INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC WORKING GROUP

2ND MEETING

REVIEW OF STOCK ASSESSMENTS

La Jolla, California (USA)
30 April-4 May 2001

Chair: Robin Allen

CHAIR'S REPORT

AGENDA

1. Welcome, introductions, consideration of agenda
2. Review of stock assessments:
    a. Methods
    b. Species composition sampling progress
    c. Results
        i. Yellowfin
        ii. Skipjack
        iii. Bigeye
        iv. Bluefin (paper only)
        v. Blue marlin
        vi. Albacore (paper only)
        vii. Others
3. Ecosystem modeling
4. Summary and recommendations
5. Other business
6. Adjournment

DOCUMENTS

A1 The surface fishery for tunas in the eastern Pacific Ocean in 2000
A2 Status of yellowfin tuna in the eastern Pacific Ocean
A3 Status of skipjack tuna in the eastern Pacific Ocean
A4 Status of bigeye tuna in the eastern Pacific Ocean
A5 Status of bluefin tuna in the eastern Pacific Ocean
A6 Status of albacore tunas
A21 Progress on sampling the eastern Pacific Ocean tuna catch for species composition and length-frequency distributions
A22 Interactive effects of climate and fishing on the tropical eastern Pacific pelagic ecosystem
A23 Some preliminary results from the bigeye tuna pilot-tagging project in the equatorial eastern Pacific Ocean
A24 A-SCALA: an age-structured statistical age-at-length analysis for assessing tuna stocks in the eastern Pacific Ocean

1. WELCOME, INTRODUCTIONS, CONSIDERATION OF AGENDA

The second meeting of the Scientific Working Group was held in La Jolla, California, USA, from April 30 to May 4, 2001. Dr. Robin Allen chaired the meeting. The participants are listed in Appendix 1.

Dr. Allen explained the general objective of the meeting, which was to review the stock assessments by the IATTC staff that were to be provided to the annual IATTC meeting in El Salvador in June 2001.

2. REVIEW OF STOCK ASSESSMENTS

Sampling and modeling

Sampling program for estimating species composition of the surface catch

Mr. Patrick Tomlinson described the recent results of this sampling program, implemented during 2000. He compared estimates of species composition in the purse-seine catch from the "standard" procedure, based on logbook and industry data, and the new "species composition" method that uses samples taken by IATTC staff when tunas are unloaded from the vessels that allows simultaneous estimation of the species composition and length-frequency distributions (LFD) of the landings of individual species of tunas caught by the surface fishery of the eastern Pacific Ocean (EPO).

The results obtained by the two procedures were not statistically different for either catch or LFD. Since differences among wells is the most important source of variation, increasing the numbers of wells sampled would increase precision of estimates, but cost and logistic implications would need to be considered.

It was pointed out that the species-composition method produces useful results, and should continue for a few years before deciding which procedure is the better. As the catch of small bigeye tuna was very low in 2000, it does not provide a good test of the methods for estimating species composition. It will be useful to see how the methods compare in years during which there are relatively more small bigeye tuna in the catch.

Modifications and additions to the A-SCALA model

Dr. George Watters described recent updates of the A-SCALA assessment model and associated methods, noting that many of them were the result of recommendations from the first meeting of the Scientific Working Group. The motivation for, and implementation of, changes for a new growth model (used for yellowfin and attempted for bigeye and skipjack), the facility for a Beverton and Holt stock-recruit relationship (used for yellowfin and bigeye), a new fecundity schedule (used for all three species), and for the development of criteria for model selection (used for yellowfin and bigeye) were explained.

The discussion centered on the relative merits of the model selection criteria developed, assumptions regarding the sex ratio, estimation of the sex ratio, mixing and movement, and the characteristics of the Beverton-Holt stock-recruitment relationship. In particular, it was suggested that the effect of other forms of the stock-recruitment relationships that would allow the maximum yield to be achieved at levels of biomass greater than 50% of the unexploited level be examined.

Results

Yellowfin tuna

Dr. Mark Maunder described assessment results for 2000, and explained changes to the yellowfin tuna version of A-SCALA. The time frame of the model is now 1980-2000, and it has been updated with surface fishery data for 2000 and Japanese (up to 1999) and Korean (1994-1997) longline data, and growth and standard deviation of length at age have been estimated.

In comparing results with previous assessments, it was pointed out that biomass estimates are slightly higher, that the estimates of recruitment are similar to those made last year, but the large recruitment estimated for 1998 is lower and the recruitment estimated for 1999 is slightly higher, and that the age-specific mortality rates are different, probably due to the difference in growth curves.

The overall results are similar to the previous assessments: the spawning biomass ratio projection is still above the average maximum sustainable yield (AMSY) level, the average weight of yellowfin in the catch is much less than the critical weight; recent recruitment appears to be less than during 1998 and 1999, but the estimates are preliminary, and the biomass is estimated to have declined in 2000. It was noted that the model would be sensitive to a stock-recruit relationship with steepness less than 1.

The usefulness of using a stock-recruitment relationship when the model response is relatively flat, the relative merits of the concept of virgin biomass, and AMSY and associated benchmarks were discussed. No specific immediate model modification recommendations were suggested, although the desirability of including tagging data for estimation of growth and exploitation and the merits of extending the analyses back to 1965 were discussed. The possible effect of a regime shift on the levels of recruitment and the relationship between stock and recruitment were also discussed.

Comments were made on ways of expanding the output to provide additional diagnostics and to facilitate comparisons with other assessments. Tables of estimated fishing mortality and population estimates were prepared for yellowfin and bigeye and made available to the participants.

Bigeye tuna

Dr. Watters described assessment results for 2000 and explained changes to the bigeye tuna version of A-SCALA since the bigeye meeting of October 2000. The model has been updated with surface fishery data for the second half of 2000 and Japanese (up to 1999) and Korean (1994-1997) longline data; a stock-recruitment relationship, a new growth model, and a maturity schedule have been introduced; the number of catchability parameters has been reduced; sensitivity analyses, using catch estimates from the new catch composition method have been performed, and model selection criteria (AIC and BIC) have been used to decide on a base case scenario.

Results show that: there has been a large change in catchability due to the expansion of the floating-object fishery since 1993; the average weight of a bigeye in the catch has been less than the critical weight since the expansion of the fish-aggregating device (FAD) fishery, more so during the mid-1990s than during 2000; recent recruitment (1999-2000) is the lowest since 1981, although, because they are very preliminary, there is uncertainty in these estimates; environmental effects explain a significant amount of variation in recruitment and the estimates of AMSY.

Dr. John Hampton presented the preliminary results from the Pacific-wide stock assessment of bigeye, and noted that future work would include extensive sensitivity testing. In comparing his model with A-SCALA, it was noted that his model contains specific spatial structure with four separate regions in the northeastern, northwestern, southeastern, and southwestern Pacific, uses tagging data, and uses catch, effort, and size-composition data from 1962 to 1999. Natural mortality is internally estimated, and the model does not use environmental data directly, although the longline effort used in the model is standardized using environmental factors. Trends in relative biomass and recruitment are similar to those of the base case of A-SCALA, but estimated fishing mortality is less for the Pacific-wide model. The model predicts net movement from the southwestern to the southeastern Pacific, contingent on a tag-reporting rate for the eastern Pacific that is much less than that for western Pacific. It was considered that the results of this model are useful, but at this stage it is premature to use them alone. Rather, results should be viewed in conjunction with those from A-SCALA.

In the discussion Dr. Naozumi Miyabe provided recent estimates of Japanese longline CPUE, which tended to confirm the estimate that a relatively large group of bigeye is currently being recruited to the longline fishery, but these estimates indicate that the recruitment is not great as the October 2000 A-SCALA estimates suggested. It was noted that the corresponding estimates of recruitment from the current base case are less than those of the October 2000 estimates.

No specific recommendations were made for immediate modification of the model, but it was agreed that the sex ratio data should be reanalyzed with respect to the growth and mortality schedules. Comments were also made on ways of improving the output to facilitate comparisons with other assessments and on presenting tables of raw data (mainly catch and intermediate results) used for the assessment, and on the

lack of data from artisanal longliners from Central America and Ecuador that target bigeye. It was recommended that the time period analyzed be extended to before 1981.

Mr. Kurt Schaefer presented preliminary results of the bigeye tuna pilot-tagging project initiated in 2000. He discussed results of conventional and archival tag recoveries, including movement, behavior, and habitat selection. There was a discussion of the usefulness of using such data for the estimation of abundance of FADs, coupled with observed residence time of bigeye at FADs, to evaluate the catchability of bigeye in the surface fishery. It was concluded that the knowledge of movements, mortality, growth, and behavior derived from tagging studies is fundamental to accurate stock assessments. The view that multiyear tagging studies would be needed to estimate these life history parameters for assessment was supported.

Skipjack tuna

Dr. Maunder presented a preliminary assessment of skipjack tuna obtained by using A-SCALA. The main differences between the skipjack assessment and those for yellowfin and bigeye is that monthly, rather than a quarterly, time steps were used and that the time frame for skipjack is 1981-1999. Two assessments were presented, with different initial conditions. No underlying stock-recruitment model was employed in the assessment. Both assessments produced estimates of large biomasses and corresponding low recruitments.

Results indicate that growth overfishing of skipjack is highly unlikely because estimates of year-class biomass in an unexploited population (given the natural mortality rate used) indicate that biomass is roughly constant from ages of about 9 through 20 months. Results indicate that recruitment overfishing is unlikely because the data do not show any obvious relationship between recruitment and spawning stock size over the range of estimated spawning levels.

Most of the catch of skipjack in the EPO comes from sets on floating objects and unassociated schools. The catch of skipjack associated with FADs has increased since 1993. It was found that biomass and recruitment are highly variable and may be driven by environmental changes; that the 2000 recruitment was quite low (although the estimate is very preliminary); and that biomass is quite large, while exploitation rates are relatively low.

The large biomass estimated by the model and the low exploitation rates and the difficulty of distinguishing between catchability and recruitment effects were discussed. Comments were also made on the growth schedule used and on the relative lack of information on benchmarks based on the spawning biomass ratio, given that recruitment and the environment drive the model.

Discussion of the two assessments was concluded by reiterating the preliminary nature of the results.

Bluefin tuna

A background document, with updated catch and effort data, referred to earlier staff analyses of the status of the bluefin stock, and a more recent cohort analysis presented at the December 2000 meeting of the Interim Scientific Committee for the North Pacific was distributed. Mr. Harumi Yamada reported further on the latter analysis of the population size of this species obtained with a tuning virtual population analysis.

Albacore tuna

A background document reviewing albacore research was distributed. It was noted that the IATTC staff have not carried out research on this species for some time, but keeps track of recent developments in case any requirements for international management arise.

Blue marlin

Dr. Michael Hinton outlined the cooperative stock assessment work that was planned to for this species by scientists from the IATTC, the Secretariat for the Pacific Community, the U.S. National Marine Fisheries Service, and the National Research Institute of Far Seas Fisheries of Japan.

3. ECOSYSTEM MODELING

Dr. Robert Olson presented a paper dealing with the interactive effects of climate and fishing on the tropical EPO pelagic ecosystem. Ecosystem model development and simulations for 36 components of the ecosystem were carried out, using the *Ecopath* with *Ecosim* approach. Trophic paths among exploited species (*e.g*. large tunas), functional groups (*e.g*. flying fish, seabirds, and sharks), sensitive species (*e.g*. marine turtles and dolphins), and ontogenetic groups (*e.g*. sharks, billfishes, and others), environmental forcing at El Niño-Southern Oscillation (ENSO) scales, and fishing were included in the analyses.

Results showed that applying realistic physical forcing to a complex ecosystem model provided insight into the behavior of the ecosystem and the effects of bottom-up processes, such as ENSO, and top-down effects of fishing on the middle and upper trophic levels.

Discussion centered on the relative merits of these complex ecosystem models to evaluate fisheries impacts and management actions. It was suggested that an analysis be conducted assessing alternative levels of complexity and aggregating and disaggregating various groups. It was agreed that at this stage these models provide a useful tool for thinking about ecosystem interactions in a rigorous manner and for guiding future research, but are not suitable as a basis for providing specific management advice.

4. SUMMARY AND RECOMMENDATIONS

Diagnostics

Some of the attendees expressed concern over the complexity of the models and the increased difficulty of interpretation of the results. It was suggested that ways to reduce the number of parameters in the models be explored and their behavior be tested with known data sets. It was pointed out that increasing the number of parameters adds flexibility to the approach. While some testing on test data sets had been carried out, fully testing the model's behavior under a wide variety of circumstances was currently limited by computing capacity.

Proposals for diagnostic measures included providing more intermediate results, various alternatives for phasing estimates of the parameters, and descriptions of the likelihood surfaces near the maximum.

The issue of movement of tunas was discussed, and the incorporation of spatial dynamics into the models was suggested. For this it was agreed that more tagging was desirable, but it was also pointed out that inferences regarding movement can be made from combined analyses of length-frequency and CPUE data.

The staff's advice to the Commission

Dr. Allen prefaced this discussion by saying that all the advice would be made in the context of the models, taking account of the sensitivities to alternatives and the uncertainty of the estimates as reflected by their confidence intervals.

There was some discussion of (1) the IATTC's goal of maintaining the stocks of tunas at the levels that would produce the AMSY and (2) the IATTC's efforts to reflect the precautionary approach contained in FAO Code of Conduct. Dr. Allen pointed out that the IATTC's management of the fishery had always been rather cautious, and referred to the expansion of the yellowfin fishery in the late 1960s. Further understanding of some aspects the dynamics of the stocks could be achieved only if they were exposed to a wide range of fishing mortality, including those greater than those corresponding to the AMSY.

Bluefin and albacore

Dr. Allen said that the staff would not make any recommendations for management measures for either of these species.

Yellowfin

Dr. Allen said that the biomass of yellowfin is at a relatively high level following strong recruitment during 1998. These fish are about to pass through the purse-seine fishery. The strong recruitment has

allowed catches above the AMSY without depressing the stock size. The recruitment after 1998 has been about average, and it is likely that catches will decline during the second half of 2001. Spawning biomass is above the level at which AMSY would be achieved, and the current fishing effort is estimated to be 84% of the effort that would provide the AMSY. However, the yield curve is fairly flat at its maximum, and there would be little to gain from allowing effort to increase to the AMSY level. Furthermore, if there is a stock-recruit relationship with a steepness less than 1, the ratio of the current effort to that which would produce the AMSY would be greater. Thus the current fishing effort should not be allowed to increase.

Skipjack

Dr. Allen said that the advice would be prefixed by the comment the analysis was preliminary. Skipjack had recently become more vulnerable to purse-seine gear with the development of the FAD fishery. Catches to date do not appear to have any significant effect on the population, and changes in biomass seem to be largely driven by recruitment. In contrast to the situation for yellowfin and bigeye, the yield per recruit and total yield is not much affected by the size of fish in the catch. There would be no difficulty in sustaining the current fishing effort, but the catches would not be as great as those of 1999 and 2000 unless there is unusually large recruitment, such as that of 1998.

Bigeye

Dr. Allen said that it is difficult to deal with bigeye because it has been highly vulnerable to the purse-seine fishery only since about 1994, and because the recruitment of bigeye has been highly variable during that period. The biomass of bigeye is presently dominated by the large recruitment that occurred in 1997 and the first quarter of 1998. The estimated biomass peaked during 2000, is declining, and is expected to continue to do so for the next two years, given the very weak recruitment that has apparently occurred since the second quarter of 1998. The remaining fish from the recruitment of 1997 and early 1998 are becoming less vulnerable to the purse-seine fishery, and will soon be taken mostly by the longline fishery. The level of fishing effort required to produce the AMSY is estimated to be 90% of the current level of effort, using the base-case estimates. However, several plausible alternatives provide both larger and smaller estimates of the level of effort which would achieve the AMSY; in particular, estimates in which the steepness of the stock-recruit relation was not constrained to be significantly less than 1 show that the current fishing effort is less than the effort which would produce the AMSY. Despite its uncertainty, the analysis does not suggest there is any particular problem that requires a reduction in effort; however, the effort should not be allowed to increase beyond current levels.

Some participants suggested that the current fishing effort should be lowered to the estimate of the level that would produce the AMSY, that catches of small (<60 cm) bigeye should continue to be monitored, and that catch quotas which depended on the estimated recruitment of these fish be considered.

It was emphasized that the assessment of bigeye was more difficult and uncertain than that of yellowfin. The purse-seine fishery has changed rapidly since FADs were introduced, and the recruitment has apparently fluctuated considerably. The estimates of the life history parameters are not as reliable as those for yellowfin. Consequently, there should be a more cautious attitude toward this fishery. Also, it is possible that there are interactions between bigeye of the eastern and western Pacific.

Ecosystem modeling

Participants noted that this work was stimulated, in part, by the IATTC staff's work on bycatch. Dr. Allen said that the Commission would be advised of the research into ecosystem modeling and the fact that it is useful as a tool to assist the consideration of ecosystems and environmental changes.

Appendix 1.

INTER-AMERICAN TROPICAL TUNA COMMISSION
COMISION INTERAMERICANA DEL ATUN TROPICAL

SCIENTIFIC WORKING GROUP
GRUPO DE TRABAJO CIENTIFICO

2nd MEETING- 2ª REUNION

La Jolla, California, USA
April 30-May 4, 2001 – 30 de abril-4 de mayo de 2001

ATTENDEES – ASISTENTES

MEMBER COUNTRIES – PAISES MIEMBROS

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Asociación de Exportadores de Pesca Blanca

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Secretariat of the Pacific Community (SPC)

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RUSSELL NELSON
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