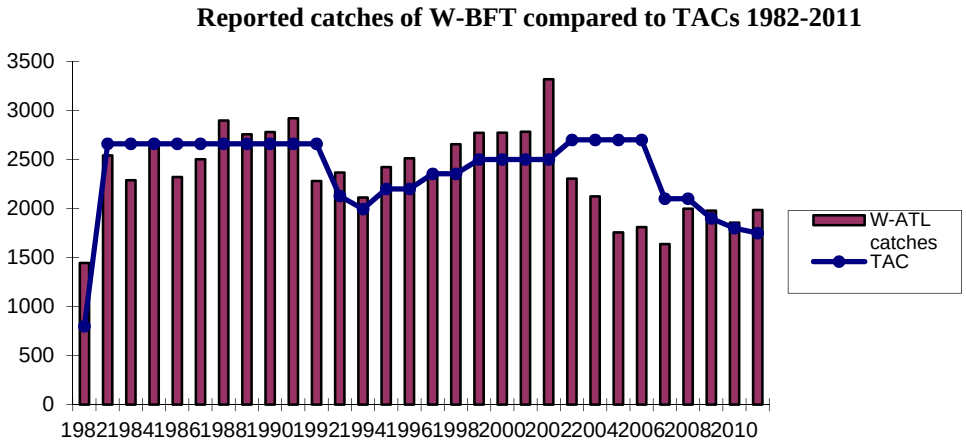


Figure 4. Comparison of reported W-Atl. BFT and TACs 1982-2011.

[2] ICCAT, 1982. *Record of the Meeting on the Western Atlantic Bluefin Management Measures*
[3] ICCAT, 1993. *Report for the Biennial Period 1992-1993, Part 1* (1992), pp71-77

Statistical Document Program and unreported catches

Growing concerns in relation to possible unreported catches, particularly by non-Contracting Parties, and the uncertainty in statistical data needed for reliable stock assessments, led to the Commission adopting a *Resolution Concerning Catches of Bluefin Tuna by non-Contracting Parties* [91-02] which paved the way for the creation of the Permanent Working Group for the Improvement of ICCAT Statistics and Conservation Measures (PWG) in 1992.

At the second meeting of the Management Review Committee for West Atlantic Bluefin Tuna (September 1992), the parties developed an outline for a Certificate of Origin Program for Bluefin Tuna, based on the deliberations and recommendations of the ICCAT Working Group to Develop Technical Details for the Implementation of the ICCAT Resolution on Catches by non-Contracting Parities (Tokyo, May 1992). Japanese trade data available at that time indicated that approximately 3,000 t of bluefin tuna was imported into Japan in 1991 from non-Contracting Parties.

The Program was presented to the Commission in 1992 and led to the adoption of *Recommendation by ICCAT Concerning the ICCAT Bluefin Tuna Statistical Document Program* [92-01], which required all imported bluefin tuna to be accompanied by an ICCAT Statistical Document, with the double aim of estimating the real level of catches and reducing catches taken in a manner which could undermine the ICCAT conservation and management measures. The Statistical Document Program was developed over several years through the adoption of *Resolution by ICCAT Concerning Validation by a Government Official of the Bluefin Tuna Statistical Document* [93-02]; *Recommendation by ICCAT Concerning the Implementation of the ICCAT Bluefin Tuna Statistical Document Program on Fresh Products* [93-03]; *Resolution by ICCAT on Interpretation and Application of the ICCAT Bluefin Tuna Statistical Document Program* [94-04]; *Resolution by ICCAT Concerning the Effective Implementation of the ICCAT Bluefin Tuna Statistical Document Program* [94-05]; *Recommendation by ICCAT on the Validation of Bluefin Statistical Documents between ICCAT Contracting Parties which are members of the European Community* [96-10]; *Recommendation by ICCAT concerning the Implementation of the ICCAT Bluefin Tuna Statistical Document Program on re-export* [97-04]; *Recommendation by ICCAT on Validation of the Bluefin Tuna Statistical Document by the European Community* [98-12]; and the *Recommendation by ICCAT Concerning the Amendment of the forms of the ICCAT Bluefin/Bigeye/Swordfish Statistical Documents* [03-19], resulting in a complicated set of measures which did not facilitate its effective interpretation and implementation. Notwithstanding, the Program has been a valuable tool in identifying illegal, unreported and unregulated (IUU) fishing activities, and the elimination of a considerable amount of IUU fishing. The data compiled from the Bluefin Statistical Document Program were compared with the reported catch statistics, and considerable differences were found, leading to the *Recommendation by ICCAT concerning unreported catches of bluefin tuna, including catches classified as not elsewhere included (NEI)* [97-03], which was later followed up by the PWG with a variety of measures aimed at eliminating this practice to the extent possible.

Catch Document Scheme

While the Bluefin Tuna Statistical Document Program has been a useful tool in detecting unreported catches, it has two major limitations; 1) domestic consumption of bluefin tuna cannot be detected and 2) quantities of tuna caged for farming purposes cannot be adequately determined.

In order to overcome the shortcomings of the Bluefin Statistical Document Program, and with a view to strengthening the conservation and management measures in force for Atlantic bluefin tuna in 2007 and the measures taken to control bluefin tuna farming, the Commission adopted the R*ecommendation by ICCAT on an ICCAT Bluefin Tuna Catch Documentation Program* [07-10]. The objective of this scheme is to ensure the reporting of all catches, whether they be destined for export, domestic consumption or farming purposes. This scheme will help to determine the level, if any, of unreported catches and can be used in the future to introduce greater certainty in statistical data and stock assessments. The scheme has been refined several times through Recommendations, with the latest modification contained in the *Recommendation by ICCAT Amending Recommendation 09-11 on an ICCAT Bluefin Tuna Catch Documentation Program* [Rec. 11-20].

In 2010, the Commission adopted the *Recommendation by ICCAT on an electronic bluefin tuna catch document programme (EBCD)* [Rec. 10-11], establishing and electronic system for bluefin catch documents. This system is currently in the process of finalisation, and the system will be implemented on a trial basis in 2013 and

become definitive in 2014, in accordance with the *Recommendation by ICCAT Amending Recommendation 10-11 on an Electronic Bluefin Tuna Catch Document Programme (eBCD)* [Rec. 11-21]

Management measures relating to scientific research

In addition to the conservation and management measures adopted for the two Atlantic bluefin tuna stocks, the Commission has remained aware of the need for further research on this species and has adopted several measures specifically covering aspects of research required. Many of these have been aimed at improving knowledge to ascertain possible mixing and relevant boundary of the two-stocks, and additional statistical and scientific elements required to assure sound management advice. These measures include:

Resolution by ICCAT for Atlantic Bluefin Tuna Recovery Programs [95-4]; *Resolution by ICCAT for the development of additional recovery scenarios for Atlantic bluefin tuna* [97-16]; *Recommendation by ICCAT on Bluefin Tuna Research in the Central North Atlantic Ocean* [00-08]; *Resolution by ICCAT for SCRS to examine the effects of mixing for stock assessments & management and consider the appropriateness of the current boundary between the western and eastern management units for Atlantic bluefin tuna* [00-11]; *Resolution by ICCAT on Conversion Factors for Bluefin Tuna from Product Weight to Live Weight* [00-12]; *Supplemental Recommendation by ICCAT on Bluefin Tuna Research in the Central North Atlantic Ocean* [01-08]; *Resolution by ICCAT regarding the SCRS Mixing Report on Atlantic Bluefin Tuna* [01-09]; *Resolution by ICCAT Concerning Atlantic Bluefin Tuna Scientific Research on Stock Origin and Mixing* [Res. 08-06] *Recommendation by ICCAT Concerning the Atlantic-Wide Research Programme for Bluefin Tuna (GBYP)* [Rec. 11-06]. It should be noted, however, that many of the conservation and management measures cited in earlier sections of this report contain provisions relating to research and tasks assigned to the SCRS.

The Bluefin Year Program (BYP) was established in 1992-1997 through informal coordination of national research activities. From 1997 to 2009, this program has been financed through the regular budget of the Commission. The aims of the Program are to improve general biological information and statistical fisheries data on bluefin tuna. In 2009, the Commission adopted the GBYP which is funded through voluntary contributions and coordinated by a full-time coordinator at the Secretariat.

Current reporting requirements

In order to try to combat stock decline and IUU fishing activities, the increasing number of measures adopted by ICCAT implies a corresponding increase in the burden of reporting for the administrations, the industry, the Secretariat and the Commission. Although the increase in requirements may seem excessive, it is only through increased controls that the legitimate fishing activities can be identified and illegitimate activity sanctioned. Current requirements for BFT-W include:

1. *Statistical data requirements:* Task I (nominal annual catch); Task II (monthly catch and effort by 5º x 5º or finer and size frequency data); fleet characteristics; catch-at-size; tagging data. Details and exact requirements are available on the ICCAT Web page at http://www.iccat.int/SubmitSTAT.htm.

Other requirements Compliance reporting tables; monthly catch reports; vessels 20 metres and over authorized to fish for tuna and tuna-like species in the ICCAT Convention Area; Annual reports of bluefin catch document scheme information on vessel chartering, where relevant.

Although the *Recommendation by ICCAT on Bluefin Tuna Farming* pertains to the entire Atlantic, there are currently no bluefin tuna farms in the West Atlantic Ocean.

Appendix 4

HISTORY OF MANAGEMENT OF ATLANTIC BLUEFIN TUNA [WBFT-005]

Submitted by Japan

Introduction

In this document, we reviewed past SCRS scientific reports, which contain management recommendations, and the Commission's Recommendations to understand the entire resource dynamics of Atlantic bluefin tuna (BFT).

Also, we compiled share ratios of actual catches and TAC allocations among CPCs as well as changes in actual catches in the Western Atlantic Area (WAA) and the Eastern Atlantic Area (EAA), taking account of the reasons for introduction of conservation and management measures.

1. History of BFT management

The history of BFT management is divided into the following 7 periods, based on the introduction of conservation and management measures.

• 1st period （～1968）

"The unregulated period before entry into force of the ICCAT Convention"

The first is an unregulated period before entry into force of the ICCAT Convention. In this period, WAA experienced the largest catch record at 18,000 tons in 1964 and the smallest catch record at 247 tons in 1956.

• 2nd period （1969～1981）

"The period of limiting the fishing mortality of BFT to recent levels after the entry into force of the ICCAT Convention"

After entry into force of the ICCAT Convention in 1969, Rec. 74/01 was established to introduce the first conservation and management measure for BFT, which is to limit its annual fishing mortality to recent levels.

• 3rd period （1982～1993）

"The period of starting introducing substantial conservation and management measures in WAA"

Rec. 81-01 for the first time divided the Atlantic Ocean into the WAA and the EAA at 45°W longitude to introduce conservation and management measures in each area, respectively.

In the WAA, allocations of catch quotas to CPCs in the name of scientific monitoring quotas were introduced, while in the EAA, limitation of the annual fishing mortality of BFT to recent levels continued.

• 4th period （1994～1998）

"The period of starting introducing substantial conservation and management measures in EAA"

In the EAA, with the introduction of Recs. 93-07, 96-02 and 96-03, fishing operations using large-scale longline fishing vessel greater then 24m in length was prohibited for two months (June-July) in the Mediterranean and fishing operations using purse seine fishing vessel was prohibited for one month (August) in the Mediterranean. In the WAA, allocation of catch quotas to CPCs in the name of scientific monitoring quotas still continued.

• The 5th period （1999～2006）

"The period of starting introducing a comprehensive stock rebuilding program in the WAA and a multi-year conservation and management program in the EAA"

Total Allowable Catch (TAC) was first introduced at the level of 2500-2700 tons in WAA as part of a 20-year rebuilding program beginning in1999 and continuing through 2018.

In the EAA, TACs between 29500-32000 tons were established for multi-year and control measures started for farming activities.

• 6th period（2007～2012）

"The period of introducing a stock recovery plan for the EAA"

In WAA, TACs were reduced to lower levels (1750-2100 tons) as part of the 20-year rebuilding program to allow the MSY target to be achieved within the rebuilding period with a 50% or greater probability.

In EAA, 15-year recovery plan starting in 2007 and continuing through 2022 was introduced with TACs reduced to lower levels ((12900-29500 tons)to allow the goal of achieving $B_{MSY,}$ with 50% probability, which was increased to 60% in 2010 (Rec.10/04). Control measures for farming activities were also strengthened.

• 7th period（2013～）

"The period of stock recovery in both the WAA and the EAA?"

The strict stock rebuilding/recovery plans for the WAA and the EAA in the 6th period led to indications of stock recovery at least for EAA, which resulted in the historical TAC increase in the EAA in 2013 even though it is small. Similar stock recovery is also expected in the WAA.

2. Change in catches in both the WAA and the EAA

(1) WAA

The largest catch in the WAA is 18000 tons in 1964, 12000 tons, of which was produced by Japanese longline fishing vessels. The smallest catch in the WAA is 247 tons in 1956 and the main fishing gear was trap nets.

(2) EAA

The largest catch in the EAA is about 50,000 tons in 1996 and the main fishing gear was purse seine. However, the SCRS estimated unreported catches between 1998 and 2007.

Counting the unreported catches, it is estimated that actual catches were about 50,000 tons from 1997 to 2006 and about 60,000 tons in 2007. The smallest catch in the EAA is about 10,000 tons since 2011 when strict conservation and management measures were introduced.

(3) Both areas

The largest total catch in both areas is 53,000 tons in 1996. However, caution should be given to the unreported catches in the EAA between 1998 and 2007 estimated by SCRS.

The smallest total catch is about 11,000 tons since 2011 when strict conservation and management measures were introduced in the EAA.

3. Change in ratio of total catch, scientific monitoring quota or TAC among CPCs in the WAA

Rec. 94-12 stipulates the traditional shares among the United States, Canada and Japan (US: Canada: Japan = 52.14%: 21.54%: 26.32%).

After Rec.94-12, only Japan's share has stayed at the level substantially reduced from the traditional level (26.32%→17.24%) from the traditional shares among three countries. Japan accepted such disproportionate sacrifices in order to alleviate difficulties of coastal fisheries of other two CPCs, which have no alternative fishing grounds in response to reduction of TAC. That is why the recovery of Japanese share in case of TAC increase has always been built in the recommendation for the western BFT stock.

TAC would be increased once the western BFT stock is rebuilt due to such sacrifice, resulting in recovery of Japan's traditional share.

Year	Related Rec.	(A) Total Catch・Scientific monitoring quota・TAC	(B) Ratio of (A) among CPCS						
			US	Canada	Japan	Mexico	UK・OT	France・OT	Dead discards or bycatches
1975	74/01	5,032	56.54%	12.74%	30.07%	0.48%	-	-	-
.....									
1982	81/01	1,445	55.85%	20.14%	20.21%	0.97%	-	-	-
.....									
1995	94/12	2,200	59.60%	24.35%	16.05%	-	-	-	-
		*** (in 1997) 2,660MT<**	**52.14%**	**21.54%**	**26.32%**	-	-	-	-
.....									
1999	98/07	2,500	55.48%	22.92%	18.12%	-	0.16%	0.16%	3.16%
.....									
2007	06/06	2,100	55.48%	22.92%	18.12%	1.19%	0.19%	0.19%	1.9%
.....									
2013	12/02	1,750	52.78%	21.81%	17.24%	5.43%	0.23%	0.23%	2.28%
*	**: Traditional shares among US, Canada and Japan**								

4. Japan's views on resource dynamics of western BFT

(1) In 1994, the Commission recognized the Japanese sacrifice and decided to reward Japan when the stock achieves recovery allowing a TAC to be increased over 2,660 tons. The Commission reaffirmed this decision at the time of establishment of the rebuilding plan in 1998 according to Rec. 98-07. In view of these past decisions of the Commission, it is clear that the Commission envisaged the significant recovery of this stock during the process of rebuilding plan based on the SCRS Report which showed that the Maximum Sustainable Yield (MSY) is 2,800-7,700 tons, assuming either a 2-line (low recruitment scenario) or a Beverton-Holt stock-recruitment relationship (high recruitment scenario).

However, the SCRS did not find the recovery even though TACs or scientific monitoring quotas in the WAA have been kept at a low level less than a half of the catches before, for 30 years since 1982 and particularly at an even lower level for most of the period covered by the rebuilding program, i.e., the last 15 years.

(2) The low recruitment scenario suggests that biomass is currently sufficient to produce MSY, whereas the high recruitment scenario suggests that B_{MSY} has a very low probability of being achieved within the rebuilding period. This situation has raised a question on whether the current scientific basis of western BFT is really correct and the current stock abundance indices used for stock assessment of western BFT can really indicate the stock status.

(3) Rec.12-02 recommended that in support of stock evaluation of western BFT, CPCs shall make special efforts to update abundance indices and other fishery indicators annually and provide them in advance of the SCRS annual species group meetings. Also, Japan is presenting the research proposal to improve stock abundance indices for western stock of BFT. More appropriate stock indices should be urgently considered to overcome the current deficiency of information/data for stock assessment of western BFT.

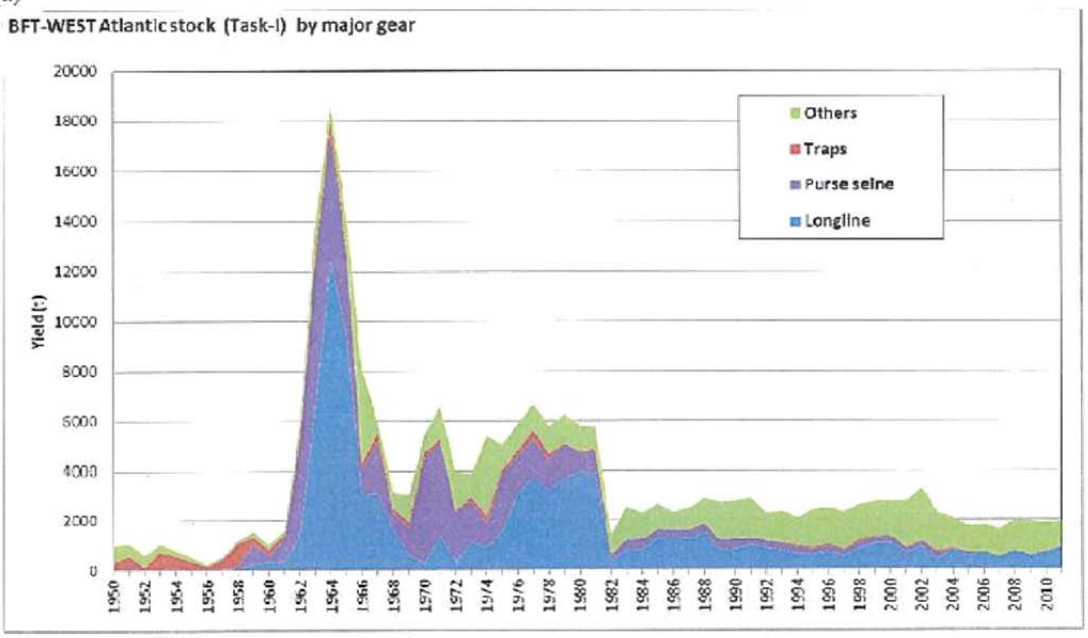
(4) Once better indices are established and stock assessment is conducted based thereon, current conservation and management measures for western BFT should be reviewed and revised to realize MSY of western BFT.

Attachments:

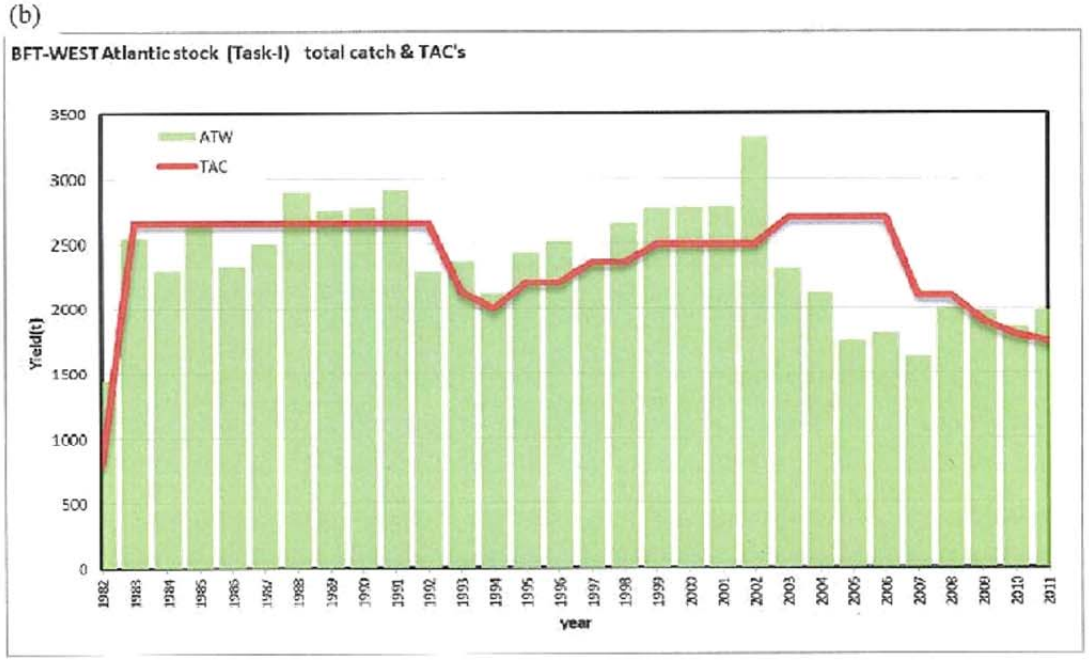
1. Historical catches of western bluefin tuna: (a) by gear type and (b) in comparison to TAC levels agreed by the Commission (2012 SCRS Report).
2. Reported catch for the eastern Atlantic and Mediterranean from Task I data from 1950 to 2011 split by main geographic area (top panel) and by gear (bottom panel) together with unreported catch estimated by SCRS from 1998 to 2007 and TAC levels since 1998 (2012 SCRS Report).
3. Total BFT Catch (Task I) by region (WAA and EAA).
4. The background of introduction of conservation and management measures on western Atlantic bluefin tuna in ICCAT.

Attachment 1 to Appendix 4

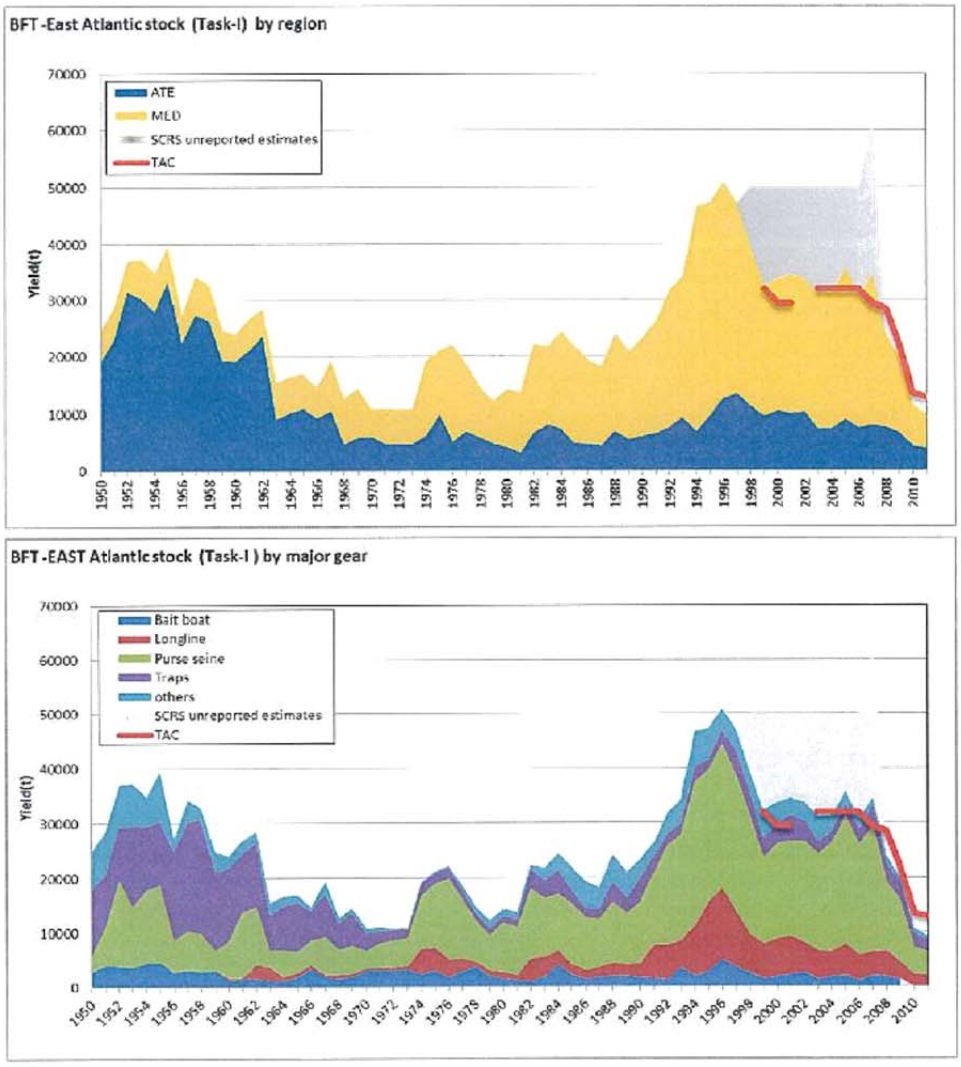
(a)



(b)

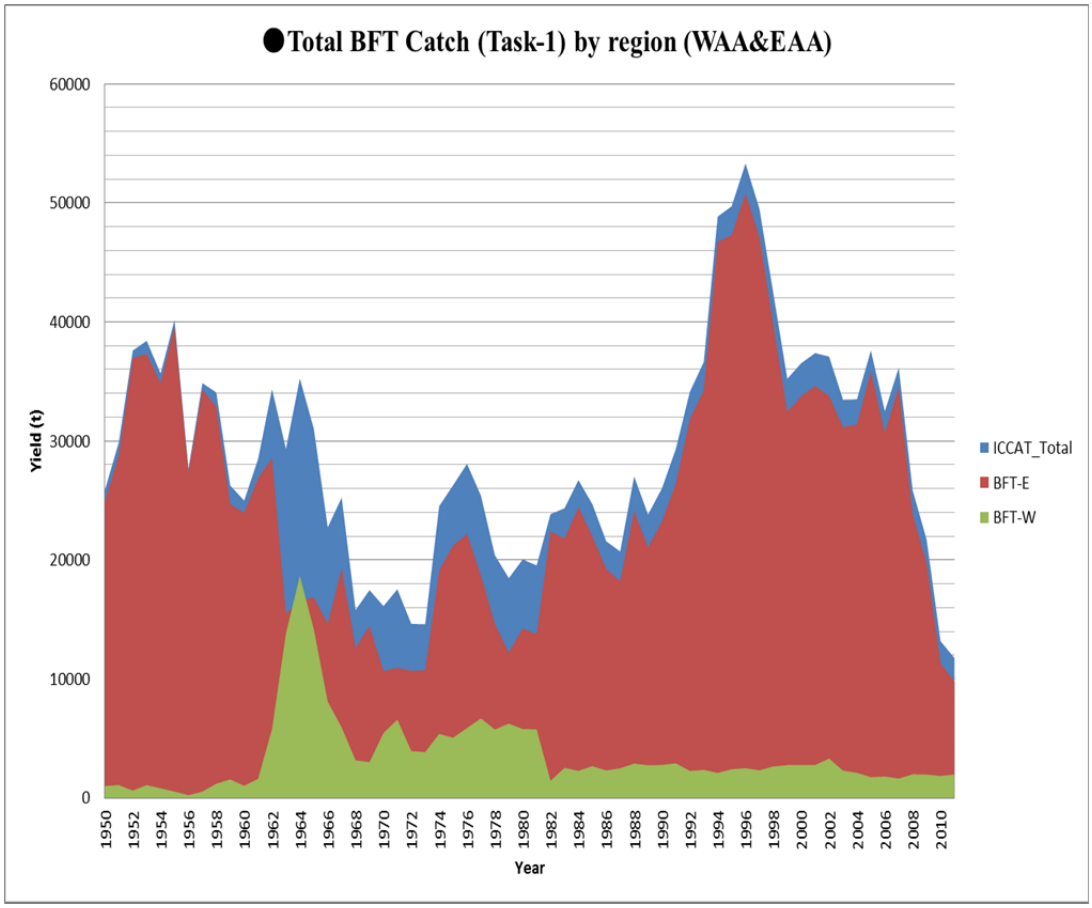


BFTW-Figure 1. Historical catches of western bluefin tuna: (a) by gear type and (b) in comparison to TAC levels agreed by the Commission.



BFTE-Figure 1. Reported catch for the East Atlantic and Mediterranean from Task I data from 1950 to 2011 split by main geographic areas (top panel) and by gears (bottom panel) together with unreported catch estimated by the SCRS (using fishing capacity information and mean catch rates over the last decade) from 1998 to 2007 (the SCRS did not detect unreported catch using fishing capacity information since 2008) and TAC levels since 1998.

Attachment 3 to Appendix 4



Attachment 4 to Appendix 4

Background of Introduction of Conservation and Management Measures on Western Atlantic Bluefin Tuna in ICCAT

	Estimated catch				*TAC or Scientific monitoring quota*			*Commission's Recommendation*	*Main SCRS scientific reports and management recommendations*	*Main measures in Western Atlantic Area (WAA)*
	Total catch	**East**		**West**	**Total-TACs**	**East**	**West**			
1950	**25,876**	**24,869**		**1,007**						
1951	**29,891**	**28,795**		**1,096**						
1952	**37,599**	**36,970**		**629**						
1953	**38,413**	**37,329**		**1,084**						
1954	**35,675**	**34,852**		**823**						
1955	**40,157**	**39,613**		**544**						
1956	**27,669**	**27,422**		**247**						
1957	**34,862**	**34,316**		**546**						
1958	**34,077**	**32,870**		**1,207**						
1959	**26,262**	**24,692**		**1,570**						
1960	**24,992**	**23,960**		**1,032**						
1961	**28,487**	**26,867**		**1,620**						
1962	**34,356**	**28,557**		**5,799**						
1963	**29,328**	**15,490**		**13,838**						
1964	**35,250**	**16,579**		**18,671**						
1965	**31,029**	**16,858**		**14,171**						
1966	**22,747**	**14,657**		**8,090**						
1967	**25,248**	**19,308**		**5,940**						
1968	**15,795**	**12,619**		**3,176**						

1969 (Enter into force, March 21)	**17,470**	**14,458**		**3,012**						
1970	**16,132**	**10,666**		**5,466**						
1971	**17,547**	**10,956**		**6,591**						
1972	**14,635**	**10,687**		**3,948**						
1973	**14,609**	**10,738**		**3,871**						
1974	**24,520**	**19,127**		**5,393**						
1975	**26,284**	**21,212**		**5,072**				**74/01**	・The total catch of bluefin tuna in the Atlantic (including the Mediterranean) has declined from a peak of a little under 40,000tons in 1964-65 to about 12,000 tons in 1973. The recent trends have varied between fisheries. The surface (purse seine and bait boat) fisheries on small fish have declined to about half their peak catches, while most fisheries on large fish (particularly the Norwegian purse seiners and the traps along the coast of the Iberian Peninsula and Morocco) have declined to a very low level. ・There is still uncertainty about the degree of separation between the tuna caught in the Mediterranean and the Atlantic, and between the eastern and western Atlantic. Recent tag returns have confirmed the trans-Atlantic migration of both large and small bluefin occurs, and may be appreciable in some years. However most tag returns, even after several years, occur on the same side of the Atlantic as the point of tagging. Therefore it may be convenient, and not incorrect, to treat the Atlantic bluefin as, in many ways, a single stock. ・Two actions have been considered by the ICES/ICCAT group, which were: a) short-term reduction of fishing intensity on giant fish, to protect spawning fish, b) long-term reduction in purse seine fishing of young fish to permit	
1976	**28,076**	**22,193**		**5,883**						
1977	**25,413**	**18,718**		**6,695**						
1978	**20,410**	**14,645**		**5,765**						
1979	**18,478**	**12,223**		**6,255**						
1980	**20,052**	**14,250**		**5,802**						
1981	**19,545**	**13,774**		**5,771**						

									escapement of maturing fish.	
1982	**23,853**	**22,408**		**1,445**			(800)	**W:81/01**	・Scientific evidence is not yet sufficient to determine with certainty if there are two separate stocks or one stock, but present evidence is towards the hypothesis of separate eastern and western stocks. ・If the resource is to be managed as though there are separate stocks: A)East stock; The east stock seems stable at current exploitation level, hence current regulations controlling minimum size and fishing mortality seem sufficient, B)West stock; The west stock of adult fish seems depleted to very low levels. The weight of evidence supports the conclusion that the total stock weight of adult fish will remain constant or perhaps slightly decrease if there is no catch in 1982. Therefore, based on the evidence available, a major reduction in catch is recommended so the catches of fish are as near zero as feasible in 1982.	・That the Contracting Parties take measures to prohibit the capture of bluefin tuna for a period of two years in the western Atlantic Ocean, as defined on the attached map (Addendum 1), except under conditions to be agreed upon by the Contracting Parties whose nationals have been actively fishing for bluefin tuna in the western Atlantic; such conditions to be based on the requirement to index the abundance of the stock. Until such conditions are developed, directed and incidental catches shall be limited to an annual level of 800 MT to enable ongoing scientific studies to be continued. ・That the Contracting Parties take measures to prohibit any transfer of fishing effort from the western Atlantic to the eastern Atlantic in order to thus avoid increasing fishing mortality of bluefin tuna in the eastern Atlantic.
1983	**24,344**	**21,802**		**2,542**			(2,660)	W:82/01		・In order to maintain and improve the data necessary to index the abundance of the stock of bluefin tuna in the western Atlantic, the Contracting Parties whose nationals have been actively fishing for bluefin tuna in the western Atlantic take measures to limit the catch for scientific monitoring in 1983 to 2,660 metric tons (MT). ・That in recognition of the possible lower level of abundance of small bluefin in recent years, no more than 15 percent in weight of the catch in the western Atlantic may consist of bluefin smaller than 120 cm fork length. ・That during 1983 there will be no directed fishery on the bluefin tuna spawning stocks in the western Atlantic in spawning areas such as the Gulf of Mexico.

1984	**26,716**	**24,427**		**2,289**			(2,660)	W:83/01	
1985	**24,695**	**22,010**		**2,685**			(2,660)	W:84/01	
1986	**21,570**	**19,247**		**2,322**			(2,660)	W:85/01	
1987	**20,723**	**18,220**		**2,503**			(2,660)	W:86/01	
1988	**27,016**	**24,118**		**2,898**			(2,660)		
1989	**23,819**	**21,061**		**2,759**			(2,660)		
1990	**26,027**	**23,247**		**2,780**			(2,660)		
1991	**29,350**	**26,429**		**2,921**			(2,660)		
1992	**34,131**	**31,849**		**2,282**			(4,766)	W:91/01, W92/04	・The Contracting Parties whose nationals have been actively fishing for bluefin tuna in the western Atlantic, institute, for the interim, effective measures to limit the quota for scientific monitoring purposes as follows: Quota for period Max in period Period period 1st year 1992 & 1993 4,788 MT 2,660 MT 1994 & 1995 3,990 MT 2,261 MT ・The three Contracting Parties will prohibit the taking and landing of bluefin tuna weighing less than 30 kg. or in the alternative having a fork length less than 115 cm. Notwithstanding the above regulatory measure, these three Contracting Parties may grant tolerances to capture bluefin tuna either weighing less than 30 kg, or in the alternative having a fork length less than 115 cm to limit the take of these fish to no more than 8% by weight of the total bluefin catch on a national basis and would institute measures such that there would not be any economic gain to the fishermen from such fish.
1993	**36,636**	**34,268**		**2,368**					

	Estimated catch			*TAC or Scientific monitoring quota*			*Commission's Recommendation*	*Main SCRS scientific reports and management recommendations*	*Main measures in Western Atlantic Area (WAA)*
	Total catch	**East**	**West**	**Total-TACs**	**East**	**West**			
1994	**48,853**	**46,740**	**2,113**			(1,995)	**E:93/06,E93/07, W:93/05**	・Consistent with the commission's goal on west Atlantic bluefin tuna to rebuild the spawning biomass to levels producing MSY, the SCRS recommends the future catches should be below 1,200 MT. ・It is apparent that higher long-term yields of east Atlantic bluefin tuna could be realized if fishing mortality rates were reduced, especially on young fish. The SCRS is concerned by the high catch of small individuals and recommended that every effort be made so that the current measures on the size limit of 6.4kg be adhered to. It is expressly recommended that steps be taken so that no age 0 fish (<1.8kg) are caught.	・That the Contracting parties, whose nationals have been actively fishing for bluefin tuna in the western Atlantic, institute, for the interim, effective measures to limit the biennial quota for scientific monitoring purposes for 1994 and 1995 to 3,195 MT, which is divided into a quota of 1,995 MT in 1994, and a quota of 1,200 MT in 1995, unless SCRS scientific information in 1994 indicates otherwise.
1995	**49,714**	**47,291**	**2,423**			(2,200)	E:94/11, W:94/12		・That the Contracting Parties, whose vessels have been actively fishing for bluefin in the western Atlantic, will institute a scientific monitoring quota for 1995 and 1996 of 2,200 MT each year, unless the SCRS scientific information in 1995 indicates otherwise.
1996	**53,320**	**50,807**	**2,514**			(2,200)			
1997	**49,489**	**47,155**	**2,334**			(2,354)	E:96/02, E:96/03, W:96/04		・The Contracting Parties whose vessels have been actively fishing for bluefin in the western Atlantic will institute a scientific monitoring quota for 1997 and 1998 of 2,354 MT each year.
1998	**42,375**	**39,718**	**2,657**			(2,354)			

1999	**35,228**	**32,456**		**2,772**	**34,500**	**32,000**	**2,500**	**E:98/04, E:98/05, W:98/07**	・Regarding west Atlantic bulefin tuna, if the Commission is satisfied with a chance of about 50% of having a net increase in 20 years of 20% in spawning stock size, then in terms of the projections based upon the Beverton-Holt stock recruitment relationship, the current catch level would need to be reduced to about 2000 MT. If the Commission wants to be reasonably sure (i.e. have 90% probability) of at least maintaining the status quo, the catch should be reduced to approximately 1500 MT. In contrast, in terms of the 2-line stock recruitment relationship, if the Commission wants to be reasonably sure (i.e. have 90% probability) of at least maintaining the status quo, the catch should be reduced to approximately 2000 MT. In terms of a goal to move with about 50% chance of reaching biomass levels supporting MSY within 20 years, current catches need not be reduced under the 2-line stock-recruitment relationship. ・The SCRS expressed concern about the status of east Atlantic bluefin tuna resources in the light of assessment results and the historically high catches made in 1996-1997 (in excess of 40,000MT). The projections indicate the future catch levels of 33,000MT, or more, are not sustainable. Catches of 25,000MT or less would halt the decline of biomass. It should be noted that even these results may be optimistic since they assume that future recruitment continues at the average level observed since 1981. Given the large increase in catches since, combined with the results of the present analyses , the Committee considers that a 35% reduction in catches from the e1993 to 1994 levels (i.e., to about 25,000MT) would be necessary to prevent further decline of stock. The SCRS is concerned about the high catch of small individuals	・The Contracting Parties whose vessels have been actively fishing for bluefin tuna in the western Atlantic will initiate a 20-year rebuilding program beginning in 1999 and continuing through 2018, with a total allowable catch (TAC), inclusive of dead discards, of 2500 MT annually. ・The annual TAC, maximum sustainable yield (MSY) target, and 20-year rebuilding period may be adjusted based upon subsequent SCRS advice. However, no adjustments to the annual TAC or the 20-year rebuilding period shall be considered unless: (1) the SCRS advice indicates that a TAC greater than 2700 MT will allow the MSY target to be achieved within the 20-year rebuilding period with a 50 percent or greater probability, or (2) if the SCRS advice indicates that a TAC less than 2300 MT is necessary to achieve the MSY target within the 20-year rebuilding period with a 50 percent or greater probability. At such time as the SCRS determines the stock size has achieved the level that would produce MSY, TAC levels up to the level of MSY will be considered.
2000	**36,541**	**33,766**		**2,775**	**32,000**	**29,500**	**2,500**		
2001	**37,390**	**34,605**		**2,784**	**32,000**	**29,500**	**2,500**	E:00/09	
2002	**37,089**	**33,770**		**3,319**		*****	**2,500**		

2003	**33,469**	**31,163**		**2,306**	**34,700**	**32,000**	**2,700**	E:02/08, E:02/10, W:02/07	and recommended that every effort be made so that the current measures on the size limit of 6.4kg be adhered to. The SCRS reiterated that effective measures be taken to avoid catches of age 0 fish (<1.8kg), and not allow any tolerance with respect to the percentage (in number) of age 0 fish in the landings. ・It should also be noted that the condition of the east Atlantic stock and fishery could adversely affect recovery in the west Atlantic because of mixing between two stocks.	・The annual Total Allowable Catch (TAC), inclusive of dead discards, for the western Atlantic management area be established 2,700 t, effective beginning in 2003. ・The annual TAC, maximum sustainable yield (MSY) target, and a 20-year rebuilding period may be adjusted based upon subsequent SCRS advice. No adjustment to the annual TAC or the 20-year rebuilding period shall be considered unless SCRS advice indicates that the TAC under consideration will allow the MSY target to be achieved within the rebuilding period with a 50 percent or greater probability.
2004	**33,505**	**31,381**		**2,125**	**34,700**	**32,000**	**2,700**			
2005	**37,602**	**35,845**		**1,756**	**34,700**	**32,000**	**2,700**	E:04/07, W:04/05		・The provisions of the Recommendation by ICCAT Concerning Conservation of Western Atlantic Bluefin Tuna [Rec. 02-07], which amend the Recommendation by ICCAT to Establish a Rebuilding Program for Western Atlantic Bluefin Tuna [Rec. 98-07], be extended through 2006. All other operative paragraphs of Recommendation 98-07 as amended by Recommendation 02-07 remain unchanged.
2006	**32,501**	**30,689**		**1,811**	**34,700**	**32,000**	**2,700**			
2007	**36,154**	**34,516**		**1,638**	**31,600**	**29,500**	**2,100**	**E:06/05, W:06/06**	・Regarding western Atlantic bluefin, Fishing at Fmsy (conditional on current recruitment) during the period 2007-2009 would be expected to increase SSB over that period by about 1.5% per year. A constant TAC over the period 2007-2009 which would produce gains in SSB equivalent to those gains in the above-mentioned sentence would be about 2,100t. The constant TAC over the period 2007-2009 which would be expected to maintain SSB at 2006 levels would be about 2,300t. ・In order to reverse these declines and to initiate rebuilding, substantial reductions in fishing mortality and catch need to be implemented. The	・The rebuilding program for bluefin tuna in the western Atlantic, which began in 1999 and will continue through 2018, will have a total allowable catch (TAC), inclusive of dead discards, of 2100 t, annually, effective beginning in 2007, through 2008, and thereafter, until such time as the TAC is changed. ・The annual TAC, maximum sustainable yield (MSY) target, and 20-year rebuilding period may be adjusted based upon subsequent SCRS advice. No adjustment to the annual TAC or the 20-year

									only scenarios which have potential to address the declines and initiate recovery are those which (in combination) close the Mediterranean to fishing during spawning season and decrease mortality on small fish through fully enforced increases in minimum size. Realized catches during the next few years implied by fully implementing these actions are expected to be in the order of 15 000 t. Clearly, an overall reduction in fishing effort and mortality is needed to reverse current trends. Current fishing capacity largely exceeds the current TAC. Therefore, management actions are also needed to mitigate the impacts of overcapacity as well as to eliminate illegal fishing. ・Management actions taken in the eastern Atlantic and Mediterranean are likely to impact the recovery in the western Atlantic, because even small rates of mixing from East to West can have significant effects on the West due to the fact that Eastern plus Mediterranean resource is much larger than that of the West.	rebuilding period shall be considered unless SCRS advice indicates that the TAC under consideration will allow the MSY target to be achieved within the rebuilding period with a 50 percent or greater probability.
2008	**25,849**	**23,849**		**2,000**	**30,600**	**28,500**	**2,100**			
2009	**21,730**	**19,751**		**1,980**	**23,900**	**22,000**	**1,900**	E:08/05, W:08/04		・The rebuilding program for bluefin tuna in the western Atlantic, which began in 1999 and will continue through 2018, will have a total allowable catch (TAC), inclusive of dead discards, of 1,900 t in 2009 and 1,800 t in 2010. ・The annual TAC, maximum sustainable yield (MSY) target, and 20-year rebuilding period may be adjusted based upon subsequent SCRS advice. No adjustment to the annual TAC or the 20-year rebuilding period shall be considered unless SCRS advice indicates that the TAC under consideration will allow the MSY target to be achieved within the rebuilding period with a 50 percent or greater probability.
2010	**13,186**	**11,328**		**1,857**	**15,300**	**13,500**	**1,800**			
2011	**11,765**	**9,779**		**1,986**	**14,650**	**12,900**	**1,750**	E:10/04, W10/03		・The rebuilding program for bluefin tuna in the western Atlantic, which began in 1999 and will continue through 2018, will have a total allowable catch (TAC), inclusive of dead discards, of 1,750 t in 2011 and in 2012. ・The annual TAC, maximum sustainable yield (MSY) target, and the 20-year rebuilding period may be adjusted based upon subsequent SCRS advice. No adjustment to the annual TAC or the 20-year rebuilding period shall be considered unless SCRS advice indicates that the TAC

									under consideration will allow the MSY target to be achieved within the rebuilding period with a 50 percent or greater probability.
2012	-	-		-	**14,650**	**12,900**	**1,750**		
2013	-	-		-	**15,150**	**13,400**	**1,750**	**E:12/03, W12/02 ・(The Appendix 3 to ANNEX 9 of the Proceedings of the 18th Special Meeting of ICCAT)**	・Regarding west Atlantic bluefin tuna, the "low recruitment scenario" suggests that biomass is currently sufficient to produce MSY, whereas the "high recruitment scenario" suggests that BMSY has a very low probability of being achieved within the rebuilding period. Despite this large uncertainty about the long term future productivity of the stock, under either recruitment scenario current catches (1,750 t) should allow the biomass to continue to increase. Larger catches in excess of 2,000 t will prevent the possibility of the 2003 year class elevating the productivity potential of the stock in the future. ・All CPUE indices of east Atlantic bluefin tuna showed increasing tendencies in most recent years. The Committee notes that maintaining catches at the current TAC (12,900 t) or at the 2010 TAC (13,500 t) under the current management scheme will likely allow the stock to increase during that period and is consistent with the goal of achieving FMSY and BMSY through 2022 with at least 60% of probability, given the quantified uncertainties. A period of stabilization in the main management regulations of the rebuilding plan would allow the SCRS to better estimate the magnitude and speed of recent trends in F and SSB in the coming years. ・Both the productivity of western Atlantic bluefin and western Atlantic bluefin fisheries are linked to	・The rebuilding program for bluefin tuna in the western Atlantic will have a TAC, inclusive of dead discards, of 1,750 t in 2013. ・The annual TAC for 2014 will be set in 2013. The annual TAC, MSY target, and the 20-year rebuilding period shall be reviewed and, if appropriate, adjusted based upon subsequent SCRS advice. No adjustment to the annual TAC or the 20-year rebuilding period shall be considered unless SCRS advice indicates that the TAC under consideration will allow the MSY target to be achieved within the rebuilding period with a 50 percent or greater probability. ・In 2013, a working group of fisheries managers and scientists will be convened. ・The SCRS shall annually review available fishery and stock indicator trends and evaluate whether they warrant advancing the scheduling of the next stock assessment. In support of this evaluation, CPCs shall make special efforts to update abundance indices and other fishery indicators annually and provide them in advance of the SCRS annual species group meetings.

									the eastern Atlantic and Mediterranean stock. Therefore, management actions taken in the eastern Atlantic and Mediterranean are likely to influence the recovery in the western Atlantic, because even small rates of mixing from East to West can have considerable effects on the West due to the fact that eastern plus Mediterranean resource is much larger than that of the West.	

Appendix 5

RESEARCH PROPOSAL TO IMPROVE STOCK ABUNDANCE INDICES FOR WESTERN STOCK OF ATLANTIC BLUEFIN TUNA [WBFT-006]

Tomoyuki Itoh
Fisheries Research Agency

SUMMARY

Stock assessment for the western stock of Atlantic bluefin tuna has to rely on a set of abundance indices. Each component of the present set of indices should be improved. New indices should be added for some part of life stage that lacking index at present. We propose four components of the set of indices: (1) starting longline research in the Gulf of Mexico for spawning fish; (2) starting research for young-of-the-year fish as recruitment monitoring; (3) improvement of rod & reel data collection in the USA; and (4) starting fishery independent research which lasts for several months in Gulf of St. Lawrence Canada.

Stock assessment and fishery management need reliable stock abundance indices. In ICCAT, both western and eastern stocks of Atlantic bluefin tuna lack highly reliable abundance indices because there is no major fishery which covers a large part of its distribution and a large part of its life history. Fishery independent scientific research is not yet carried out on a large scale for a long period.

In the western stock of bluefin tuna, a set of indices comprised of six indices are used for stock assessment (**Figure 1** and **Table 1**). As a whole, the set covers a wide geographical range from the Gulf of Mexico to the central Atlantic through Canadian waters including the Gulf of St. Lawrence and a wide range of life history from larvae to spawning fish. All the indices have relatively long periods of time, more than 20 years. However, each index has insufficient points, such as a small number of data, possibly including migrants from the east stock, and regulation change that resulted in a change of the fishing operational pattern that should be corrected in the index. Some indices show a contradictory trend within each other; age 8+ in the U.S. rod and reel decreased from 1995 but CPUEs of Japanese longline and the Canadian fishery in southwest Nova Scotia or Gulf of St. Lawrence were increased or stable. There are some parts of the life stage that are not yet monitored due to the selectivity of fishery.

Each component of the present set of indices should be continued and improved. New indices should be added for some part of the life stage that lack index at present. Particularly, we propose three components of the set of indices as follows, which are practical measures and expect the set to be much more reliable.

1) Longline research in Gulf of Mexico for spawning fish

Bluefin tuna in the Gulf of Mexico (GOM) are important for stock indices of adult fish as well as for investigate spawning ecology. The index is considered to be for fish of western origin only. The present index in GOM is derived from longline fishing targeting other species, such as yellowfin and bigeye tunas, and swordfish, which take bluefin tuna as by-catch. Then, the index is based only on a small number of bluefin tuna caught which would cause a large variance in the result.

Research by longline that targets bluefin tuna is valuable. By using several vessels, it covers the whole spawning season and areas. The result provides not only an index of adult fish but also correction factors to the present index in GOM in terms of spatio-temporal distribution of bluefin tuna. In addition, gonads for spawning studies can be collected from the fish caught. Furthermore, the length data of bluefin tuna caught are derived and provide data to examine the age and size at maturity, which is under debate for the western stock in ICCAT, at least for fish in GOM.

The start of this survey is practical and the result useful for stock assessment will be obtained soon. Longline fishing has already existed in GOM by the U.S. fishery. Japanese longliners are also being a candidate to operate. The longline operation and its catch should be monitored by on-board scientific observers. The research should be designed scientifically, but fishermen’s knowledge is quite important especially to determine the location of the longline set.

2) Research for young-of-the-year fish as recruitment monitoring

At present, there is no index of young-of-the-year (YOY) bluefin tuna, i.e., 20-50 cm in body length. The YOY index is useful because YOY has already passed through the larval stage, which has a severe mortality rate with high variability under fluctuating environmental conditions, it has relatively high correlation with recruitment stock of the fishery, and it provides managers warning of the state of the stock a few years earlier than at present. In addition, because the YOY of bluefin tuna are more distributed in coastal areas than in older ages, it is easier to do research than doing in high-seas and it may provide information from whole the cohort which will disperse in wider area along with getting older. It is also a strong merit that YOY would be comprised solely with western origin fish, which can be evaluated if samples were collected.

It is not well known where the YOY are distributed because there is no fishery for these in the USA. They would be distributed in coastal areas of GOM and the east coast of the USA between July and December. Any sampling gears are possible but tuna Japanese type trolling is proposed here as one candidate. Various commercial trolling gears for small Pacific bluefin tuna have been developed in Japan. There are some gears used for 20-30 cm fish and others for 40-50 cm fish.

Fishery independent trolling transect surveys have already conducted by Japan for southern bluefin tuna and Pacific bluefin tuna. Trolling surveys for southern bluefin tuna have been carried out since 1996 and modified in 2006 and continued at present (Itoh et al. 2012). The survey is carried out in the southern coastal area (across the edge of the continental shelf) of western Australia for 18 days in January-February every year by a chartered Australian fishing boat 18 m in length with 8 lines of Japanese style trolling. The number of schools detected as catching per transected distance is used as a recruitment index. While the survey have been aimed at detecting warning signs of recruitment failure or providing information on the recruitment level in low resolution, the derived index is in good agreement to the recruitment level estimated from the operating model (**Figure 2**). The survey is endorsed by CCSBT and its index is used as one of important key indices of recruitment for southern bluefin tuna assessment in CCSBT (Anon. 2012). A fishery independent trolling survey for Pacific bluefin tuna which started in 2008 has been carried out in Tosa Bay for 20-30 cm fish by two boats (Kai et al. 2012).

Because it is new index for Atlantic bluefin tuna, several years are necessary to find any trend in recruitment abundance change useful for stock assessment. There is little information of YOY distribution from the fishery, probably data for three years are needed for a feasibility study, an additional two years to establish the index and a further additional three years (in total seven years) to produce a useful index with trend. However, YOY is valuable as a biological sample so that the survey can contribute largely to ICCAT from the first year. Length frequency of YOY, coupled with some otolith daily increment analysis, provide a range of spawning seasons from different points of view from spawners or larvae as well as the degree of contribution of any part of the spawning season to the whole recruitment stock (Itoh 2009).

3) Rod & reel data in USA

Catch rate data of rod & reel off the east coast of the USA are important information for young (age 2 to 8 or older) bluefin tuna. The data have several advantages such as they span 20 years, they provide the index by age and they are the only source of index for young age bluefin tuna. At present, these data are based on information collected through telephone interviews for sampled boats. Because the number of fish caught was small, it seems that these catch rates include only a small part of the catch and effort of recreational fishing.

These data are expected to be improved, largely by collecting data from all the rod & reel fishermen. A Report by submitted document would be convenient way in terms of work force and speed of procedure. Note the importance of collecting effort data for zero- catch. Because it seems promising that some additional work is needed improve stock assessment immediately, urgent strengthening of the system is effective.

The fish for rod & reel are comprised of both western and eastern origin fish. Therefore, it is necessary to distinguish the two origins of fish based on sufficient a number of otoliths collected. Biological sampling and a routine analysis program should also be established.

4) ***CPUE of Gulf of St. Lawrence in Canada***

Longline, tended line and rod and reel are operated in the Gulf of St. Lawrence (GSL). The index spans more than 20 years since 1981. The fishing season was quite short in the GSL in 2009 and 2010, which resulted in

extremely high CPUE. In 2011, the season expanded by implementation of ITQ. The SCRS expressed concern that such an inconsistency of fishing pattern may change the relationship between CPUE and stock abundance.

It is effective to conduct fishery independent research which can continue for several months using longline or other suitable gear. Derived results will be used to correct the fishery data and to establish an independent index.

While it was shown that giant fish in the GSL were of western origin in the previously examined samples, this should be further examined. In addition, there were smaller size fish (90-135kg) in the GSL in 2011 and 2012 (Hanke et al. 2012), whose origin should be confirmed. Therefore, it is necessary to distinguish the two origins of fish based on a sufficient number of otoliths collected. Biological sampling and routine analysis program should be established.

References

Anon. 2012, Report of the Nineteenth Annual Meeting of the Commission. CCSBT, 1-4 Oct. 2012 in Takamatsu City, Japan.

Cass-Calay, S. L. and Walter, J. F. 2012 Standardized catch rates of bluefin tuna from the United States pelagic longline fishery in the Gulf of Mexico during 1987 to 2011. SCRS/2012/160.

Hanke, A. R., Andrushchenko, I., Neilson, J. D. and Whelan C. 2012, Indices of stock status obtained from the Canadian bluefin tuna fishery. SCRS/2012/118.

Ingram, G.W. Jr 2012, Annual indices of bluefin tuna (*Thunnus thynnus*) spawning biomass in the Gulf of Mexico (1977-2011). SCRS/2012/159.

Itoh, T. 2009. Contribution of different spawning seasons to the stock of Pacific bluefin tuna *Thunnus orientalis* estimated from otolith daily increments and catch-at-length data of agte-0 fish.

Itoh, T., Sakai, O., and Tokuda, D. 2012, Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2011/2012. CCSBT-ESC/1208/33.

Kai, M., Nakano, H., Okamoto, H., Minami, H., Oshima, K., Sato, K., Fujioka, K., Uosaki, K., YOkawa, K., Abe, O., Matsumoto, T., and Takeuchi Y. 2012. Annual Report of Japan. ISC/12/PLENARY/08.

Kimoto, A., Itoh, T., Sakai, O. and Miyake, M. 2012, Overview of the Japanese longline fishery for bluefin tuna in the Atlantic Ocean, up to 2011. SCRS/2012/130.

Kimoto, A., Itoh, T., Suzuki, Z. and Miyake, M. 2012 Updated standardized bluefin tuna CPUE from the Japanese longline fishery in the Atlantic up to the 2011 fishing year. SCRS/2012/131.

Lauretta M.W. and Brown C.A. 2012 Updated standardized catch rates of bluefin tuna,*Thunnus thynnus*, from the rod and reel/handline fishery off the northeast United States during 1980-2011. SCRS/2012/158.

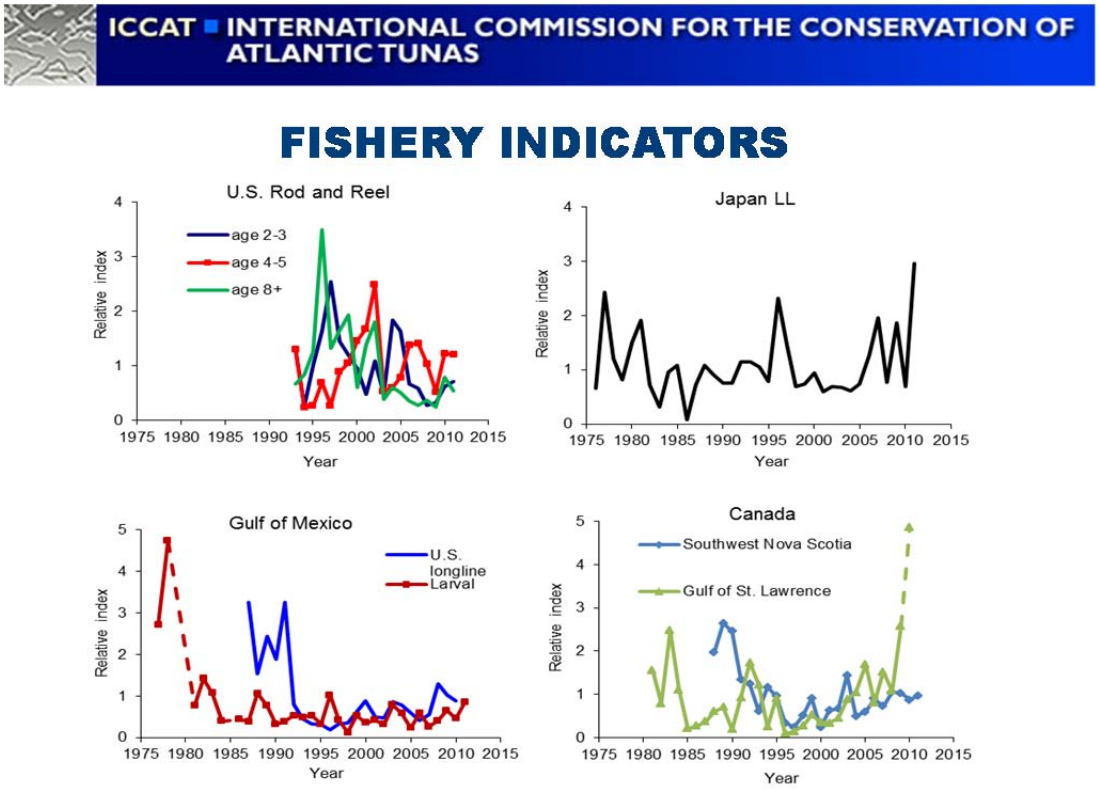


Figure 1. Abundance indices of the western Atlantic bluefin tuna stock used at present. From western stock Chair's presentation at the 2012 SCRS.

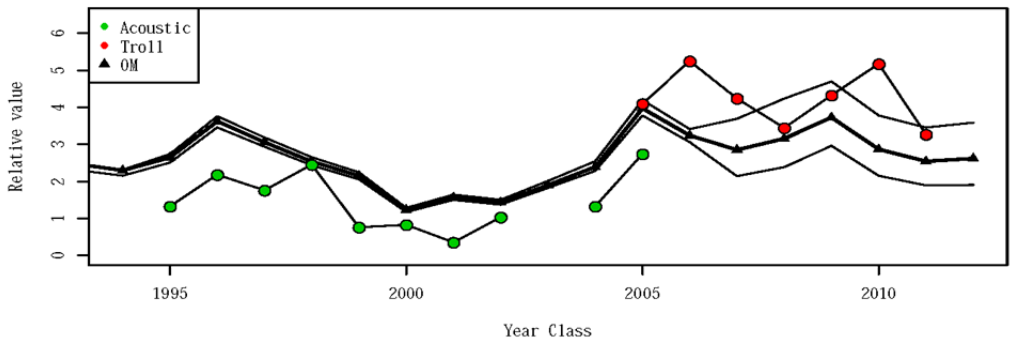


Figure 2. Trolling index of southern bluefin tuna by trolling survey. "Acoustic" is the trolling index using trolling catch data in the acoustic research survey for age-1 fish and "Troll" is the index from the trolling research survey for age-1 fish. "OM" is estimation of the recruitment by operating model used for stock assessment of southern bluefin tuna in CCSBT, with median and 25 and 75 percentiles.

Table 1. Information of abundance indices of the western Atlantic bluefin tuna stock used at present.

Name	*Area*	*Method*	*Start*	*Provide country*	*Scale*	*Fish size*	*Possibility of mixing*	*References*
US LL	Gulf of Mexico	Longline CPUE (N / 1000 hooks)	1987	USA	1202 sets with 0.207 nominal CPUE in 2010	Spawning fish	west only	SCRS/2012/160
Larval index	Gulf of Mexico	Larval net sampling (N pre $100m^2$)	1977	USA	37 stations and 49 larvae in 2011	larvae	west only	SCRS/2012/159
Rod & reel	Northeast coast of USA	CPUE of recreational catch (N per hours)	1993	USA	In 2011, 260 boats with 1548 hours and 223 fish (66-114cm and 115-144cm fish) and 329 boats with 2605 hours and 30 fish(>177cm fish)	age 2-3, age 4-5, age 8+	west & east	SCRS/2012/158
Gulf of St. Lawrence	Gulf of St. Lawrence, Canada	CPUE of Rod & Reel and Tended line	1981	Canada	55,297 hours and 859 fish in 2006. 5,204 hours and 503 fish in 2011.	Large fish	west only	SCRS/2012/118
Southwest Nova Scotia	Southwest Nova Scotia, Canada	CPUE of Rod & Reel, Tended line and harpoon	1988	Canada	2,769 hours and 383 fish in 2011	Large fish	west & east	SCRS/2012/118
Japan LL	West of 45W	Longline CPUE (N / 1000 hooks)	1976	Japan	285 sets with 5.211 nominal CPUE in 2011	Large fish	west & east	SCRS/2012/130 SCRS/2012/131

Appendix 6

OVERVIEW OF KEY UNCERTAINTIES IN THE WESTERN ATLANTIC BLUEFIN TUNA STOCK ASSESSMENT [WBFT-007]

Submitted by Canada

ABSTRACT

The International Commission for the Conservation of Atlantic Tunas' (ICCAT) Standing Committee on Research and Statistics (SCRS) has employed a Virtual Population Analysis (VPA) model in its western Atlantic bluefin tuna stock assessments since 1982. Stock projections are based on two scenarios/relationships: the Beverton-Holt and the "two-line" model. Unfortunately, the SCRS has been unable to provide clear advice to managers on the stock status relative to various harvest levels and has consistently referred to the two extremely divergent recruitment scenarios as being "equally plausible". Under the high recruitment scenario, the stock will not achieve the recovery plan objective of B_{MSY} by 2018 even with no fishing. On the other hand, under the low recruitment scenario the stock is considered fully rebuilt and a significant quota increase would be sustainable.

Without clear science advice on the stock's recovery status, managers were presented with significant challenges at the 2012 annual meeting. This led to the decision to hold a workshop of WBFT fisheries managers and scientists with the aim of improving the communication of scientific advice to fisheries managers to enhance the decision making process for sustainable management of the resource.

The paper explores the consequences of not incorporating the significant amount of mixing between the western and eastern Atlantic bluefin populations. It also outlines several key differences in the assumptions used in western and eastern Atlantic bluefin stock assessments, including very different population growth curves, schedules for age at maturity and natural mortality, the lack of genetic evidence to support these differences, and the similar environmental conditions of the two distinct spawning populations. Additional areas of uncertainty include the indices of abundance used in the WBFT assessment and estimates of recruitment.

Finally, the paper addresses the bases for Beverton-Holt and "two-line" recruitment scenarios and concludes that it is unlikely either approach captures the recruitment dynamics of the Gulf of Mexico spawning population.

Introduction

The objective of this paper is to: (1) highlight the key uncertainties related to the assumptions in the current stock assessment including, but not limited to, the stock recruitment relationship: (2) demonstrate, where possible, the significant impacts these uncertainties may have on the resulting scientific advice; and (3) identify areas the SCRS might consider for further research/analysis in the lead up to the next stock assessment in 2015.

1. Geographical Distribution and Management Units (mixing)

In 1981, ICCAT took the decision to split the management of North Atlantic bluefin between the western Atlantic spawning population and the eastern Atlantic and Mediterranean spawning populations. Prior to this decision, the North Atlantic bluefin tuna was assessed as a single stock. The decision in 1981 essentially treated east-west mixing as negligible from a management perspective, and discounted the impacts of east or west fisheries on the other population.

Today, there is considerable evidence of adult and juvenile mixing (except during spawning season) from the western Atlantic bluefin tuna (WBFT) spawning population and the eastern Atlantic and Mediterranean bluefin tuna (EBFT) spawning population. While the degree of mixing varies by geographic area, decade, and age, aggregated estimates of mixing within the Northwest Atlantic fisheries for all years found that for the mid-Atlantic Bight 42.6% of schools (ages 1-4), 55.7% of mediums (ages 5-9), and 64.9% giants (ages 10+) were from the Gulf of Mexico population, whereas 94.8% and 100% of giants in the Gulf of Maine and the Gulf of St Lawrence were from the Gulf of Mexico[1].

An update to these estimates of natal origin for the landings of "school size" tuna off of the USA was undertaken in 2012. Based on the results, 84.8%, 39.9% and 15.8% for the period 1976-1977, 1997-2000, and 2011-2012,

[1] Rooker et al. (2008).

respectively were from the Gulf of Mexico[2]. Essentially, the degree of mixing in the fishery off the coast of the USA has changed over the several decades of observations, with an increasing proportion of the landings coming from the Mediterranean population complex.

Recent studies using satellite tags indicate that the movement of bluefin tuna across the stock boundary (i.e., mid-Atlantic) has been much greater than thought possible when the stocks were first assessed separately (Anon. 1992; Anon. 1993; National Research Council 1994; Secor et al. 2012). In addition, micro-chemical assays of otoliths (ear bone samples) from the western Atlantic were examined to determine the natal origin of the fish taken by various fisheries at various times and locations (Secor et al. 2012). The results indicate that while all of the spawning size fish taken in the Gulf of St. Lawrence were of Gulf of Mexico origin, as much as 84% of the fish taken in the U.S. small fish fishery, fish that represent age one recruits, were of Mediterranean origin (Secor et al. 2012).

Although it is difficult to estimate mixing rates over decades and age classes based on the relatively small amount of tracking data (most of which has been carried out in the western Atlantic), the aggregate observations indicate that there is considerable mixing in the western fishery when the fish are young, and this shifts to all fish being of western origin when the fish reach maturity.

There have been several attempts to estimate the implications of mixing on the assessment results. Two categories of models on the nature of the mixing/interchange have been investigated 1) the "diffusion model" which assumes mixing during the entire life cycle of the populations (including during the spawning aggregations); and (2) the "overlap model" which assumes that migrations amongst the populations overlap by varying amounts during the feeding migrations, but there is still assumed to be birth site fidelity. The first attempt was presented at the 1993 ICCAT meeting (Butterworth and Punt 1994) using the "diffusion model". The conclusions were dramatic, in that relatively low levels of exchange resulted in very different estimates of recruitment (R) and Spawning Stock Biomass (SSB) for the two management units. However, subsequent work with the "overlap" model led to the conclusion that there is little difference in the estimates of R and SSB for the two management units. In summary the nature of the exchange itself (spawning versus feeding) makes a large difference.

1.1 Incorporating Mixing in the Stock Assessments

The variable and sometimes significant stock mixing of mainly the juveniles from the east in the west may invalidate the assumptions associated with recruitment, particularly if the high juvenile catches of the early 1970's were primarily of eastern origin fish.

Examination of recruitment estimates for the eastern and western stocks suggests there is some correspondence between years of strong recruitment especially over the past 10 years. In these years, strong recruitment in the west lags those in the east by 1 year, giving time for these small fish to make their trans-Atlantic migration before being captured in the western fishery, where an unknown proportion have been misinterpreted as western recruits. Since these eastern "visitors" do not seem to be present in western fisheries when they reach spawning age, this may also explain the disappearance of several strong year classes in the West that have been detected in several stock assessments only to later disappear, notably the 1987 and 1995 year classes.

A key impact on the assessment is the assumption that all reported WBFT catches are of western origin – there is no estimate to address the fact that a significant amount of reported WBFT catches are actually of eastern origin.

1.2 Considerations for the 2015 stock assessment

a) Given the potentially high degree of mixing of tuna from the two populations during some parts of their life history, the varying degree of mixing over time, and the unknown rates of mixing; what are the implications of the defined management units on the estimates of the SSB/R relationships?

b) Given that it is assumed in the SCRS assessments to date that there is little or no mixing, have the assessments of the two management units captured the underlying dynamics of the Gulf of Mexico population and the Mediterranean population complex?

c) What is the nature of the mixing/interchange ("diffusion" versus "overlap")?

2. Estimates used in the catch-at-age matrix

[2] Secor et al (2012a, b).

Catch-at-age (CAA) is a critical component of any age-based analytical assessment. The Virtual Population Analysis (VPA) model used for WBFT assessment assumes that the CAA is without error. Length frequencies are generated from the landed weights using a length-weight key (even when direct measurements of lengths are available). In the case of WBFT, a model of age in relation to length is used which includes samples from different time periods. This is problematic given that decadal differences in growth have been observed. The end product is an estimate of the numbers of tuna landed in each age class over many years (e.g. the catch-at-age matrix from 1970 to 2012) for input to the assessment model.

There are a number of potential "errors" associated with the WBFT CAA matrix.

First, the scientific assessments for the two management units assign all fish landed (as well as estimates of misreporting) east and west of the 45 degree line to the respective management units. This means that tuna from the Mediterranean spawning population, which have migrated to west of the line are included in the CAA estimates for the western management unit, and vice-versa.

Second, under or misreporting of catches has had a significant impact on CAA. This has been corrected to a large extent in recent years due to new regulations and enforcement practices in the EBFT fishery. However, in the past there have been a number of documented cases which adversely affected the CAA in that fisheries related mortalities were not captured in the appropriate CAA.

Third, applying an incorrect age/length growth model to the landings of eastern origin fish within the western management unit and vice-versa leads to further errors. The western unit uses a growth curve of Restrepo et al (2011) for tuna caught to the west of the 45 degree meridian, while the eastern unit uses a growth curve of Cort (1991). Longevity estimates also differ between east and west with the former living to 20 years and the latter to 32 years based on two different methodologies (tagging and radiocarbon tracers). This occurs despite there not being any genetic evidence to support having different growth curves and longevity estimates.

The inter-mixing of tuna from the respective spawning populations within the two management units is probably the most significant source of error and the most difficult to investigate. Limited collections of hard parts during past decades make it difficult to study temporal changes in the degree of mixing, and thus how these phenomena may have influenced the construction of the CAA annual estimates.

2.1 Impacts on the Stock Assessment

The CAA matrices used in the assessments of EBFT and WBFT were constructed using different age-growth models and longevity estimates. Fromentin and Powers (2005) noted that it seems odd the two populations would have such different growth patterns and longevity, given the high degree of sharing of the same or similar environmental conditions.

Virtual Population analysis such as ADAPT (current assessment model used by the SCRS for WBFT) do not perform well when there is significant error in the CAA or at low fishing mortalities. Based on the uncertainty expressed throughout the literature about reported catches it is likely that several major sources of error exit in the multiple decade time series. There are a number of analytical models that take into account error in the CAA, as well as mixing. Alternative models should be explored for the 2015 stock assessment.

Estimates of recruitment and biomass in an analytical assessment depend on reliable catch data and representative indices. During the early years of the WBFT fishery, a sizeable proportion of the removals were due to the purse seine fishery occurring in the western Atlantic[3]. After 1970, this fishery was constrained by market regulations and changed focus to smaller/younger (<age 5) fish. From 1970 to 1976 purse seine landings accounted for an average of 49% of the western Atlantic catch, with a peak of 78% in 1970.. Following the implementation of a minimum size regulation by ICCAT of 6.4 kg in 1975, the purse seine fleet shifted its efforts to a larger size class of tuna for the sashimi market. Because this fishery targeted age 1 to 5 year-old tuna for a short period of time, it may have had an impact on the CAA (likely a change in catchability) and the subsequent estimates of recruitment for the early 1970's.

Finally, it should be noted that the purse seine fishery prior to 1980 was a "mixed" tuna fishery targeting bluefin, yellow fin, skipjack and albacore tuna of approximately the same size range in the eastern and western Atlantic.

[3] Ruais 2011/12.

2.2 Considerations for the 2015 Stock Assessment

a) Consider alternative assessment models that account for error in the CAA and mixing between populations.

b) Consideration should be given to using the same growth and age assumptions for both populations to create the CAA.

c) Undertake a sensitivity analysis to evaluate the model and age spans for the "Mediterranean" tuna in the western unit assessments (and vice versa), as well as the implications of unreported catch from the fisheries in the eastern management unit.

d) Consider investigating the effects of changes in catchability (i.e. inter-annual variable targeting of specific size groups) in the fisheries on SSB and R over time.

3. Indices of Abundance

Indices of abundance are used to tune or calibrate a VPA and can be either fishery dependent or fishery independent. These relative indices are considered to reflect changes/trends in abundance of the population or some component (e.g. age groups) of the population. The index does not have to encompass the entire range of the group, but must represent a constant portion of the population through time if it is to be reflective of trends in the population.

For the WBFT assessment there are 15 relative indices of abundance available (only 12 used in the 2012 assessment) representing several size categories and fishing areas as well the spawning grounds in the Gulf of Mexico.

Detailed reviews were provided in working papers for each of the indices in 2012 and a number of concerns were expressed about several of the indices.

For example, due to the unquantifiable effect of management changes on abundance estimates within the Canadian fisheries, there are concerns with the interpretation of the two Canadian indices. This shortcoming is not, however, unique to the Canadian data. The 2011 USA longline fleet operated very differently from previous years with only 18 trips meeting the filtering criteria, consequently the 2011 data point was dropped from the Gulf of Mexico longline index. Changes in the composition of the USA juvenile fisheries (i.e. the trend in the percentage of "Mediterranean" tuna in the landings over time) undermine these indices[4]. The Japanese longliner index does not appear to track the collapse years of the 1980s. Recent high values may be due to increases in the landings of "Mediterranean" tuna to the west of the 45 degree line, or be an accurate indicator of the strong 2003 year-class of "Gulf of Mexico" tuna. This is the only fishery dependent index that covers the full range of abundance levels (1976 to present).
Concern has also been expressed about the spatial distribution and timing of Gulf of Mexico spawning biomass index estimated from the larval survey data. Large values occur for 1977-1978 but the rest of the series is low. Reviews by Richards (1990) and Murphy (1990) identify some of the survey weakness and note that the survey was not designed for BFT nor should it be used to calibrate or fine tune a VPA.

3.1 Considerations for the 2015 Stock Assessment

The WBFT indices of abundance were examined in terms of their strengths and weaknesses in 2012; however, because the 2012 assessment was only an update the inputs were not changed nor the indices scored or ranked. Overall, due to the sometimes contradictory trends in relative abundance, the shortness of some of the indices, as well as the concerns about specific indices, these series collectively may not always reflect the population abundance trends. The removal of a single year from the USA longline fleet in 2011 due to changes in the fishery and very low fishing effort is suggestive that similar events may have occurred in the past in some of the other indices.

A thorough review of all WBFT abundance indices is required for the 2015 assessment.

4. Estimates of abundance and fishing mortality at age

[4] Secor et al 2012a, b.

There are a number of differences in assumptions between the EBFT and WBFT stocks that directly affect the VPA and the subsequent estimates of SSB and R. In neither case is consideration given to eastern fish caught in the west or vice versa.

The WBFT assessment assumes age independent natural mortality (0.14) for tuna from age 1 to 32 while the EBFT assessment assumes age dependent natural mortality (age 1, 0.49; age 2, 0.24; age 3, 0.24; age 4, 0.24; age 5, 0.24; age 6, 0.20; age 7, 0.175; age 8, 0.0.15; age 9, 0.125; ages 10 to 20 years, 0.10). Fromentin and Powers (2005) consider the differences in natural mortality to be "unsatisfactory" and recommend further research.

In its estimates of SSB, the SCRS assumes that 50% of EBFT mature at approximately 25kg or at age 4, while 100% of WBFT mature at approximately 145kg or age 9; however, recent reports note that some individuals caught in the west as small as 47kg (or age 5) where mature, suggesting that there may be little difference in age of maturity for EBFT and WBFT. Alternatively they may have been eastern origin fish caught in the west.

A sensitivity run conducted during the 2012 assessment showed that SSB estimates are affected by the age at maturity assumption. Earlier maturity for the Mediterranean tuna resulted in larger SSB's over the entire time series. The assumption of later maturation in Gulf of Mexico tuna (knife-edged - 0% at age 8 to 100% at age 9) resulted in decreased estimates of SSB. However, the overall long term trends of SSB were similar. Estimates of fishing mortality and R were nearly identical across the model runs.

In summary, the many assumptions are rather complex, such that it is difficult to rank (without sensitivity analyses) how important each of these biological characteristics is with respect to the time series of R and SSB for the two management units.

A key issue in evaluating the recovery plan is how well the estimates of R and SSB for the management units reflect the actual recruitment dynamics of the two spawning populations even in a qualitative manner. Fromentin and Powers (2005) recommend that a trans-Atlantic study of maturity be carried out using the same sampling protocols to re-evaluate the reported differences for the two spawning populations.

Furthermore, treating of all of the landings of mixed population sources (within the respective management units) as having the same growth and maturation schedules, and the observations from the tracking studies that the degree of mixing has varied considerably over time, generates considerable uncertainty in the model results. Whether or not the model outputs on SSB and R reflect in a general qualitative way the actual recruitment dynamics for the two populations is uncertain.

4.1 Considerations for the 2015 Stock Assessment

It is evident from the information presented about that differences in natural mortality and age at maturity for EBFT and WBFT can affect estimates of abundance, SSB, and R.

Several options are available to explore the sensitivity of these population descriptors.

a) Consider applying a common age at maturity and natural mortality to both stocks; or

b) Consider Atlantic bluefin tuna as a single stock for stock assessment purposes.

5. Estimates of Recruitment (R)

Although data are available since the 1950's, the current western bluefin tuna assessment uses catch at age data from 1970 forward (Anon. 2012). The earlier data was used in assessments up to the mid-1980s, but were dropped due to the lack of size data. Hester (1983) identified the period from 1960 to 1975 as having the poorest catch at age estimates. He also identified several sources of error and bias that would affect estimates of western spawning and recruit biomass such as the low rate of convergence of F on Z, aging errors, over estimation of catch of older fish and under estimation of the catches of young fish in some years. He further noted that stock trends for the early years are poorly estimated due to bias in the early catch at age data.

During the 2008 bluefin assessment (ICCAT 2008) a sensitivity analysis was conducted which involved estimating benchmarks and reference points using data from 1960 forward (case 4). The resulting S/R relationship indicates that the full range of SSB has provided 2 levels of recruitment. The first 14 years support high recruitment and the remainder supports low recruitment. The estimates of SSB/R are quite different from those shown in recent assessments which only include data from 1970 forward.

5.1 Considerations for the 2015 Stock Assessment

There are a number of issues associated with recruitment estimates depending upon the parameterization of the assessment and the starting point. Simply starting the assessment in a different year or decade can produce substantial differences in past and present recruitment numbers. Valid estimates of recruitment are essential to tracking the recovery of bluefin tuna and for the projections of SSB under a variety of catch levels. Although there have been numerous discussions and debate on the subject further investigations are warranted.

6. SSB and R time series estimates and the resulting SSB/R Models

One of the most critical factors associated with evaluating the recovery plan are projections of future stock status under different catch scenarios and management decisions is the two "equally plausible" SSB/R models for the western management area: the "two-line" model and the Beverton Holt model.

Estimated recruitment rates show that the EBFT and WBFT management units have very different temporal patterns. From 1960 to 1974, recruitment for WBFT was relatively high and showed no relationship with SSB. Conversely, from 1975 to the present, recruitment is relatively low, again showing no relationship with SSB. The relative recruitment for EBFT increased dramatically in the early 1980s, while the rate for WBFT declined in the 1960s and 1970s. These contradictory patterns infer either significant errors in the assessment models, or opposing shifts in the recruitment dynamics in the distributional areas of the early life histories. It would be unexpected that the opposing environmental shift would occur simultaneously in these two separated inland seas (i.e. Gulf of Mexico and the Mediterranean Sea). The estimates of recruitment rate trends suggest that the assessment models are not capturing the recruitment dynamics of the two populations. More to the point, the SSB/R relationship is unclear.

6.1 Considerations for the 2015 Stock Assessment

The rationale for using Beverton-Holt SR model is based on a group of 4 recruitments occurring at the beginning of a 42-year long time series which has noted bias in the CAA for the early years. A sensitivity analysis should be undertaken to provide some indication of the relative biases of the SSB and R estimates for the two populations due to the diverse assumptions.

The "two-line" and Beverton -Holt SSB/R models for the western management unit are artifacts of the VPA modelling approach which assumes that: (1) mixing is negligible; (2) misreporting of landings has been adequately addressed; and (3) that the very different population specific growth / maturation/natural mortality schedules can be applied to the aggregate landings of tuna within the two management areas (the landings comprising unknown but significant mixtures from the two populations). In the end it may be counterproductive to argue about the preference of the two "equally plausible" models, as they are both likely to be unrepresentative of the real population dynamics.

The present modelling approach, involving VPA estimates of SSB and R of the WBFT and EBFT management units, is unlikely to capture the recruitment dynamics of either the Gulf of Mexico or Mediterranean populations.

Appendix 7

CHAIR'S PAPER [WBFT-009B]

Acknowledging that the SCRS has developed a work plan for the 2015 western Atlantic bluefin tuna stock assessment, and that the SCRS will be developing a management strategy evaluation for the stock,

The Working Group recommends that:

In the medium to long term:

1. Given the fact that both the high and low recruitment scenarios are "equally plausible" and generate conflicting management advice for the Commission, the SCRS continue to develop new stock assessment models for western bluefin and explore alternative approaches.

2. All CPCs that participate in the western bluefin fishery make every effort to enhance their data collection efforts, and otolith and other biological sampling efforts, consistent with SCRS recommendations, including for those fisheries where mixing is known to occur between the western and eastern stocks.

3. Given the importance of continuing a dialogue between fisheries managers and scientists, the Commission consider when, in advance of the 2015 western bluefin stock assessment, to reconvene the Working Group.

In time for the 2013 Annual Meeting:

4. In order to increase the Commission's understanding of Atlantic bluefin tuna, that Contracting Parties make every effort to ensure that available electronic tagging data and otolith and other biological sampling data are submitted to the SCRS, and that Contracting Parties submit research plans to expand their tagging programs and otolith and other biological sampling, consistent with SCRS recommendations.

5. When collecting and submitting catch data, Contracting Parties shall make every effort to ensure that all sources of fishing mortality will be reported, including discards.

6. In consideration of the research proposal [WBFT-006], submitted by Japan, and the discussion that occurred within the Working Group, based upon SCRS advice, the Commission consider possible measures to support methodologies and sampling programs aimed at improving and developing fisheries-dependent and fisheries-independent abundance and recruitment indices, which would reduce uncertainties associated with the stock assessment, as well as detect possible stock collapse.

7. The SCRS provide the Commission with information on how long it would take the western Atlantic bluefin tuna stock to reach spawning stock biomass levels under different total allowable catch (TACs) that would allow for the testing of the stock-recruit relationship (i.e., to see if a significant change in recruitment results from allowing biomass to reach a certain level). This information should include different probabilities, e.g., 50%, 60%, etc.

8. In recognition of paragraph 17 of Recommendation 12-02, the Commission provide greater clarity and direction concerning its request that the SCRS prepare risk analyses in the form of decision tables.

8. The SCRS prepare a summary from the 2013 Bluefin Meeting on Biological Parameters Review and the Bluefin Tuna Stock Assessment Methods Meeting, including the prioritization of tasks that is to take place at the Stock Assessment Methods meeting, for presentation at the 2013 annual meeting.