RESULTS OF A REVIEW OF THE U.S. BLUEFIN TUNA LARVAL ASSESSMENT WITH A BRIEF RESPONSE

W. J. Richards
NMFS, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida, U.S.A.

SUMMARY

A review of bluefin tuna larval assessment was conducted by an independent panel. The panel concluded that the assessment was valid, but noted several areas of concern which were addressed in a brief response.

RESUME

Un examen de l'évaluation des larves de thon rouge a été effectué par un comité indépendant. Ce comité a conclu que l'évaluation était valide, mais a noté plusieurs zones d'inquiétude qui ont été étudiées dans une brève réponse.

RESUMEN

Se efectuó una revisión de la evaluación de larvas de atún rojo por un grupo de expertos independiente. El grupo llegó a la conclusión de que la evaluación era válida, pero observó varios sectores de preocupación que se trataron en una breve respuesta.

INTRODUCTION

Bluefin tuna larval assessments have been made for many years following the results of a 1973 Cuban ichthyoplankton survey of the Gulf of Mexico. From that survey Richards (1976) calculated an index of larval abundance and spawning stock size. In subsequent years ichthyoplankton surveys have been conducted chiefly by the Southeast Fisheries Center in the Gulf of Mexico and the results reported to ICCAT or in the scientific literature (Richards 1977; Richards and Potthoff 1980; Richards, Potthoff, and Houde 1981; Sherman et al. 1983; Richards et al. 1984; Kelley et al. 1986; McGowan and Richards 1986; Richards 1987; McGowan and Richards 1987; McGowan and Richards in press; and Richards et al. in press). As the importance of the resulting indices on bluefin stock size increased it was decided to convene an independent panel to review this research. The panel consisted of Drs. Michael Sissenwine and Kenneth Sherman of the Northeast Fisheries Center, Dr. Richard Deriso of the Inter-American Tropical Tuna Commission, and Dr. Edward Houde of the University of Maryland. The panel was provided background information several weeks prior to its meeting in Miami on March 22-23, 1989. The following is the unedited report of the panel followed by a brief response to each of the points raised in the panel report.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northeast Fisheries Center
Woods Hole, Massachusetts 02543

April 17, 1989

MEMORANDUM FOR: F/SEC - William Richards

FROM: F/NECx1 - Michael Sissenwine

SUBJECT: Bluefin Tuna Larval Assessment

Enclosed is the panel's report on the bluefin tuna larval assessment program. The report has been reviewed by all of the panel members. It confirms the importance of the larval surveys, but it notes several problems that must be resolved. I hope the report proves useful.

On behalf of the panel, let me thank you and your colleagues for your hospitality while we were in Miami.

c: R. Deriso
E. Houde
K. Sherman

REVIEW OF BLUEFIN TUNA LARVAL ASSESSMENT

March 22-23, 1989
Miami Laboratory
Southeast Fisheries Center

The review panel members were R. Deriso, K. Sherman, E. Houde, and M. Sissenwine. The review panel was provided several documents which describe the bluefin larval assessment project and were given an oral briefing by M. McGowan, University of Miami, and W. Richards, SEFC. Several other SEFC staff were present during portions of the review. The comments below were prepared by the review panel members.

Past Results

1. There is a serious data-management problem. In spite of the fact that larval bluefin tuna surveys have been ongoing for many years, the data is not readily accessible to stock assessment scientists and other potential users. Some computerized data files exist, but they are unaudited and extracts--software is lacking. The current situation is unacceptable if the data are to be defended in an international stock assessment arena.

2. Larval bluefin tuna spawning biomass indices have been questioned because they are based on a relatively small number of larvae collected during each year. The panel noted that the reliability of an index is not indicated by the number of larvae collected. In fact, the number of larvae that have been collected is not unreasonable relative to VPA biomass estimates and available estimates of demographic parameters. The panel would feel more confident about this conclusion if samples of spawners could be obtained upon which to base fecundity, sex ratio, and maturity estimates.

3. Apparently, neuston net samples have been collected on all surveys. Most of these samples have been processed. The additional cost for processing the remaining samples is not prohibitive (much less per sample than for bongo nets). Since neuston nets appear to be an effective sampler of bluefin larvae, neuston data should be used for a second index. They should be evaluated as an alternative to bongo nets. Since neuston net samples contain relatively large numbers of larvae, length frequency distributions may be sufficient to derive estimates of apparent mortality rate.

4. Growth information about larval bluefin tuna is necessary for interpretation of the survey data. The current analysis of the data uses the mean age at length derived from summarized results of a study of otolith microstructure. It appears that the existing data on size at age is very variable. Growth rate may vary over time. Therefore, it is probably necessary to repeat the study of otolith microstructure.

5. The seasonal timing of surveys appears to have shifted (to later in the spawning season) over the years. The potential effect of this shift on spawning biomass indices should be examined. One option is to calculate an index based on the same area/time strata each year, although this is not a satisfactory alternative to sampling throughout the spawning season in the future.

6. The mesh size used in bongo nets has changed from 0.505 mm to 0.333 mm during the survey time series. The effect of the change should be evaluated and taken account of in the index. Criteria for making adjustments in the index could be derived from comparison of catches by the two meshes. (They were used on opposite sides of the same bongo net in some tows.) There is also an extensive literature on size retention by the two meshes.

7. The panel was not convinced that there is a strong relationship between the loop current and larval abundance. Before proceeding with further fieldwork to establish the

relationship, a more rigorous analysis of the existing data is necessary.

Future Surveys

1. The Delta distribution described by Pennington is used to calculate the standard error of the sample mean within surveys. Although the variances are not unusually large for larval surveys (in fact they are smaller than is typical of larval surveys in the Northeast), the formula for calculating the variance (in Pennington's paper) should be examined to determine the primary source of error (i.e., within the samples with positive catches or in the fraction of positive catches). This might help to determine the relative merits of increasing the size of the sampling unit (which may reduce the number of zero catches). Note, the neuston net has a larger sampling unit.

2. The panel was skeptical that precision could be improved very much by stratification. Nevertheless, the possibility should be evaluated quantitatively by post-stratification of existing data, instead of speculating about the merits of stratification based on superficial visual inspection of the data.

3. The panel recommended against pursuing "real time" or "dynamic" stratification schemes that used hydrographic features to define strata. The premise of stratifying on hydrographic features is that a high proportion of the larvae are in these features. While there is evidence that the density of larvae near the loop current frontal region is higher, it is not enough higher to account for a high proportion of the total population of larvae. The fact that the broad-scale systematic surveys catch about the expected number of larvae (i.e., back-calculated spawning biomass estimates are in rough agreement with the VPA) argues against stratifying on small-scale features. There are also logistic reasons that the panel recommends against stratification on dynamic hydrographic features (e.g., ability to detect the loop current during warm months, requirement for additional sea days).

4. In theory, sampling should be random in time (over the entire course of the time window when larvae are vulnerable to the sampling gear), as well as in space. In practice, this means there should be multiple evenly spaced (i.e., systematic sampling) surveys throughout the larval bluefin tuna window. The current hypothesis is that the window is from April 15 to June 15. The historical data that is the basis of this hypothesis should be summarized in a background document (e.g., NOAA Technical Memorandum).

Depending on how convincing the historical data is, it may be necessary to conduct some sampling outside of the window to test the hypothesis.

5. Even if the hypothesis about the window for bluefin tuna larvae is correct, there is a serious problem, in that surveys have not been conducted during the later part of the window, when spawning is known to occur, nor are they planned. The panel recommends that appropriate sampling be conducted to overcome this problem.

Calculations of Indices

1. To date, the methods that have been used to calculate indices of abundance (and absolute estimates of spawning biomass) have been ad hoc. They are crude at best, and sometimes they are incorrect. In the future, formal derivations or literature citations should be given for the methods used to calculate indices.

2. The mortality rate of larvae affects the indices in two ways. The value of the mortality rate scales the index relative to absolute biomass. Variability in mortality is a major source of variability in the indices (which is not accounted for by the within-survey standard errors).

3. The panel felt that the mortality rate that has been used is too low. A better estimate should be selected after a thorough literature review (note papers in press by Houde and by Morse, both in Fishery Bulletin 87(3)), and examination of pooled larval length frequencies using better growth data. If the number of larvae collected in each survey is sufficient (it might be for the neuston net samples), annual estimates of mortality should be used.

4. The 1987 larval index is overestimated, since it overweighted samples that were collected for very small "strata" specified by a hydrographic feature.

General Comments

1. There is a long history, and widespread application, of ichthyoplankton surveys as an assessment tool. The approach is often controversial. The best results are obtained when there are time series of intensive sampling, with concurrent collection of detailed biological data (e.g., egg production method of the La Jolla Laboratory, NMFS).

2. In spite of several problems with the larval bluefin tuna index, the results are consistant with other sources of information, including the VPA. To the extent that the VPA depends on the larval index for tuning, the former can not

be used as verifying the latter. But the VPA is tuned on other indices in addition to the larval index, so agreement between the two might provide weak verification. Unfortunately, in recent years, the larval index is the only source of information on current abundence.

3. Monte Carlo simulation should be used to investigate the robustness of the VPA relative to the larval index.

4. Even if the overall VPA is robust relative to the larval index, it is almost certain that the current year assessment of the spawning population is heavily dependent on the larval index (i.e., in the most recent year it was the only index used to tune the adult biomass). This means that the index should be as sound as possible.

5. Unfortunately, even under the best of circumstances, the larval bluefin tuna index is not likely to be very precise. There are many sources of uncertainty that are unqualified (e.g., variability in fecundity, egg mortality, losses of larvae from the survey area, areas of spawning outside of the area). It seems unlikely that the true coefficient of variation (cv) of larvae bluefin tuna indices is better than about 100%, and it could be much larger. It should be noted that the true variance of other indices (e.g., CPUE data) used to tune VPAs may also be underestimated by calculated cv's.

Nevertheless, the panel acknowledges the utility of the larval bluefin tuna index as an important component to a comprehensive assessment strategy for following trends in bluefin tuna abundance, contingent on some tightening of the survey operations, sample processing, and improvements in quality control and accessibility of the survey data.

6. Ecological studies of larval bluefin tuna should be evaluated based on their scientific merit (which may be considerable), independent of the assessment need for an index. Ecological studies could be useful to detect shifts or changes in distributions that relate to dependence on environmental conditions, density-dependent effects in growth, and make inference about behavior and distributions of spawners.

RESPONSE TO THE REPORT

Following the format of the preceding report I have prepared the following response to each point to serve as a summary of progress to date.

Past results

1. Efforts are continuing to improve the data base. The data base is not restricted to bluefin, but includes data from the entire SEAMAP data base (the SEAMAP data base is a cooperative State-Federal Gulf of Mexico biological sampling program which includes plankton sampling) with multiple users. A complete data base restricted to bluefin is being prepared at the present time.
2. It was determined that studies resulting in more harvest of adults for the purpose of obtaining better estimates of biological parameters was not warranted because of the small spawning stock size.
3. Neuston samples are being processed and an index based on them will be developed in 1990.
4. Additional larval samples were collected in 1989 for otolith analysis.
5. Survey times are based on ship availability, and other factors, especially shrimp research needs, impact available ship time.
6. A few samples from the other bongo net from previous cruises where both meshes were used are still extant and they will be analyzed and compared.
7. Analyses of environmental data is underway and some results will be available in 1990.

Future Surveys

1. This will be investigated.
2. This will be investigated.
3. There are no plans for dynamic stratification of sampling until more evidence is accumulated to warrant this approach.
4. We are constrained by ship time availability especially in June because of shrimp research needs. A summary document will be prepared which will outline the variation in survey time and scope.
5. As mentioned in No. 4, shrimp research begins in June and vessels are not available. However, some plankton sampling is done in inshore waters as part of the shrimp research and these samples have yielded a few bluefin larvae which will be included in the data base and always have been included in the indices. In late June, 1989, a limited survey using neuston nets was conducted to determine if bluefin larvae were present in offshore waters in the Gulf of Mexico.

Calculations of Indices

1. The methods have been documented, but not on a consistent basis each year. More formal approaches will be used in the future and a formal review of past indices is in preparation.
2. This problem is discussed in the papers listed in the literature citation of this report.
3. Because of so few specimens this problem has been recognized and efforts are continuing to deal with it. In the 1989 survey bongo tows and a second neuston tow were preserved in alcohol for otolith preservation for aging studies and the neuston tows may yield enough specimens for mortality rate estimates.
4. The 1987 index was adjusted for samples taken in a small area near the edge of the Loop Current and was not overestimated since one index was prepared without those data and another prepared using those data. Both indices and all the data used were presented in the report to the review panel.

General Comments

These are all recognized and concurred with by the investigators.

CONCLUSIONS

I wish to thank the panel members for their candid comments and suggestions. All of their suggestions will be acted upon within the limits of the available data. It must be realized that the Gulf of Mexico is oceanographically dynamic and that the adult bluefin spawners are probably reacting to variable conditions coupled with reduced population size compounds the efficacy of increased precision.

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