WOODS HOLE LABORATORY REFERENCE DOCUMENT NO. 87-12

REPORT OF THE FIFTH

NEFC STOCK ASSESSMENT WORKSHOP

(FIFTH SAW)

APPROVED FOR DISTRIBUTION

(APPROVING OFFICIAL)

Jan 28, 88

(DATE)

NATIONAL MARINE FISHERIES SERVICE
NORTHEAST FISHERIES CENTER
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1. INTRODUCTIONS

1.1. OVERVIEW

The fifth in a series of stock assessment workshops was held at the Swope Center of the Marine Biological Laboratory in Woods Hole, Massachusetts November 16-20, 1987. The workshop had the same general goals as previous ones (NEFC 1986a, 1986b, 1987b). The reports of this series of workshops are designed to serve as the best available scientific advice on the status of the stocks for use by various groups with fishery management responsibilities. The annually produced document "Status of the Fishery Resources Off the Northeastern United States" provides a more general description of the status of each of the stocks in this region. (NEFC 1987a). In the present report, a source document is identified for each assessment where available for further information.

1.2. REVIEW OF TERMS OF REFERENCE

The participants in the previous SAW recommended several terms of reference for the 5th SAW (NEFC 1987b). These terms have been adjusted somewhat in the intervening months; the final terms of reference were:

1.2.1. Management Terms of Reference

1. Review the status of stocks of northern shrimp, sea herring, and bluefish.

2. Review recent estimates of target and current spawning stock biomass per recruit for stocks managed under the NEFMC Multispecies FMP.

3. Review research directions for estimating squid availability.

4. Review research directions for determining the effects of temperature and fishing activities on mackerel availability.

5. Review research directions for determining the properties of "trigger mechanisms" for management of summer flounder, and possibly bluefish.

1.2.2. Scientific Terms of Reference

1. Review methods for assessing the status of estuarine winter flounder, sea herring, and black sea bass stocks.

2. Review properties of spawning stock biomass per recruit as a basis for management.

3. Review current status of research on fishing gear efficiency and control (conservation engineering).

1.2.3. Generation of Stock Assessment Information

1. Develop dates and recommend Terms of Reference for the 6th SAW.

2. Develop preliminary scientific Terms of Reference for subsequent SAWs.

3. Review Research and Management priorities of the Mid-Atlantic FMC, the New England FMC, the Northeast Regional Office, the several states, and the Northeast Fisheries Center.

1.3. IDENTIFICATION OF WORKING PAPERS

Several working papers were distributed to participants, as listed in Appendix 2. These are cited as WP#-SAW5, indicating Working Paper (WP) number # for the 5th SAW. One paper was a draft from which the workshop report would be constructed, and it included drafts of some of the reports to be presented (WP9-SAW5). Some papers prepared for other purposes were relevant to specific topics to be discussed. Others were manuscripts prepared only for review or use during the meeting; these latter are not publications and should not be cited without prior reference to the present report.

1.4. REVISION AND ADOPTION OF AGENDA

A revised agenda was distributed, reflecting several additions and adjustments made since the preliminary version was distributed in September to meet changes in participation and in priorities. It is included as Appendix 1 of this report.

2. COASTAL AND ESTUARINE FISHERY RESOURCES

2.1. UPDATED NORTHERN SHRIMP ASSESSMENT

Source Document: Northern Shrimp Technical Committee. 1987. Gulf of Maine Northern Shrimp, 1987. Report presented to Northern Shrimp Section, Atlantic States Marine Fish Commission, Oct. 23, 1987, 15pp.

2.1.1 Status of the Resource

Aspects of the distribution and life history of Gulf of Maine northern shrimp were presented. Landings declined to very low levels in the late 1970's but have since increased, and reached 4,600 mt during the 1985-86 (DEC - MAY) season; the 1986-87 season total was 5,200 mt. Effort, estimated as the number of trips, increased by 40% during the 1987 season. Larger shrimp (females) account for the bulk of the landings in Maine where fishing is most intense earlier in the season, whereas a considerable quantity of smaller shrimp (males) are landed by Massachusetts vessels later in the season. This stock has been managed under the auspices of the Atlantic States Marine Fisheries Commission; management has primarily involved seasonal closures and mesh size regulations. Under current ASMFC policy the fishing season is limited to a period not to exceed 183 days between December 1 and May 31.

Data collected during the R/V GLORIA MICHELLE summer survey provide the most reliable information on the current condition of the resource, although the NEFC autumn survey time series provides the best historical perspective. NEFC autumn survey abundance indices show a general increase in stock size from 1982 until 1986. Summer survey index values for 1987 were approximately 30% lower than in 1986. A strong 1982 year-class has supported the fishery during the past several years; this year class has now passed through the fishery and subsequent year-classes appear to be much weaker. Total mortality (Z) rates on age 2+ shrimp increased from insignificant levels in 1985 to 0.53 and 0.69 in 1986 and 1987 as a result of increased natural and fishing mortality on the 1982 year-class. Natural mortality is thought to increase in the third and fourth year of life of these shrimp.

Management recommendations from the Northern Shrimp Technical Committee for the 1987-88 season were to prohibit fishing after March 31 in order to reduce fishing mortality on small shrimp. Action taken at the October meeting of the Northern Shrimp Section of the ASMFC was to allow fishing through the end of May, but to require use of a 2 inch cod end mesh size in April and May. Also, starting this winter, the 1/4 inch tolerance on cod end mesh size has been removed, thus requiring use of 1 3/4 inch mesh trawls.

2.1.2 Discussion

Questions were raised concerning (1) estimates of effort (number of trips) which ignore aspects of fishing power, such as the number of trawls used by individual vessels, (2) trap fishing versus trawl fishing trips, and (3) possible effects of reduced inshore bottom temperatures on summer survey results. It was recognized that total effort estimates currently in use do

not account for recent trends toward larger vessels and double trawl rigs. Trap fishing trips are included in effort estimates, but trap fishing remains an insignificant component of the fishery. Bottom temperatures are related to research vessel catch rates. During GLORIA MICHELLE summer survey cruises fewer shrimp are caught in areas where bottom temperatures reach 7-8°C; 5-6°C seems to be optimum. Sampling effort during the summer survey appears to cover the distributional range sufficiently to render effects of temperature related shifts in distribution insignificant.

2.2. REVISED ATLANTIC HERRING ASSESSMENT

Source Document: Fogarty, M.J., and S.H. Clark. 1983. Status of herring stocks in the Gulf of Maine region for 1983. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-46, 33 pp.

2.2.1. Status of the resource

Trends in Landings

Coastal Maine nominal catches averaged 57,000 mt during 1950-1965, subsequently declining to an average of 23,000 mt during 1966-1979. Nominal catches increased to an average of 45,000 mt during 1979-1981 with recruitment of a succession of relatively strong year classes (1976, 1977, 1979). The 1981 yield of 48,200 mt was the highest since 1963. The 1986 nominal catch was 15,500 mt, a slight increase relative to the 1985 level of 13,900 mt (Table 2.2.1.). Catches in the fixed gear fisheries (stop seines and weirs) have declined dramatically since 1981, accounting for just 10% of the coastal Maine landings in 1986 (Figure 2.2.1.). The fixed gear fisheries traditionally have dominated landings along the coast of Maine. The general reduction noted since the early 1980's appears to be related, in part, to reduced availability to the fixed gear fisheries.

Landings in the western Gulf of Maine (Jeffreys Ledge) mobile gear fishery in 1986 of 17,000 mt (including catches from NAFO statistical areas 5Zw and subarea 6) represented an increase relative to the 1985 level, but remained below the 1975-80 mean level of 22,900 mt (see Table 2.2.1., Figure 2.2.2.). Market constraints have affected catch levels in the fishery for adult herring in the western Gulf of Maine.

Relative Abundance Indices

Trends in relative abundance based on NEFC spring inshore and offshore research vessel surveys indicate an increase since 1984 (Figure 2.2.3.). NEFC survey indices, however, remain below levels observed during the late 1960's. It should be noted that a change in survey gear (otter trawl doors) was initiated in 1985; the effects of this change on the herring abundance index can not currently be evaluated. The NEFC survey appears to track general trends in herring abundance. Spring survey catches in the Southern New England - Mid-Atlantic region are dominated by larger fish on the overwintering grounds. In contrast, catches in the Gulf of Maine region are dominated by the younger age groups.

A standardized beach seine survey has been conducted in selected Massachusetts bays and estuaries since 1976 (A. Howe, MDMF, personal communication). Catches of YOY herring have been recorded in this survey since 1978. Indices of herring recruitment have been derived using catches in Cotuit and Lewis Bays for this time period (T. Currier, MDMF, personal communication). This survey indicates relatively strong year classes in 1977, 1981, 1983, and 1985 (Figure 2.2.4.). These observations are consistent with information from the commercial fishery.

Virtual Population Analysis

A preliminary virtual population analysis was undertaken to provide estimates of stock size and fishing mortality rates for the Gulf of Maine herring complex. Work is currently being conducted to re-evaluate the catch-at-age matrix and to provide variance estimates for the catch-at-age. Accordingly, the results presented here are provisional. The MDMF seine index was used to provide measures of year class strength for the 1983-85 cohorts. Terminal fishing mortality rates were derived from these estimates of year class size; terminal fishing mortality rates were set for all other ages assuming an historical partial recruitment vector. Stock biomass (ages 2 and older) for the total Gulf of Maine region (coastal Maine and western Gulf of Maine) averaged 270 thousand mt during 1965-1969 but declined sharply by 1971 (Figure 2.2.5.). Recruitment of the strong 1970, 1976, and 1977 year classes resulted in a partial recovery from these low levels. Stock biomass subsequently declined to low levels during the early 1980's. Recruitment of the 1981 and 1983 year classes has since resulted in increased biomass levels although biomass levels remain well below levels observed during the latter 1960's. Trends in population size derived from virtual population analysis are generally consistent with NEFC biomass indices from trawl surveys.

2.2.2. Discussion

An overview was presented of historical landings by gear type and area, survey abundance indices, virtual population analysis (VPA), and reviews of progress on calculating variance estimates for catch at age data and stock recruitment forecasts. It was noted that in recent years that Maine herring landings taken by fixed gear (i.e., stop seines and weirs) have sharply declined, whereas purse seine landings have increased. This change is significant since landings by fixed gear have been assumed to be related to fish abundance. Thus, it was suggested that different fishery independent analysis (i.e., larval and egg surveys) may be required to help determine year class strengths.

Spring bottom trawl survey abundance indices have been increasing in recent years. Although these data have not been analyzed for effects of changing doors in 1985, it was noted that the recent increases were begun in 1984. Since 1968 the 1970, 1976, and 1977 year classes were the dominant contributors to the survey abundance estimates. The survey abundance index (numbers) was used to tune the VPA.

Simulations were conducted using an age structured model. A Shepherd stock-recruitment (S-R) model was fitted to herring S-R data to model the recruitment dynamics. Empirical estimate of variability in recruitment were

incorporated in the simulations assuming a log normal distribution of residuals from the S-R curve. Stochastic simulations over 30 years of the model indicated that fishing at a constant F=0.4 with a juvenile fishery would maintain a stable fishery. The model showed stable behavior at F up to 1.0, but not beyond given the spawner-recruit curve estimated. Without a juvenile fishery, the model indicated that sustained catches over 60,000 mt at all three F levels can be maintained. Probability distributions of recruitment with and without a juvenile fishery indicated that the probability of a stock collapse is increased at higher levels of F with a juvenile fishery.

The main component of the research to be completed is the estimation of the variance of the catch at age data. Preliminary results of the analysis using the 1986 Western Gulf of Maine data indicated that the variance was somewhat lower compared to earlier studies conducted by Brennan and Palmer (1978) on mackerel. The implication of these preliminary results is that VPA stock sizes will have variance estimate which are of the same order of magnitude as the catch-at-age estimates. It is probable that terminal F values will have a larger effect on the variance in stock size estimates in the latter years. The results presented were preliminary, and several of the calculations of the variance had not been completely validated.

The resource status appears to be improving due to reduced fishing pressure in recent years and moderately good recruitment of the 1981 and 1983 year classes. Furthermore, the stock appears to have recovered from low levels observed in the early 1980's.

Most of the discussion focused on the sampling design used to calculate the variance estimates and effects of variability of catch at age on assessments and management. It was noted that the data were treated as a cluster sampling problem. For those months with catch data but with less than 2 length samples, nearest neighbor data (i.e. data from neighboring months or areas) were applied to the undersampled catch.

Two points were raised concerning the relatively low coefficients of variation. One was a comparison of these results to preliminary results obtained for several groundfish species. The variance estimates for the latter were much higher and were in part attributable to sampling. Groundfish samples are taken in several ports from a large number of different vessels, whereas herring are taken in a few ports and from a few number of vessels. A second point addressed the possibility of aging errors. It was noted that herring are easy to age and that frequently the data are cross checked by two readers.

Table 2.2.1. Landings of Atlantic herring by fishery in the Gulf of Maine.

Year	Coastal Maine Fixed Gear	Coastal Maine Mobile Gear	Jeffreys Ledge Mobile Gear
1983	2,543	15,644	4,281
1984	380	19,132	12,255
1985	4,691	9,166	12,089
1986	1,667	13,865	16,944

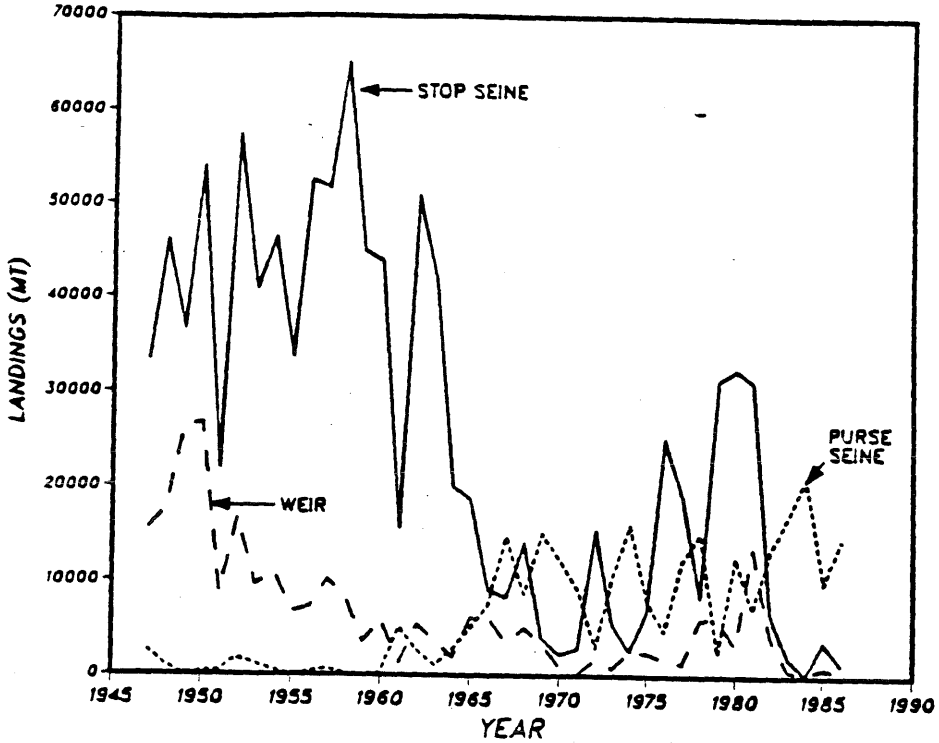


Figure 2.2.1. Landings by gear type in the coastal Maine fishery.

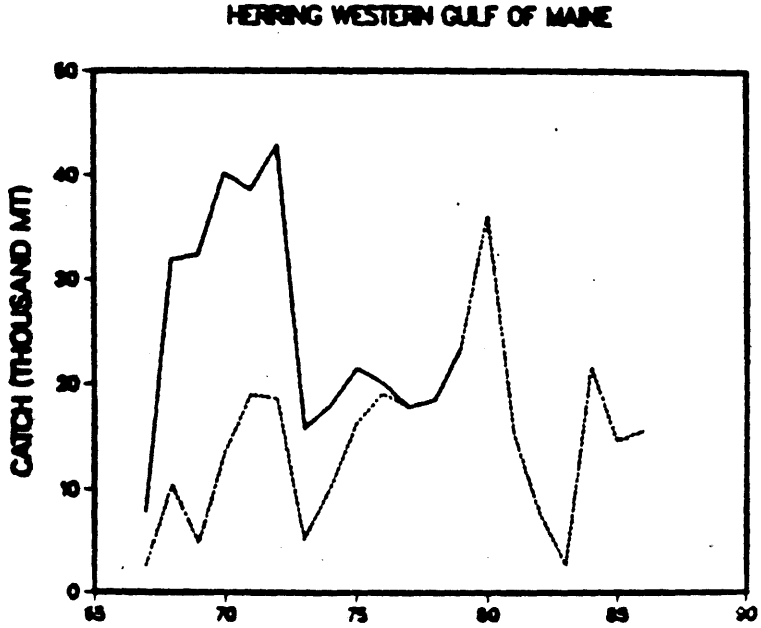


Figure 2.2.2. Landings in the western Gulf of Maine (Jeffreys Ledge) mobile gear fishery for total international catch (solid line) and U.S. catch (dash line).

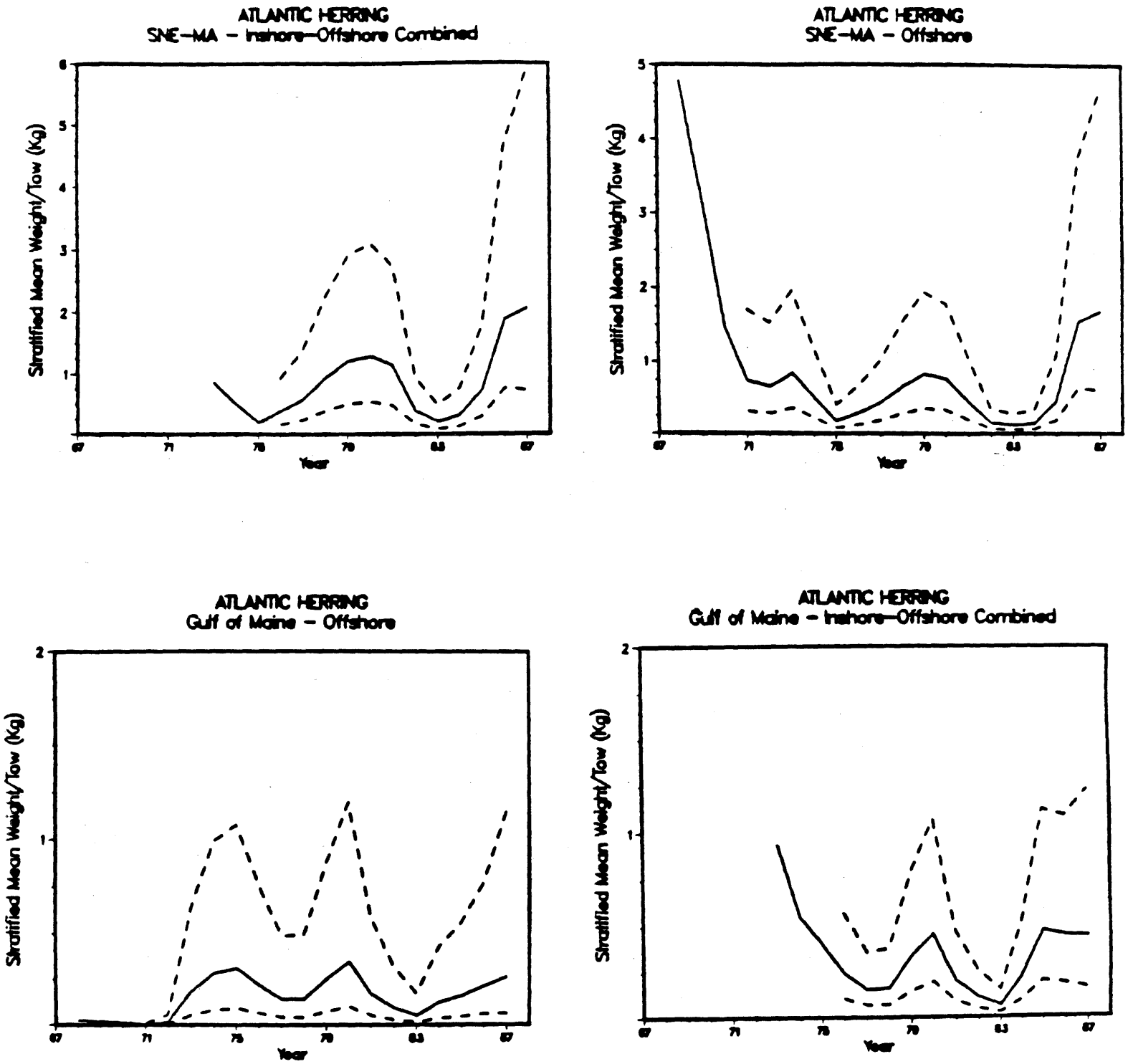


Figure 2.2.3. Trends in NEFC research vessel survey indices (kg) smoothed using a first order moving average process (80% confidence intervals for the estimate are shown).

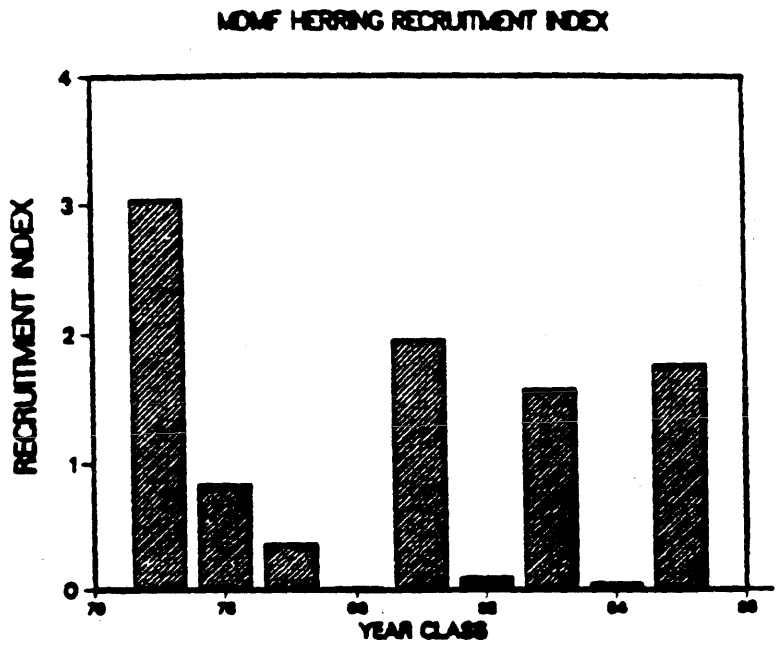


Figure 2.2.4. Massachusetts Division of Marine Fisheries beach seine index (No. per area swept) for young of year herring.

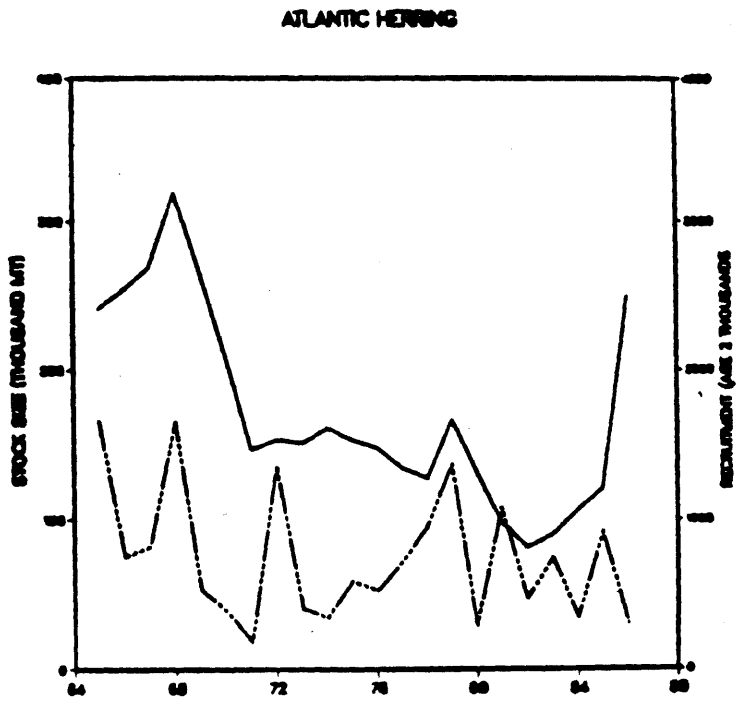


Figure 2.2.5. Trends in biomass (age 2+) for Atlantic herring in the Gulf of Maine (solid line) and recruitment (thousands at age 2) (dash line) derived from virtual population analysis.

2.3. REVISED BLUEFISH ASSESSMENT

Source Document: Terceiro, M. 1987. Status of Atlantic Coast Bluefish - 1987. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 87-10, 54 pp.

2.3.1. Status of the resource

The Executive Summary of WP12-SAW5 is reproduced here as a summary of the assessment presented.

> The objectives of this stock assessment are to determine for the bluefish: 1) estimates of growth, natural (M) and fishing (F) mortality rates; 2) how fishing mortality and large-scale oceanographic events influence the stock-recruitment relationship; and 3) the level(s) of fishing mortality that provide the highest sustainable yields to the recreational and commercial fisheries, while protecting the spawning stock to maximize recruitment.
>
> Commercial bluefish landings have steadily increased from 1960 (1252 metric tons (mt) through 1986 (6328 mt), and currently comprise about 10% of the total bluefish landings. The total recreational landings for bluefish have also increased since 1960. Estimated fishing effort (trips) on bluefish also rose steadily from 1960 (9.2 million) through 1980 (36.7 million) and then varied without trend thereafter. Most bluefish landings by weight (mt) and number are taken in the Mid-Atlantic subregion (NY to VA) by boat-based fishermen. The largest fish on average, however, are usually caught by the boat fishery in the North Atlantic subregion (ME to CT), and the smallest in the South Atlantic subregion (NC to FL). Over 75% of the shore-based catches in the North and Mid-Atlantic are juvenile (age 0) bluefish, whereas the boat fishery in these subregions catches mainly adult fish (ages 1 through 8). In the South Atlantic, however, both the shore and boat fisheries exploit primarily young (ages 0 and 1) bluefish.
>
> Mean lengths (mm FL) for Atlantic coast bluefish more than doubled between ages 1 to 4, and then increased more slowly thereafter. The oldest bluefish of 11 years old was from the 1982-1985 North Carolina fishery. The length-age data for bluefish were well described by the von Bertalanffy growth equation.
>
> The mean natural mortality rate (M) of adult bluefish was estimated to be about 0.35, which is consistent with the relatively short life-span (11-12 years) and fast growth rates of bluefish. The mean monthly natural mortality of juvenile (0 age) bluefish was estimated as about 25%, which is well within the range of monthly mortality rates for a variety of fishes.
>
> Fishing mortality rates on adult bluefish based on catch curve and VPA analyses have more than doubled from 1974 (F=.13) to the current fishing rates between 0.30 and 0.40. By contrast, fishing rates (F)

experienced by juvenile bluefish appear to be an order of magnitude lower (F=0.01 to 0.03). Stock biomass estimates (mt) of age 1+ bluefish from the VPA declined by 67% from 601,000 mt in 1979 to 200,000 mt in 1986.

There was a significant positive correlation ($r=0.87$, $P<0.001$) between the 1979-1986 juvenile indices from the NMFS fall survey and the corresponding mean CPUE indices of juvenile bluefish from the coastwide shore fishery. Bluefish recruitment since 1974 showed no consistent trend; the strong 1977, 1981 and 1984 year-classes occurred at irregular intervals. Despite the geographical limitations of the NMFS survey, we assumed that the 1974-1986 juvenile indices accurately measure bluefish recruitment from Cape Hatteras, North Carolina to Cape Cod, Massachusetts.

Examination of the stock-recruitment relationship for Atlantic coast bluefish revealed that spawning stock size from 1974 through 1986 accounted for only 14.5% of the recruitment variability, whereas mean March wind vectors (100 dynes/cm^2) off of Delaware Bay and Albermarle Sound, N.C. explained 72% and 56% respectively, of the bluefish recruitment variability. When spawning stock size and the March wind vectors off Delaware Bay were merged into an environmentally-dependent stock-recruitment model, this two-variable model explained over 86% of the recruitment variability from 1974 through 1986.

The results of equilibrium yield modeling suggested that the highest sustainable yields for Atlantic coast bluefish (62,000 to 68,000 mt) occur at fishing rates between 0.30 and 0.40. These models also predicted that the bluefish stock would eventually collapse if fishing rates exceed 0.60 for an extended period (10-15 years). Given that fishing rates on adult bluefish have recently increased between 0.30 and 0.40, it seems wise to implement some restrictions on the recreational and commercial fisheries to stabilize F at or below the 0.40 level.

2.3.2 Discussion

Initial questions centered around the methods used to age the catch data, and on the estimation of mortality and stock size from the VPA. It was noted that the catch from all years was aged by a combined age/length key developed from samples taken coastwide over the 1982 - 1986 period (N = 4861). The group recognized that use of the key in this manner might bias the catch-at-age matrix if growth is variable from year to year. Examination of recreational survey data indicates that length frequency distribution modes are consistent over time. The possibility of stratifying the age/length key by years was mentioned. It was suggested that a catch-at-age matrix determined by length-frequency mode separation methods or length-based cohort analysis [e.g., the method of Jones in Sims (ed.) 1985] might be useful in future work for comparative purposes.

Questions were raised about the large increase in fishing mortality indicated by the VPA from 1985 to 1986. There was discussion of the tuning measures employed to calibrate the estimate of terminal F, and the reliance of the procedure on relative stock size estimates derived from NEFC trawl survey data was noted. It was suggested that instead of comparing the entire series of predicted Fs with the exploitation index used to calibrate F, that the latest estimate of fishing mortality (terminal F) be predicted by regression of VPA calculated F versus the exploitation index. An analysis of catchability versus bluefish stock size suggests that an inverse relationship may exist which would cause fishing mortality to rise more quickly than fishing effort as the stock declines.

NEFC trawl survey and recreational fishery survey indices of YOY bluefish abundance indicated that strong year classes occurred in 1977, 1981, and 1984. Recreational survey data indicate additional possible strong year classes in 1978, 1980, and 1982 as well. Concern was expressed over the inconsistencies between trawl survey indices and VPA estimates. It was noted that the assumption of full recruitment to the fishery for ages 1+ was made based on catch proportion at age. It was suggested that annual differences in the availability of bluefish to the recreational fishery might result in some ages not being fully available to the fishery. Further analysis using a partial recruitment vector derived from a separable virtual population analysis (SVPA) may help resolve this question.

The VPA and catch curve analyses indicate that recent fishing mortality rates have ranged between 0.1 - 0.4. Analysis of stock/recruitment data using the Shepherd model (1982) incorporating wind stress effects on recruitment success indicated that maximum yield from the fishery would occur at a fishing mortality of about 0.40. It was noted that this relationship was being driven by the three year classes that appear to be strong in the survey data. It was suggested that an examination of the autocorrelation of the residuals of regression might be useful to help validate the model. It was also noted that the statistically significant correlation between wind stress and recruitment success may be due to random chance; further efforts to validate the relationship were encouraged.

Current estimates suggest that fishing mortality on young of year may be an order of magnitude less than on the adult stock due to limited availability to recreational anglers.

Discussions of the specific details of the assessment presented suggested several possible additional analyses that need to be completed before definite conclusions can be drawn. Taking these several suggestions into account, however, the participants felt that the highest sustainable yields for Atlantic Coast bluefish occur at fishing rates between 0.3 and 0.4 (yield per recruit analysis, using a natural mortality rate of 0.35). Therefore, it would be unwise to allow fishing rates on bluefish to exceed 0.4 for more than a few years. Fishing rates on adult bluefish have recently risen and it may be wise to stabilize F at or below the 0.4 level.

2.4. SPECIAL TOPIC: HERRING ASSESSMENT METHODS

A review of four ongoing projects was presented by researchers analyzing the status of the coastal Maine - New Brunswick herring stocks. These projects include 1) larval herring studies, 2) egg bed surveys, 3) "transboundary" brit and larval surveys, and 4) acoustic surveys. A description of each project was followed by discussion of the methods and current results.

2.4.1. Larval Herring Project

This research is a continuation of studies originally carried out by the Maine DMR with the objectives of understanding larval production, transport survival and growth. Components of the project are analyses to determine the relative importance of early vs. late spawning, larval catch rates, survival, and winter mortality rates. A portion of the research is utilized to forecast sardine catches in the Maine juvenile or fixed gear fishery, e.g. the 1988 catch of the 1986 year class of herring. An underlying assumption of the research is that there is no direct relationship between larval abundance and year class size. For this reason, a number of population characteristics are considered in making the forecast. The forecasts have generally been quite good with efficiency ranging from 50 to 100% of the actual catch.

The discussion that followed the description of this project generally centered around the validity of the calculated indices and their applicability to the broader stock concept accounted for in the NEFC VPA results. Spring larval survey indices calculated for 1986 in all areas were very high in comparison to other years. The question of whether the indices from samples along the Maine coast were representative of smaller 'stocklettes' vs. the generally accepted stock was discussed. It was suggested that the question of stock structure may need review given the fact that several questions of stock identification still exist. For example, biologists are unsure where the juveniles in the New Brunswick fishery originate.

2.4.2. Egg Bed Surveys

This project, conducted since 1983, utilizes bottom samples and video cameras to define the habitat characteristics, substrate, timing, and the extent (size) of individual spawning sites along the eastern shore of Maine north to Grand Manan Island. The results of this research provide the basis for fishery independent estimates of spawning stock size from egg abundance, based on estimates of the area and number of eggs at all spawning sites, and an estimate of adult size and fecundity in the area.

Estimates of the quantity of fish which spawned at one site in 1986 calculated using this method appear to be quite high given VPA estimates for the entire coastal stock, and an explanation of this apparent inconsistency was not reached. Estimates of egg abundance at this site seem quite accurate. Fecundity estimates used here were taken from the literature, and it was noted that direct measurements on the spawning fish observed should be made. One assumption that may require further examination is if the egg mat is

continuous in both thickness and integrity. The question of whether or not herring are serial spawners was raised in light of the results of other recent research indicating that species such as mackerel and anchovies appear to be serial spawners. Participants felt that this does not seem likely, however. Possible partial reasons for the inconsistency between VPA estimates of spawning stock size and estimates from the egg bed surveys could be that mature herring may not spawn each year, or that estimates of natural mortality may be incorrect. Further examination of spawning stock biomass estimates from this approach are needed.

2.4.3. Larval and Juvenile Surveys

The primary objective of this project is to examine the "transboundary" nature of herring in eastern Maine and New Brunswick. Specific goals include: 1) the location of spawning areas on either side of the border, 2) determining the distribution of brit (0-group juveniles) along the Maine and New Brunswick coasts, and 3) determining the origin of juveniles along the coast through the examination of otolith morphology, microstructure, and elemental composition, and the morphological characteristics of the brit herring.

Brit surveys were conducted between Boothbay Harbor and the upper Bay of Fundy on three occasions during 1987. Brit were observed and collected inshore in late May and early June; no significant quantities of brit were observed inshore later in the year.

Three larval surveys were completed in September and October of 1986 between Mt. Desert Island and St. Johns, N.B. consisting of 50 stations arranged in a grid pattern. Plots of the distribution of three size groups of larvae were presented along with plots of the distribution of possible prey items and hydrographic parameters. Back-calculated estimates of spawning stock size from larval abundance estimates obtained during these surveys were quite low in comparison with estimates which were extrapolated from egg bed surveys. Indeed, estimates of spawning stock biomass for the entire survey area were approximately equivalent to estimates derived from only one egg bed. Spawning stock biomass estimates based on larval abundance data are not considered to be as accurate as estimates derived from egg abundance estimates or acoustic surveys since the standing crop of larvae at any point in time during the spawning season only represents a fraction of total larval production during the spawning season.

2.4.4. Acoustic Surveys

A preliminary survey designed to determine the overall distribution of herring in eastern Maine was conducted in the fall of 1987 in order to provide a basis for future acoustic assessments of herring in this area. The equipment used and the sampling design was described. While echosounder traces characteristic of herring aggregations were obtained during this survey and preliminary estimates of adult abundance along survey tracks were calculated, there has been only limited verification of the species sampled by the echosounders. This survey indicated a complex distribution of adults and juveniles in the area. It appears that spawning stock assessments along the eastern Maine coast need to be undertaken on known spawning sites. Further

research is needed, using capture techniques, to determine the size composition of herring offshore. This work has raised questions concerning the separation of stocks in eastern Maine and Grand Manan Island.

2.5. SPECIAL TOPIC: ESTUARINE WINTER FLOUNDER

A simple life history model was developed as part of the EPA Estuarine Studies to provide a framework to study the effects od pollutants on living marine resources (LMR). The purpose of this modeling study was not to develop specific numbers, because the input data are not available, but to suggest approaches to the goal of evaluating relative effects of pollution on populations.

Presently, scientists at the NEFC Milford Lab are studying the reproductive success of winter flounder. Further development of this model may incorporate starvation, disease, predation, and pollution mortality components based on these studies. Movement in and out of the affected habitat, mostly by adults, will also be included. Partitioning mortality due to these components will be difficult, especially since mortality due to pollution may have varying impacts. In order to estimate contributions by each component sensitivity analyses will be performed to simulate varying components.

At present, causes of changes in the population at different life stages are not clearly understood. Experiments should be conducted that study in situ effects of pollutants on the resource, because laboratory results may not be directly applicable to the natural environment.

2.6. SPECIAL TOPIC: BLACK SEA BASS

2.6.1. Review of approaches to assessment of black sea bass

Life History

Black sea bass are protogenous sequential hermaphrodites within the family Serranidae. Female sea bass mature by age 2 and may undergo a sex change between ages 1 and 6, with most switching occurring between ages 2 and 5 (127 to 255 mm SL). Not all females change sex (about 49% according to Mercer 1978), although there is some evidence that all females have the potential to develop into males (Wenner et al. 1986). Male sea bass mature by age 2 and are generally the predominant sex after age 4 or 5. Therefore the population at any given time may contain females which will remain female, females which are in transition to male but still serve as functional females, males which began life as males and males which are the result of hermaphroditic females.

Growth rate and potential maximum size varies between the sexes. Male sea bass have a value of K, from the von Bertalanffy growth equation, between 0.163 and 0.207 and maximum length values between 449 mm and 498 mm (Alexander 1981, Mercer 1978). Females have more variable K values (0.138 to 0.356) but lower potential growth with maximum length between 330 and 438 mm (Alexander 1981 , Mercer 1978). There is also evidence that growth parameters and size at

50% maturity vary by latitude, with larger, slower growing individuals in the northern end of the range.

Assessment Problems

The hermaphroditic life history strategy of black sea bass appears to be unique among the exploited finfish species of the North Atlantic and also presents unique problems in preparing a population assessment. The following are some issues which may present a problem.

Mortality estimation

Given the growth characteristics of the two sexes, the natural mortality rate estimated from usual cohort methods will also differ. Females have a higher rate (M), yet some of the females contributing to the apparent mortality rate will not actually die but will have only changed sex. The result will be a varying estimate of M depending on the rate and size of transition. If fishing mortality (F) reduces the estimated M by altering the rate of transition, then an increase in F may not result in a linear increase in total mortality (Z). Most likely the level of F is high enough to mask the changes in M relative to Z.

Age and size at recruitment

Just as the rate of transition from female to male may affect mortality estimates, it may also affect the estimate of age and size at recruitment. Sea bass tend to stratify by depth with smaller fish being in shallower areas, therefore the age at full recruitment to a fishery will also vary by area (Low 1981).

Y/R and SSB/R

Since the growth potential of the two sexes varies, the potential yield per recruit will be affected. The yield will vary according to the ultimate sex of the individual, with a higher short term yield resulting from more males being produced. The trade off is fewer females and lower spawning stock biomass.

The ultimate problem is lack of knowledge about the basic biology and behavior of the species. It will be difficult to model the effects of fishing without adequate baseline information about the social structure of the groups within a reef, the factors regulating the frequency of sex reversals, reproductive success under different sex ratio scenarios, and whether compensation for fishing mortality occurs. Furthermore, we do not know if year class strength will cause a density dependent response in growth as well as transition rate.

The approach which will have to be taken is to use stochastic yield models with various sex ratio scenarios. Under different fishing intensities, different responses may occur in the reproductive potential and sex change

frequency. One assumption will have to be that the same type of responses will occur throughout the population and will not just be community specific.

2.6.2 Discussion

Age of maturity, sex ratio at size and growth rates for black sea bass were presented. The limited data on these parameters suggest the life history patterns for the northern stock is different from the southern stocks. Additionally, fishing mortality, particularly the selective mortality on faster growing males, could have an effect on the accurate determination of these parameters. The need for integrated regional studies on basic life history patterns was identified.

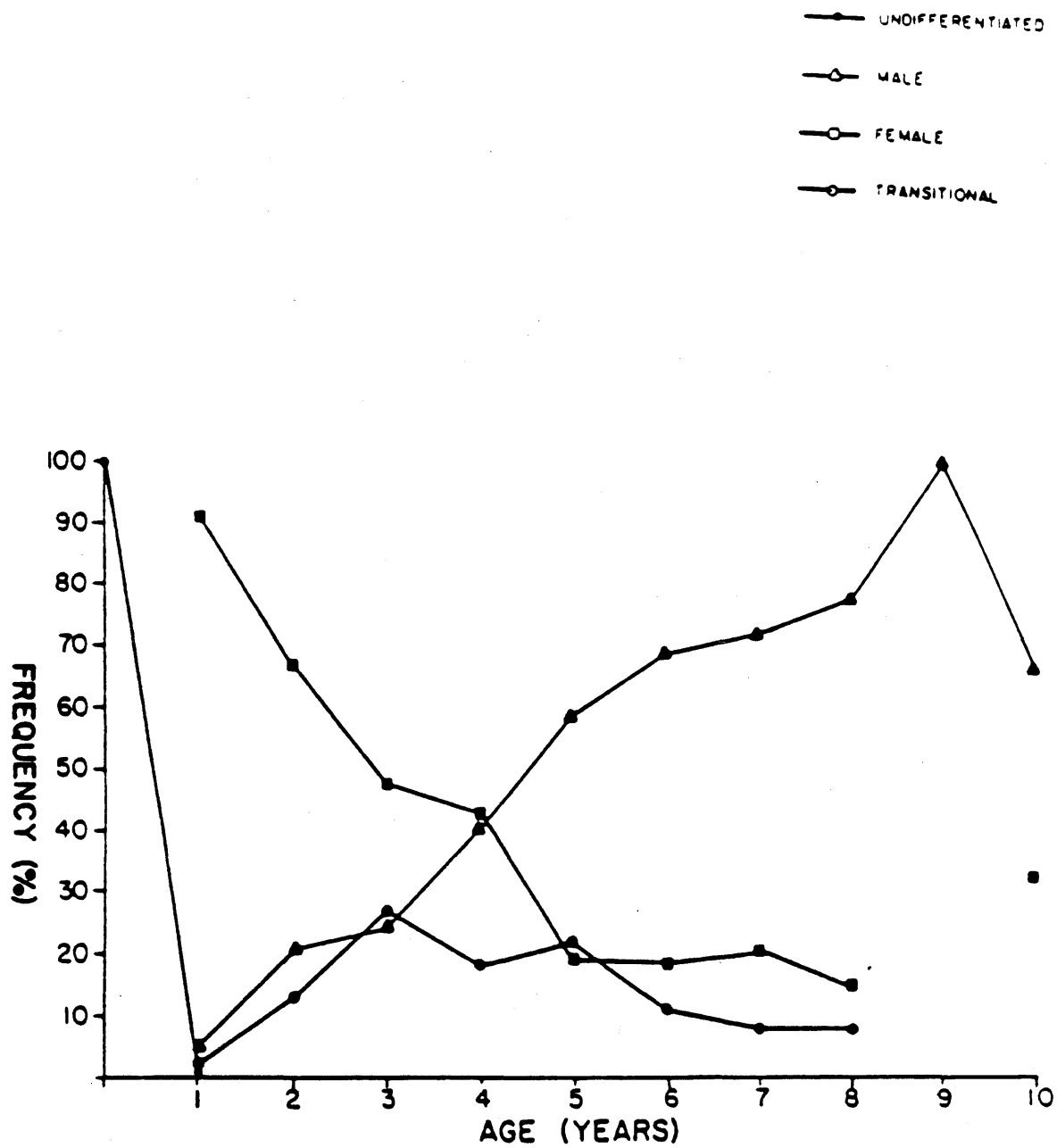
Important components of a black sea bass assessment will include models of the growth rates of sexual components of the stocks and sex change at size. No specific recommendations on modeling growth rate between sexes were given other than to recognize that the difference may be insignificant. It was suggested that sex change could be modeled as either a constant or density dependant function of size. A possible problem was raised in maximizing yield per recruit from large males while maintaining population reproductive potential.

Simulation modeling to assess the effect of different management regimes on a species with a similar life history pattern suggests black sea bass may be very sensitive to exploitation. The modeling, performed with the protogenous hermaphroditic grouper Epinephelus cruentatus, suggest that age of entry into the fishery should be delayed to avoid the effects of sex specific mortality (Huntsman and Schaaf, 1981). A similar modeling approach with black sea bass may be useful.

The method of computing the recreational harvest of black sea bass was clarified. Recreational catches were the sum of catches of type A, B1 and 0.5 x B2 (A: catch available for identification and measurement of length and weight; B: catch not available for identification and either used for bait, cleaned or discarded dead; C: catch released alive). The 0.5 adjustment for B2 catches was an assumed hook and release mortality not based on any direct evidence for black sea bass. The importance of this assumption was stressed.

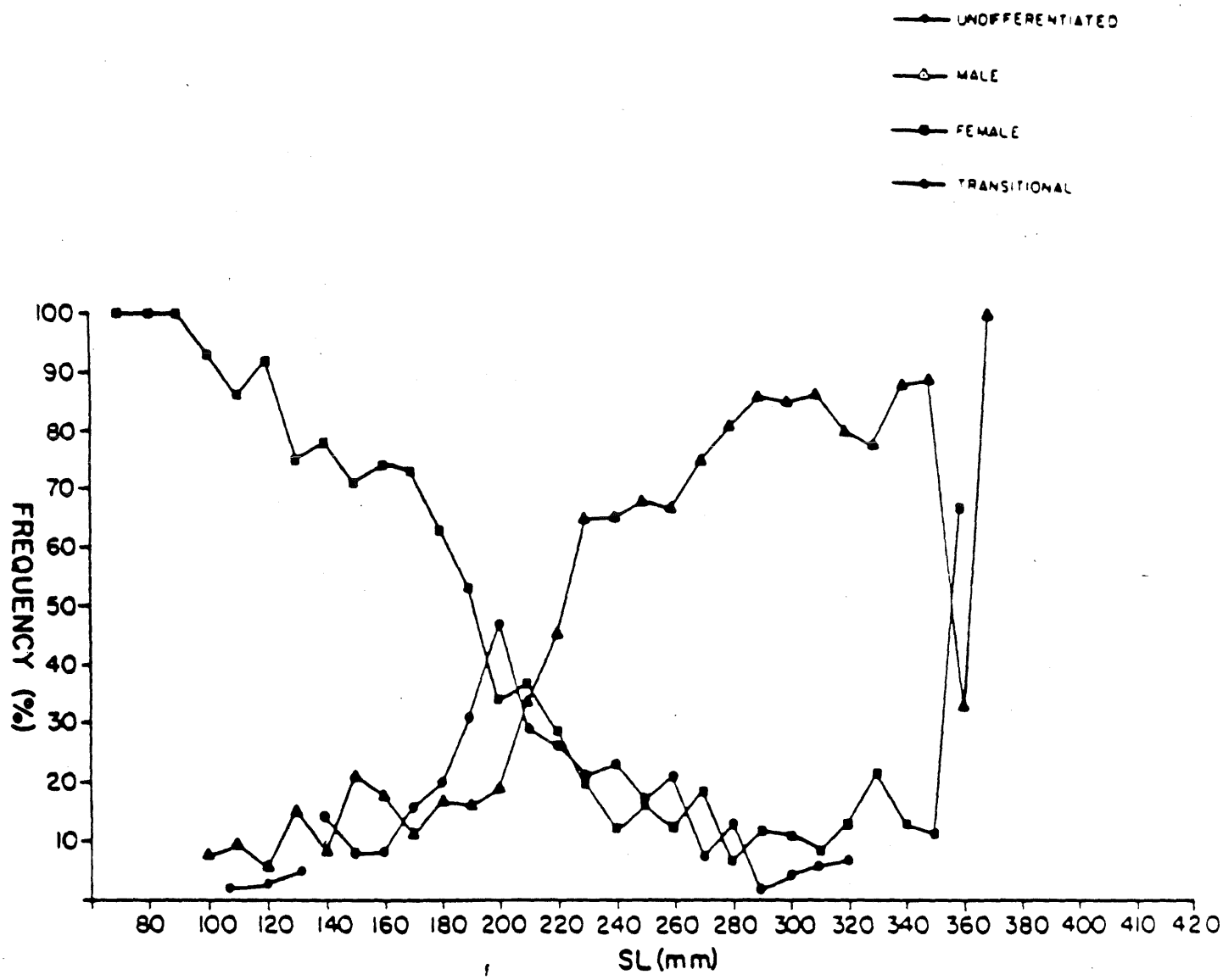
Further analysis needs of recreational and commercial catch data were identified. The need to describe the variation of recreational catch estimates was mentioned owing to the high coefficient of variations associated with these data. Effort and commercial landings data require further analysis.

A quantitative assessment of black sea bass is considered a high priority item by the Mid-Atlantic Council. Interest in seeing a cooperative effort among research agencies to perform the necessary research to complete the assessment was expressed. Specific research initiatives on age of sexual transition, aging, regional or stock specific growth variation, and the effect of artificial habitat on production were suggested.



Waltz, W.,Roumillat, W.A. and P.K.Ashe. 1979. Distribution, age structure, and sex composition of the black sea bass, Centropristis striata, sampled along the southeastern coast of the United States. S.C. Mar. Res. Cent. Tech. Rpt. # 43.

Figure 2.6.1. **Percent frequency of sexual types of South Atlantic Centropristis striata at age.**



Waltz, W., Roumillat, W.A. and P.K.Ashe. 1979. Distribution, age structure, and sex composition of the black sea bass, Centropristis striata, sampled along the southeastern coast of the United States. S.C. Mar. Res. Cent. Tech. Rpt. # 43.

Figure 2.6.2. Percent frequency of sexual types of South Atlantic Centropristis striata in each 10mm size interval.

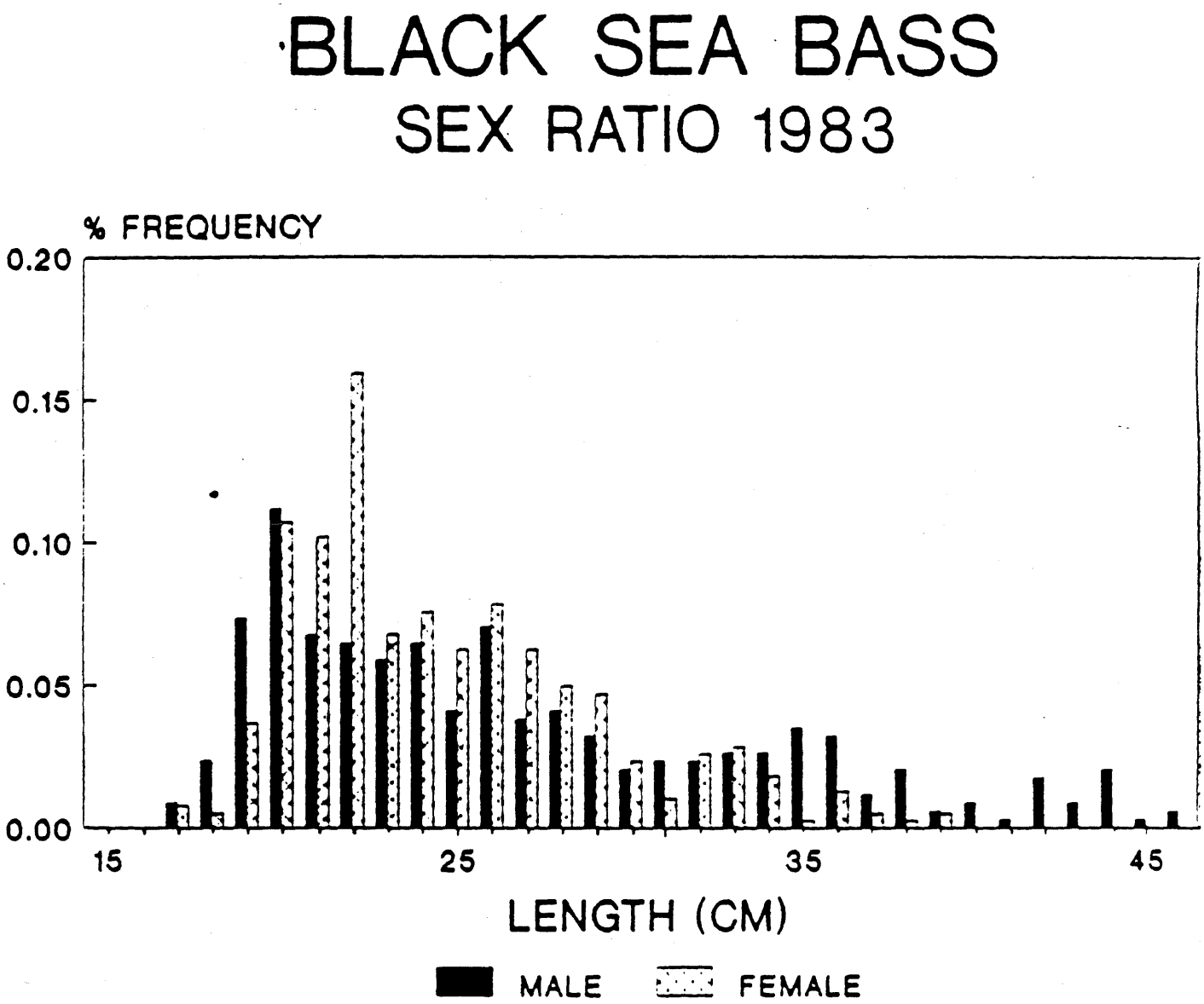


Figure 2.6.3. Black sea bass sex ratio 1983.

3. NEW ENGLAND FISHERY RESOURCES

3.1. SPECIAL TOPIC: SPAWNING STOCK BIOMASS PER RECRUIT ESTIMATES

3.1.1. Review of SSB/R concept and theoretical behavior

The concept of spawning stock biomass per recruit (SSB/R) was a key element in the Multispecies Management Plan developed by the New England Council. The purpose of this session was to review the concept of SSB/R and some of its theoretical behavior, and to examine some refinements which were made during development of the Plan.

SSB/R was defined as the biomass contributed to the spawning stock by each new recruit over the lifetime of that recruit in the fishery. The SSB/R model is analogous to a yield per recruit model, with a term added to account for the proportion mature at age with some additional assumptions (Sissenwine & Shepherd 1987). A related concept is percent maximum spawning potential (%MSP), which is the proportion of the maximum possible spawning biomass (achieved at F=0) produced at various combinations of fishing mortality and age at entry. A useful form for presenting the results of SSB/R analyses is to plot %MSP as a function of F and alternative mesh sizes.

SSB/R analyses can be used to estimate the %MSP required for replacement from an observed time series of number of recruits and spawning stock biomass. This can be done by comparing the spawning stock biomass in year t to the number of recruits in year t + r (r= age at recruitment to the fishery). The problem, however, is that there is much variability in the data, which makes evaluation difficult. The model assumes equilibrium conditions, which are unlikely to hold in the short term. Confidence in any one point is low, and the results should be viewed in the context of long term averages.

Some theoretical considerations on the behavior of SSB/R models were presented. A fundamental question is the relationship between theoretical (SSB/R) and observed (SSB/R*) values. Six potential problems on the performance of SSB/R as a reference point were considered:

1. process error (e.g. recruitment variability),

2. measurement error in estimating both calculated and observed SSB/R,

3. assumptions in estimates of calculated SSB/R values of density independence in growth, fecundity, maturity and adult mortality and size independent fecundity on a per weight basis,

4. non-equilibrium conditions,

5. non-linear relationships between F and SSB/R,

6. observed SSB/R as a performance measure.

Results of simulations which addressed some of these concerns were presented. It was noted that using the target SSB/R in the simulations did

not guarantee that the corresponding target F value would be low enough to prevent stock declines. Discussion on this point included whether this result was due to the shape of the Ricker stock-recruitment curve used in the simulations. It was noted that this result was due to the target F being higher than what the population could sustain. Such behavior can occur with any stock-recruitment relationship which is not a constant.

It was noted that SSB/R is an equilibrium model and thus needs to be evaluated as a long term average. This was reiterated several times.

It was noted that since a non-linear relationship exists between F and SSB/R, a small change in the estimate of a target SSB/R may have large effects on target F's for a heavily exploited stock.

The final discussion centered on the utility of SSB/R as a performance measure for management purposes. Again it was pointed out that it probably is not very useful on an annual basis. However, averaged over a longer time frame, SSB/R may be a useful biological reference point and can be considered along with other indicators (such as F_{max}) of where the stocks should be.

The SSB/R approach appears to be valid for defining a reference point, but it does not appear to be appropriate for monitoring the condition of a stock with respect to that reference point.

3.1.2. Discussion of Technical Monitoring Group Terms of Reference

Following the presentations on SSB/R theory and the review of SSB/R results presented in NEFC (1987c), the following objectives specified by the Technical Monitoring Group were addressed:

(1) To reconcile the differences between the conclusions of the Multispecies Plan and NEFC analyses, and (2) to offer a scientific opinion as to the validity of the assumptions behind either analyses and to the usefulness of new approaches for dealing with the SSB/R concept applied to multispecies fisheries management.

It was noted that density dependent compensatory processes are the usual null hypotheses in the theory of fishing, although the evidence supporting the existence of significant compensatory effects in the recruitment phase is limited. The true relationships are often assumed to be obscured by the large variability in the recruitment process. It was pointed out, however, that in the absence of firm data on compensatory recruitment processes, the hypothesis of depensatory recruitment at low stock sizes could not be rejected. Presently, it is unclear how SSB/R would perform as a reference point at low stock levels if depensatory processes were occurring.

In a similar vein, details about the data used to determine seasonal timing of spawning activity, fecundity, growth, and fishing mortality were discussed with respect to determining the sensitivity of the procedure for calculating SSB/R estimates.

It was recognized that, in certain instances, the staff of the New England Fishery Management Council had used somewhat different data sets in their SSB/R calculations. However, differences between the SSB/R analyses performed by the Council staff and those performed by the NEFC were not resolved during the present discussions.

Uncertainties exist about the statistical properties of several ratio estimators such as (1) maximum spawning stock biomass per recruit itself, (2) SSB/R isopleths, and (3) the maintenance targets. These uncertainties might be addressed by analytical techniques to evaluate of the propagation of variances, and alternately by simulation or by resampling techniques for variance estimation.

Further discussion ensued on the relationship between effective and nominal mesh sizes, and the finding (NEFC 1987c) that the effective mesh size in the fishery was one inch lower than the nominal mesh size (Table 3.1.1.). The applicability of this finding to the present fishery was challenged due to possible improvements that have occurred in enforcement. However, it was pointed out that the current depressed state of the stocks encourages non-compliance, and that, even with increased enforcement, the situation is possibly worse than seen previously.

Recognizing the limitations of the presently available data on effective mesh sizes, several approaches were identified to obtain additional critical data, including:

1. evaluate the age composition of the landings, in comparison with the NEFC research trawl catches, and the size limits in the fishery

2. measure actual mesh being used

3. measure the size composition of the catch during sea sampling research

4. review enforcement data, and

5. evaluate the selectivity of other gear besides the regulated otter trawls.

Priorities for these approaches were not reviewed during the discussion, and it was suggested that these be reviewed by the SAW Working Group on Data Needs.

Concerns were also raised as to the value and reliability of the %MSP targets and the estimation of theoretical %MSP for a given management regime. Evaluation of such estimates, particularly considering the equilibrium assumptions of the SSB/R model, is problematic. Additional research was noted as being needed in this area in order to better evaluate the utility of SSB/R as a biological reference point.

The importance of considering the effect of the Canadian fisheries on Georges Bank on the degree to which the Multispecies FMP can meet its SSB/R goals was pointed out. Similarly, the need to evaluate the effect of other FMP management measures such as closed areas was pointed out.

It was noted that in structuring the specific management measures in the Multispecies FMP, the goal was to select combinations of measures (i.e. F and mesh size) that would generate future average %MSP levels that were equal to either maintenance or rebuilding target %MSP levels. The results in NEFC (1987c) suggest that the estimates of the anticipated %MSP levels under current management measures are below the targets. Further, if the general approach used in the formulation of the FMP target %MSP levels were followed using revised analytic procedures and updated data, lower maintenance targets would be obtained for two of the three stocks where sufficient data are available: Georges Bank haddock and Georges Bank yellowtail flounder.

Although several of the uncertainties noted above could affect these conclusions, the most discussed issue was the age specific exploitation pattern estimated for different mesh sizes. The exploitation pattern for ages 1 to 4 that was observed during the 1982-85 period when mesh was regulated at 5 1/2" was noted to be similar to the theoretical pattern that would be obtained from a 4 1/2" mesh size as indicated by earlier experimental studies (Table 2.4). The close agreement between this observed pattern for a 5 1/2" regulated mesh and the theoretical or experimental pattern for a 4 1/2" mesh suggested that regulated or nominal mesh sizes may behave in actual use like mesh as much as one inch smaller behaves during experimental studies. It was suggested, but not agreed, that this calculated one-inch difference between effective and nominal mesh sizes is an upper bound, and that the true value might lie between one-inch and zero. However, even if the difference were zero, which was agreed to be unlikely, the theoretical %MSP levels for the three stocks would still be lower than the original maintenance or rebuilding targets.

Given the concerns raised about SSB/R being a theoretical equilibrium model and the actual SSB/R observations resulting from non-equilibrium conditions, alternate bases for "measurable criteria for evaluating the effectiveness of the amended plan," as requested by the Regional Director, were discussed.

The possibility of using some form of aggregate catch per unit of fishing effort was discussed. It was suggested that defining CPUE for certain functionally similar species groups would give greater sensitivity than a general aggregate. On the other hand, it was suggested that a more broadly-defined CPUE index, such as one for all regions and all vessel classes, would give a more representative measure. However, several participants expressed concerns about the sensitivity of CPUE-based indices to measure real-time changes in population status.

It was noted that changes in age or size structure of the exploited stocks should occur as a result of changes in age specific exploitation patterns. Such changes could be tested using research vessel survey data and might provide an early indication of the performance of the plan.

The value of research survey indices to measure management plan performance was also noted as being useful elsewhere e.g., draft Summer Flounder Fishery Management Plan; Striped Bass Management Plan]. The possibility of using total fishing effort or VPA estimates of F as plan performance measures was also discussed, although it was noted to be useful only in estimating fishing mortality in earlier years.

Technical limitations associated with each of the measures discussed were noted, and the SAW came to no conclusion as to the most useful approach. It was suggested that additional research is needed to develop adequate bases for evaluating short-term and long-term plan performance.

Table 3.1.1. Comparison of observed exploitation patterns for Georges Bank cod with age specific selection patterns corresponding to a 4 1/2" effective mesh [including adjustment for 17" minimum fish landing size].

Age	Observed[1] Exploitation Pattern (A)	Predicted Exploitation Patterns, 4 1/2" Mesh		
		Proportion Retained[2] (B)	Proportion Landable[3] (C)	Proportion Landed (D)
1	0.02	0.17	0.00	0.00
2	0.52	0.69	0.82	0.57
3	1.00	0.97	1.00	0.97
4	1.00	1.00	1.00	1.00

[1]Geometric mean of partial recruitment values during 1982-1985 (from Serchuk and Wigley 1986).

[2]From probit analysis of data in Smolowitz 1983, assuming selection factor of 3.6 (Smolowitz 1983).

[3]Percentage of fish at age equal to or greater than 17" in length (Penttila and Gifford 1976).

4. MID-ATLANTIC FISHERY RESOURCES

4.1. SPECIAL TOPIC: SQUID AVAILABILITY

4.1.1. Review of progress

In response to terms of reference defined in the report of Working Group 11 during the 4th SAW, the use of NEFC research vessel survey data to predict relative availability of the long-finned squid (Loligo pealei) to the domestic fishery was examined. This preliminary analysis identified functional relationships between survey-derived dispersion indices and domestic catch-per-unit-effort (CPUE), which served as an index of inshore availability. These dispersion indices were shown to be independent of squid abundance as well as free of biases resulting from changes in survey sampling by depth.

The strongest correlation was found between the proportion of tows in which no squid were taken during autumn surveys and the CPUE index for the succeeding year; this inverse relationship was significant for all size classes analyzed. Results suggest that reliable forecasts of the relative availability of Loligo to the inshore domestic fishery may be obtained from NEFC bottom trawl survey data.

4.1.2. Development of a Research Program

There are three potential paths in developing a research program for the assessment of long-finned squid. These are to: (1) revise the current assessment to account for changes in the fishery and knowledge of the life history of the species, (2) re-analyze the alternative uses of the survey data base, as presented in WP10-SAW5, and (3) design a survey to specifically address the inshore squid availability issue. These three approaches are discussed below.

1. Revised Assessment for Long-finned squid (Loligo pealei)

The nature of the long-finned squid fishery has changed significantly in the last several years. No longer an offshore fishery prosecuted during winter by large, foreign freezer trawls, long-finned squid are now taken almost entirely by USA vessels, fishing on the shelf and into shallow areas primarily during spring and summer. This has substantially changed the size (age) composition of the catch, and mortality estimates must be reevaluated. Total catch is also less than during the peak years of the fishery (1972-76). In addition, new evidence indicates that the spawner-recruit relationship for this stock may be stronger than assumed previously. Rather than updating the assessment for this species based on population parameters determined under an outdated fishing regime, a revised assessment is now warranted.

The methodologies developed in the previous assessment are still valid, based on current understanding of the population, so revisions would center on reevaluation of the population parameters associated with changes in the prosecution of the fishery and improved knowledge of the life history. Revision of this assessment would involve: 1) updating monthly catch in number estimates from the foreign, domestic and joint venture fisheries, by cohort,

2) recalculation of fishing (F), natural (M) and spawning (S) mortality rates, and 3) reevaluation of the spawner-recruit relationship and of the monthly relative fishing mortality estimates. Once all population parameters are determined, yield-per-recruit and spawning-stock-biomass-per-recruit simulations may be run to provide revised estimates of equilibrium yield under the current fishing regime.

2. Potential alternative uses of the current survey data base.

Preliminary results of research into the use of the current NEFC survey time series to forecast relative availability of Loligo to the inshore fishery was presented during the meeting. These preliminary analyses have promising results, and refinement of those analyses may provide very useful indices. Data should be reexamined on an area and depth basis, possibly eliminating areas (or depths) where squid are never taken in a given season. Additional comparisons may be made among the spring and autumn indices, relative to each other and to CPUE. An improved definition of directed effort in the squid fishery may also result in CPUE indices which better reflect inshore availability. These analyses have utilized alternative statistical measures based on survey catches. Equally, alternative measures of central tendency from the fishery should be explored, given that mean CPUE may not be a representative statistic for annual relative fishery performance.

3. Design a survey to specifically evaluate inshore availability.

Important considerations involved in designing a survey to provide predictive indices of inshore squid availability include: 1) the time of year to conduct such a survey, 2) the areas to be covered to provide the most information on the location and amount of squid, 3) development of a time series to provide relative indices from year to year, and 4) the ability to provide timely information to managers and industry.

1) The current NEFC autumn survey has historically been able to provide consistent abundance indices for this stock. However, many factors affect the stock between the time of this survey and the inshore fishery, and abundance indices from the autumn survey have not related well to subsequent inshore availability. It is unlikely that additional field work during the autumn would improve on the data base already obtained with the NEFC surveys. A more appropriate time to survey squid is probably during spring, shortly before inshore migrations to the fishing grounds. The effects of mortality and environmental factors could thus be minimized. However, with annual variations in temperature and current patterns influencing the shoreward migration of squid, setting the exact dates of the survey to maintain comparability between years will be difficult.

2) The most likely areas to locate Loligo during early spring would be in the deep offshore waters from southern Georges Bank and southwest along the edge of the shelf. The distant-water-fishery had always been prosecuted during the winter in these deep waters and it is presumed that the stock was concentrated there. The survey should be of a depth-stratified random design to provide consistency between years and allow comparability of annual variations in distribution by depth due to migration.

3) A time series of several years will be needed to develop any relationship with what is subsequently observed inshore.

4) Since management regulations are generally established in late autumn, any information obtained from a spring survey would have to be analyzed immediately and used to adjust initial values, if necessary. This will be more difficult for industry since it will have very little time to adjust to changes it regulations (ie. to increase gear if the stock is more available than anticipated, or to move gear to other fisheries if less available).

Recommendation

Priority in research should probably be placed on revising the assessment for this stock. If estimates of equilibrium yield are found to differ substantially from previous estimates, adjustments to allocations based on availability to the inshore areas may be inappropriate. Once the assessment is revised, however, detailed research into inshore availability may be useful in providing adjustments to annual potential yield estimates. Designing and implementing a new resource survey is not warranted until the other alternatives are explored.

4.1.3. Discussion

Initial discussion of the squid availability analysis focused in the linear regressions of autumn indices versus CPUE. An exponential function was proposed as a possible model for the relationship. It was also pointed out that classification of survey tows by weight instead of numbers would result in consistent units for the variables involved. It was emphasized that, while initial results were extremely promising, the analyses were preliminary in nature and should be refined.

A question was raised concerning school sizes for squid, and whether or not hydroacoustics might be employed to address issues of schooling and dispersion. However, the squid's lack of a swim bladder and its variable position in the water column were cited as two potential problems for applications of hydroacoustic techniques.

A discussion ensued regarding the seasonal aspects of the analysis with respect to the changing fishery and management needs. The suitability of a functional relationship using autumn survey data to predict succeeding summer inshore availability was questioned in view of increasing domestic offshore effort during winter months, and it was suggested that perhaps similar relationships need to be developed from the spring survey data. At this point it was observed that, historically, the spring survey has been less useful since squid are off the shelf at that time; a suggestion was made that, if timing was in fact the problem, a solution might be to add sampling stations at the end of the current spring survey. An industry representative noted that necessary adjustments on its part to information on changes in squid availability could be made on short notice.

Important with respect to the proposed research program for analyzing factors influencing availability of long-finned squid, the need for a revised assessment was identified as the top priority. Concern was expressed that this assessment would be more useful if predictive capabilities for both inshore and offshore availability were addressed. This is important in view of the rapid changes occurring in the fishery, i.e., increasing domestic pressure, shifts in effort from inshore to offshore areas, and the increased harvesting of small squid.

4.2. SPECIAL TOPIC: LONG TERM POTENTIAL CATCH OF SURF CLAMS AND OCEAN QUAHOGS

The Surf Clam-Ocean Quahog FMP currently specifies an MSY value of 50 million pounds of meats per year for the Mid-Atlantic fishery. This value is problematic for several reasons: (1) it is based on an historic average catch for a period of years when the surf clam populations were in substantial state of flux, (2) it included landings from the inshore areas not regulated under the plan, (3) it does not include provisions for resources in areas such as Southern New England and Georges Bank, that began contributing to the landings after the period considered for the long-term average catch, and (4) it is not clear that average catch values, taken for any period, represent the "long-term potential catch" from a stock. Although the concept of maximum sustainable yield certainly does not apply in the true equilibrium sense to stocks such as surf clam that exhibit substantial inter-annual variability in recruitment, there is nevertheless the ability in stocks with low natural mortality rates to "stock pile" fishable biomass, and thereby buffer the effects of highly stochastic recruitment. The purpose of the research described was to develop an analytical model to examine various constant catch scenarios in terms of the ability of the stocks to support exploitation. The problem of MSY for the stock is thus cast as one of determining the maximum constant catch, subject to the risks inherent in reducing the stock to levels at which the specified catch cannot be taken.

A stochastic simulation model was constructed to simulate the dynamics of surf clam populations under various constant catch strategies. The model incorporates provisions for very infrequent but strong year classes (as observed in the Mid-Atlantic region). The basic structure of the model is outlined in Figure 4.2.1. Various population dynamics data (mean weight at age, natural mortality rate, partial recruitment vector, partial maturity vector), as well as information on the expected frequency and amplitude of recruitment, and the specific harvest strategy to be simulated, are inputs to the computer program. The recruitment process is simulated by a multi-modal frequency distribution: the frequency of recruitment is first determined as "good" or "bad", based on a specified probability (in Mid-Atlantic simulations the frequency of "good" year classes was set at 5%, or a 1 in 20 chance). The model first generates a uniform random number from 0 to 1. If that number is below the cut-off for good recruitment, the recruitment is characterized as "bad". A second pair of uniform random numbers is used in conjunction with the specified mean and SD of good or bad recruitment to determine the annual recruitment value (the Box-Mueller method for Gaussian random numbers). Next, the simulation determines if in fact there is sufficient fishable stock to give the desired constant catch. In order to keep the simulation from crashing, the maximum allowable F in any year is set at 3.0 (or a 95% annual

harvest rate). If the harvestable stock is not sufficient, the constant catch value is set to 95% of that available at F=3.0. The simulation then uses an iterative technique to solve for the F level giving the specified catch, and the catch equations are used to solve for stock size, catch, and to update the populations for the next year of the simulation. At the end of simulation, distribution statistics are computed for F, catch, spawning stock size, and total stock size. Also, the proportion of years in which the population was not sufficient to give the specified constant catch is computed.

Sample input data are based on research vessel survey data (for starting numbers at age), as well as growth and natural mortality rates based on standard assessment techniques. Various simulations were conducted to validate the model structure assuming constant annual catches from 10,000 to 50,000 mt of meats. It is apparent from these preliminary simulations that as constant catch is increased above 25,000 mt, the frequency of years in which the stock is not capable of supporting the constant catch increases dramatically. Also, the mean F level increases 50 fold, and the CV in stock size and catch increases with increasing catch. At levels in excess of 25,000 mt, the stock does not buffer the effects of variable recruitment, and the variability in the underlying populations and the fishery increases dramatically. These results are preliminary, based on only a few model simulations. Further simulations are necessary before reliable conclusions can be drawn, as is a sensitivity analysis of the model assumptions. Other simulations are being conducted to assess the applicability of this model formulation to other populations that may exhibit very different underlying population dynamics (e.g. Georges Bank surf clam).

It is feasible that a constant catch can be used as a surrogate for MSY, in terms of defining a risk adverse harvesting strategy for those stocks exhibiting appropriate population dynamics (i.e. low M). Critical parameters such as the frequency of "good" year classes will be vital to the correct interpretation of these results, as will of course be the most problematic to determine from empirical analysis.

4.2.1. Discussion

In response to a question on the surf clam growth rate used in the model, it was stated that the density-dependent growth rate was used.

In reference to model evaluation a suggestion was made to use the same sequence of randomly generated recruitment numbers in comparing the effects of alternative constant catch levels on F and stock sizes.

A question was raised as to whether the model would show the same results if it were based on fixed fishing mortality rates instead of fixed catch rates. The answer was probably not, because a constant F will cause the catch to vary and the stock would recover more quickly. It was noted that the model is currently being modified to allow for F driven and multi-management options. These modifications will allow managers to evaluate different management policy decisions. It was pointed out that numerous models have been used to examine the effects of constant F on stock and catch levels, and that constant effort management seems better for finfish stocks than constant

catches. In response, it was stated that managers may want to avoid a management scheme that results in extreme annual variability in catch, and thus, a constant catch scheme may have merit in certain circumstances.

A point was raised regarding the models' recruitment mechanisms. The model assumes that successive good year classes are possible; this may not be possible in the natural environment. In response, it was stated that this could be evaluated in the model. This might involve incorporating a spatial component; the age data are being reexamined to determine if there is any bias in the sampling or aging.

A question was raised as to whether there is enough surplus effort in the system to respond quickly to changes in stock biomass. It was noted that there is some, but probably not as much as required in the model. A determination of boundary conditions on effort response will help determine when the maximum catch allowed will be taken.

A point was made that by increasing the catch were you pushing toward F_{max}, and that at high F's the fishery becomes a pulse fishery directed to the strong year classes. There was agreement with this point, and it was noted that surf clam processors may want to minimize variability around the annual catch.

A question was raised concerning the starting condition for the model. It was stated that the initial stock biomass was derived by aerial expansion of the 1986 survey data, and that the model was constrained by that estimate. However, the point is bound by other survey points and reflects survey availability. A point was raised concerning the spatial distribution of the resource, (i.e., concentrated in several areas), suggesting that aerial expansion of the survey data may not be the appropriate point estimate. In reply, it was noted that the starting value for recruitment was the mean for the two good year classes. Furthermore, it was noted that the spatial distribution will affect the mortality on the resource and that it is related to the reality of the fishery (i.e., vessels have preferred fishing regions).

A question was raised concerning the comparison of the model output for recruitment and stock size with observed values. It was stated that the model values looked realistic, but that formal sensitivity analysis has not been conducted yet. This was followed by a question on modifying the model to account for the spatial distribution of the resource. It was noted that this will be attempted, but the utility of this change was uncertain since it does not respond to the initial management request. However, given the uncertainties in parameterizing the model, the more important results may be the general model behavior rather than the specific catch levels. In this context, evaluation of alternate negative density dependence processes on recruitment success may give very different overall behavior of the model. It was noted that the model was still in its development stage, was derived using parameters pertinent to the Mid-Atlantic stock, and that for the Georges Bank stock the recruitment dynamics are different and the model performs differently. Use of the model for the latter stock is still under examination.

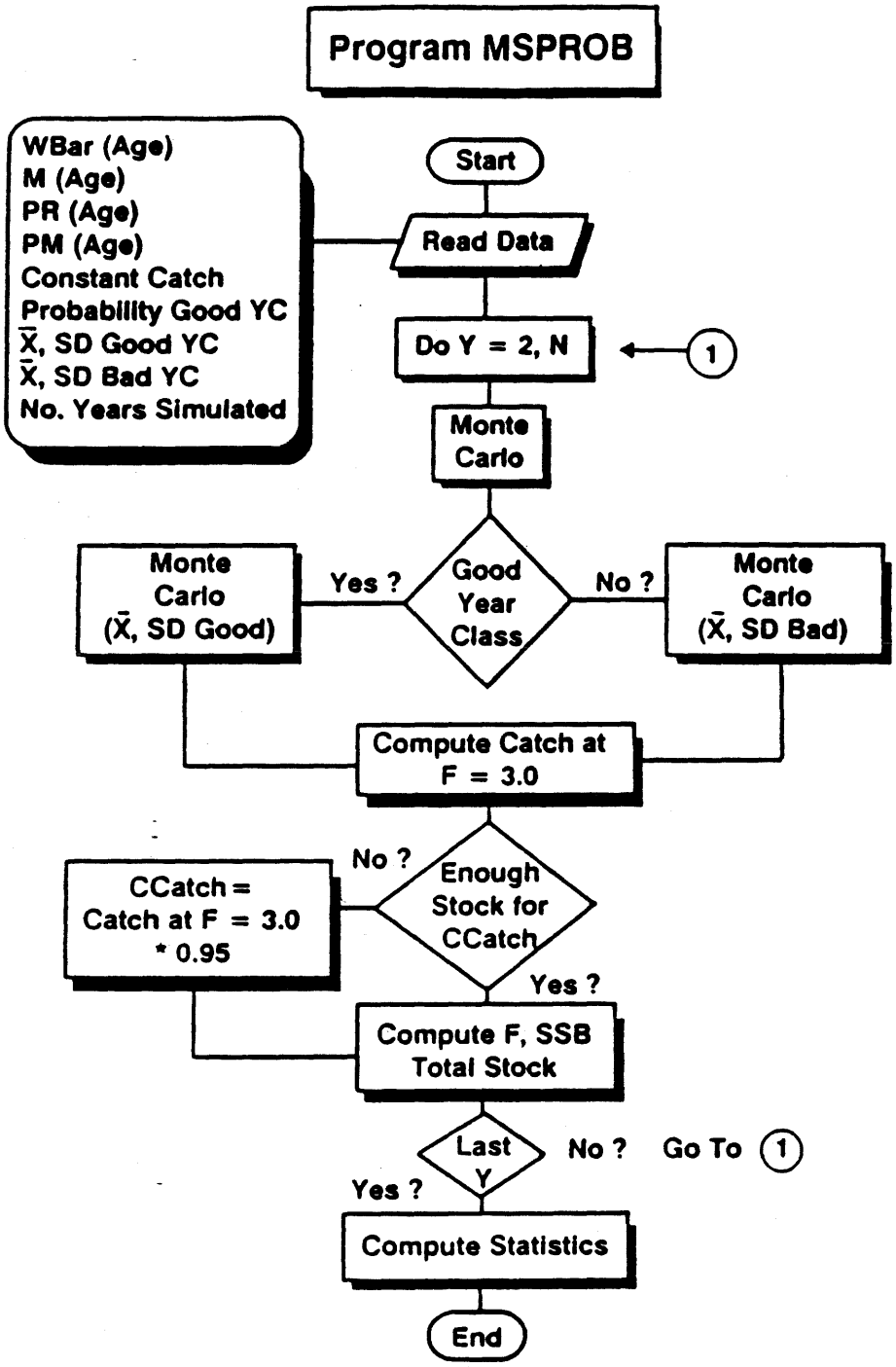


Figure 4.2.1. Logic flow diagram for program MSPROB.

5. WORKING GROUP REPORTS

5.1. WORKING GROUP 9: METHODS OF MEASURING LONG-TERM POTENTIAL CATCH

5.1.1. Terms of Reference:

Review the classic definition of maximum sustainable yield (MSY) as well as the qualifications associated with that definition. Consider alternative to that definition and specify how these alternatives provide advice on either maximum yield, sustainable yield, or the desired combination of the two. Review existing FMPs to determine how this problem has been handled under the FCMA. Make recommendations on future research, pointing as well to any constraints in implementation that might be evident.

Members: Brian Rothschild (Chair), Ray Conser, Tom Hoff, Vaughn Anthony, Howard Russell, Mike Fogarty

5.1.2. Report

No report was given.

5.1.3. Discussion

Objective of group was noted to be to document procedures for standardized calculation of long-term potential catch from an analytical assessment using methods other than traditional surplus production models. A final report was deferred until the next SAW; the need for additional participation by members was noted.

5.2. WORKING GROUP 12: SCIENTIFIC GOALS OF COLLECTING DATA ON FISHING VESSELS

5.2.1. Terms of Reference

Evaluate the utility of a sea sampling program for collecting scientific data for enhancing our ability to assess the status of stocks and the likely or actual impact of specific management measures. Evaluate the likely magnitude of such a program to meet different objectives. Consider at least the objectives of measuring discarding practices, evaluating mesh selectivity, and refining measures of fishing effort.

Members: John Mason (Chair), David Pierce (Mass), Howard Russell (NEFMC), Jeff Ross (NC), Fred Serchuk (NEFC), Ronnee Schultz (NEFC), Sal Testaverde (NEFMC)

5.2.2. Report

Sea Sampling is an important program and provides data essential for certain studies which is not otherwise available. In order to insure an orderly development of a sea sampling program at any level of funding, it is important that a coordinator be identified and charged with the responsibility for 1) identifying the short term and long term needs, 2) prioritizing those needs, and 3) identifying the resources necessary to meet those needs. The

group felt that because of the existing experimental fisheries sea sampling program and the expertise which resides in the NMFS Regional office, a coordinator should be located there. In addition, experience gained from coordinating the foreign fishing observer program there will facilitate the establishment of this sea sampling program.

The group felt that at the present minimum level of funding, various State, Federal, and academic volunteers could be utilized for short term (quick fix) type projects. Coordination of this effort is still essential to improve the efficient use of these volunteers and provide a focal point for requests. Longer term questions, however, would require significant funding and a program designed for integrated planning.

Given the number of items which the group felt have been identified as informational needs which relate to sea sampling, there is a clear need to prioritize the areas of concern in terms of short term vs long term time commitment as well as available resources to carry out such projects. The group is prepared to assist in such prioritization and examination of sea sampling needs, but felt that program design needed to be addressed first. Without coordination, it will be a random approach at best.

5.2.3. Discussion

The first recommendation of the working group was the need for a coordinator of any sea sampling program. It was agreed during the discussion that such a program needed coordination, whether by an individual or committee, but a decision regarding the organization responsible for coordination could not be resolved in the current forum. There was some difficulty in making specific recommendations concerning sampling priorities without initial development of the scope and potential funding available for a sea sampling program. Nevertheless, it was agreed that any increased sampling activity beyond the current level would be beneficial. Specific needs that were raised included increased sampling of small-mesh fisheries (specifically the shrimp fishery and whiting fishery), increased recreational sampling, sampling to provide better mesh size/catch data, and increased sampling within state waters.

Suggestions were made for revised terms of reference for this group:

- Prioritize user needs based on responses from Councils,

- Evaluate data needs involving sea sampling and categorize scope into short-term and long-term,

- Identify sea sampling programs already implemented and evaluate effectiveness,

- Develop standard data collection methods and data needs,

- Identify resources to conduct sampling.

The discussion resulted in agreement to the following revised terms of reference:

> Based on priorities for various data collection needs being developed by the Fishery Management Councils, identify and prioritize those that would involve sea sampling, and categorize into short-term and long-term tasks. Define general data elements that should be collected in such sampling. A report is expected at the next SAW.

5.3. WORKING GROUP 13: ADEQUACY OF PRESENT PORT AGENT INTERVIEW SYSTEM

5.3.1. Terms of Reference:

Evaluate the present system of port agent interviews in terms of coverage and the questions asked to determine if it might be able to provide better and more detailed information on catches, fishing effort and fishing practices. Alternate sources of data or methods of collecting such information should be identified.

Members: Darryl Christensen (Chair), Tom Hoff (MAFMC), Guy Marchesseault (NEFMC), Sukwoo Chang (NEFC), Dave Stevenson (Maine).

5.3.2. Report

The working group reviewed WP-11 and identified several issues not addressed in it, including:

- Priorities for sampling and interviewing may not reflect current needs of users. Therefore, criteria need to be established for directing interview effort.

- The draft does not review the overall question of what portion of the landings data are covered in the weigh-out and interview databases. The coverage varies by species and state.

- The draft does evaluate the distribution of samples collected.

- A problem exists in obtaining North Carolina landings data in a format comparable with interview data.

It was recommended by the working group that WP-11 be revised to account for these points, and that the revision be made available to the Data Needs Working Group as soon as possible.

5.4. WORKING GROUP 14: IMPORTANCE OF TEMPERATURE AND TRAWLING ACTIVITY ON MACKEREL AVAILABILITY

5.4.1. Terms of Reference

Review existing information on (1) the likely effect of trawling activity disrupting mackerel schools, and (2) the likely effect of year to year

variability in sea temperature on migration of mackerel schools, and evaluate the effect of these factors on the availability of mackerel schools to USA fishermen. Prepare recommendations on likely importance of these processes, and on most promising directions and approaches for research should further information be required by managing agencies.
Members: Bill Overholtz (chair), Ron Schlitz (NEFC), Tom Hoff (MAFMC), Mert Ingham (NEFMC)

5.4.2. Report

The Working Group met and discussed the terms of reference. The problem has been that in the last several years, in spite of a large mackerel biomass, the recreational fishery in the spring has had some difficulty in catching mackerel, especially along the Virginia coast.

Effect of Trawling Activity

One suggestion has been that foreign and domestic trawling activity may be dispersing the schools during the winter fishery that has developed off the Mid Atlantic area and that this is contributing to changes in distribution and hence availability of mackerel to the recreational fishery. The Working Group felt that this was probably not a significant issue, and that there are so many other factors that could change the short term configuration of mackerel schools that it would be a very difficult problem to study. The group felt that there was some evidence available that trawling would affect school shape shortly after a vessel made a tow, but that there was no evidence to suggest that trawling would cause changes in distribution some months later. Further, the Working Group felt that there was no available evidence to suggest that the activities of the fleet as a whole would have an impact on the inshore distribution of mackerel in the spring.

The group discussed the many other possible variables that may influence short-term school dynamics and decided that such factors as naval and merchant traffic, diel changes in school size and shape, and dispersal of schools by storms are all in operation during the time of the winter mackerel fishery. Further it was felt that other evidence is available to suggest that the problem may be very isolated. A study by the Mid-Atlantic Fishery Management Council that reviewed the recreational fishery data for mackerel suggests that the fishery is doing quite well, especially in the New York Bight area, the region that traditionally produces the best catches. It is possible that a local problem exists on the Virginia coast. Information from the Polish research fishery in 1986 and 1987 showed that the Polish vessels have had no difficulty locating and remaining on large concentrations of mackerel throughout the time of the fishery in the winter. This suggests that mackerel are available to the commercial gear and remain concentrated even during the repeated trawling activity of the fleet.

The working group felt that further action on the issue of school dispersal by fishing vessels was a problem that even considerable directed research effort and expense would not solve because (1) there are so many possible factors operating, and (2) it would be difficult to relate the activity in the winter fishery to events onshore several months later. The

effects of trawling on school size and shape could perhaps be studied by using methods such as aerial photography, remotely operated vehicles, hydroacoustics or some type of typical research survey vessel. The results of this type of research would probably not give satisfactory answers because of the reasons cited above. The Working Group, though, did feel that recreational fisherman and party boat operators in the Virginia area could usefully be contacted to quantify the problem and collect some information.

The information provided to the Mid-Atlantic Council by a visiting scientist was reviewed. Although the references cited did show that concentrations of haddock were made to change configuration by trawling (Ona and Chruickshank 1986) and that herring can respond to noise stimuli (Olsen 1969), it was felt that the problem of breakup of schools was not addressed and the information did not contribute much to understanding this issue.

Effect of Environmental Changes

The group also reviewed the impact that the environment may have on the spring distribution of mackerel off the middle Atlantic area. Several different factors such as temperature, pollution, predation, and changes in the Chesapeake Bay discharge were discussed. Since mackerel are so intolerant of cold water, temperature seemed to the group to be the probable dominant factor in controlling the spring distribution of mackerel. Sette (1950) suggested that mackerel seldom inhabited water less than 7-8°C while Olla et al (1975) showed that mackerel swimming speed increased significantly below 6 to 7°C. Several studies suggest that mackerel are seldom caught in research surveys or commercially below temperatures of 5°C (Overholtz and Anderson 1976; Shepherd 1986). Another study documented the northern shift in distribution of mackerel that accompanied a warming trend in the mid 1970's along the eastern seaboard (Anderson and Almeida 1977). This northerly shift in distribution also coincides with a drop in catches by the recreational fishery from 1974-1976.

The Working Group felt that although temperature is probably the important driving variable for controlling the spring migration, several possible mechanisms that interact could be important. The northerly shift mentioned above could account for reduced catches in the Delmarva area, while the temperature and magnitude of the Chesapeake Bay discharge may also be important. Storm events in the early spring may also disrupt the thermocline that forms on the shelf, mixing very cold water with the near shore warmer water and forcing mackerel offshore. It was agreed that several events that cause inshore waters to remain cool or turn cool during the March-April period could cause the fish to remain further offshore or start their northern migration early, thus possibly bypassing the Delmarva area.

These factors could be studied by examining the research vessel time series more thoroughly and utilizing time series of environmental data that are available. Flow patterns from Chesapeake Bay could be examined by utilizing records from USGS gauging stations in the Bay. Satellite information could be used to study sea surface temperature regimes. The working group felt that a coordinated study that examined these and other

factors might be useful in determining the phenomena that determine and influence the spring migration of Atlantic mackerel.

5.4.2. Discussion

Questions were raised concerning the historical pattern of recreational catches in the Virginia area relative to the abundance of mackerel. The reasons for inshore migration are traditionally believed to be food availability, temperature preference and spawning migrations. Since mackerel feed little during the time in question and spawn in the Mid-Atlantic Bight, it was believed that factors such as freshwater runoff, salinity, and particularly temperature would have the greatest impact on the mackerel migration inshore.

The terms of reference of the Working Group were fully met, and the members were thanked for their work.

5.5. WORKING GROUP 15: RESEARCH NEEDS FOR EVALUATING LIKELY BEHAVIOR OF TRIGGER MECHANISMS FOR MANAGEMENT OF SUMMER FLOUNDER AND POSSIBLY BLUEFISH

5.5.1. Terms of Reference

An approach to establishing a "trigger mechanism" for implementing management measures for summer flounder has been defined. The statistical properties of several of the input data and the overall properties of the triggering rule need to be further evaluated before the details of the trigger mechanism can be specified. Identify research activities needed to develop the specifics of the mechanism. Estimate the amount of time required for each research activity. If time is available, review possible similar mechanisms for bluefish, and identify needed research activities.

Members: Anne Richards (Chair), Mark Terceiro, Tom Hoff, Ray Conser, John Mason, Vic Crecco, Tim Smith, Wendy Gabriel

5.5.2 Report

The draft Fishery Management Plan for the summer flounder fishery, prepared by the Mid-Atlantic Council, proposes management measures for summer flounder in US waters of the western Atlantic Ocean from North Carolina northward. Three years after the Plan is implemented, its success in achieving its stated management goals will be evaluated using an adjustment or "triggering mechanism". If the evaluation shows that the goals are not met, more restrictive management measures will automatically go into effect.

The proposed trigger mechanism is two tiered, with the primary indicators being (1) mortality estimates for ages II to III summer flounder based on NEFC spring survey data, and (2) abundance indices from the NEFC spring offshore survey. The secondary indicators are (1) CPUE in the commercial fishery, and (2) CPUE in the recreational fishery. To initiate more stringent management, both primary indicators and one secondary indicator must show that the stock is declining. The stock is considered to be in decline if the following

conditions hold: (1) a 3-year declining trend in mortality is not detected, (2) 3-year average abundance indices are within the lowest quartile for the spring survey time series, and (3) 3-year CPUE averages (commercial or recreational) are within the lowest quartile for the CPUE time series.

The group agreed that further specification of the individual mechanisms was needed before a detailed program for evaluating its overall behavior could be suggested. Questions and suggestions that arose were:

1. What is the best method for estimating mortality? It was agreed that a VPA is possible with the data now in hand, and that this may provide the most reliable estimates. However, it was noted that VPA does not yield reliable estimates of F for the most recent years, and the variance of different estimates should be examined to determine the most precise estimator. A related question was whether mortality of age groups II and III is the most appropriate measure to use.

2. How should effort be defined for the commercial CPUE indices? A more detailed analysis of existing effort data needs to be undertaken, including examination of how the total catch is apportioned among vessel classes and "minimum poundage" or "percent trips". Resulting CPUE indices should be validated by correlation with survey indices using corresponding age classes; effort measures can also be correlated with fishing mortalities generated from the VPA (particularly using estimates of F that have converged) to determine whether CPUE will be proportional to stock size.

3. Definition of effort for a recreational CPUE index will require considerable exploration of the recreational data base. Considerations include whether to use trips directed on summer flounder, all trips that caught summer flounder, directed trips for an assemblage of species that would be caught under similar conditions as summer flounder, or some variant of these; similarly whether one mode (eg. party/charter boats vs. beach/bank/pier) might provide a more precise estimate of effort than others. The approach suggested was to start with several logical definitions of effort and to evaluate the CPUE indices derived from each by examining the variances and by comparing with other indices of abundance.

4. What is the most appropriate time frame for evaluating the indicators? Is evaluation at 3 years too soon to reliably indicate trends, given the likely variability in the data? Can a few years of historical data be included in the time frame? These questions can be evaluated by examining the existing summer flounder data.

Once the elements of the adjustment mechanism are more specifically defined, the overall behavior of the trigger can be evaluated, both by using the existing data bases and through simulation studies. Data from the past several years can be used to estimate sampling variances for a simulation model of the performance of the proposed trigger mechanism. This model can then be used to determine the likelihood of the trigger being invoked in response to changes in the resource.

Approximate time frames for completing the analyses were discussed. The Council representatives noted that the analyses to support further specification of the individual trigger mechanisms, particularly ones involving CPUE, would be needed by the end of March 1988. The group estimated that these analyses could be completed in about 5 months (of working time, not elapsed time); however this estimate is very tentative. The examination of overall behavior of the triggering mechanism could occur over a longer time period, as the FMP would be in place for three years before the need for adjustment will be evaluated.

5.5.3. Discussion

Suggestions were made to examine the impact of large year classes in a depleted population on the mortality criterion. Large year classes may mask the decline needed to initiate the trigger. A problem in the use of trigger mechanisms in management was seen to be the criteria needed to "de-trigger" the regulations. The current rule structure does not give consideration to such mechanisms.

It was not clear who would have primary responsibility for further analysis. It was recommended that the proposed trigger mechanism should be evaluated by the Technical Monitoring Group as a possible performance measure for the Multispecies FMP.

5.6. WORKING GROUP 16: ESTUARINE WINTER FLOUNDER ASSESSMENTS

5.6.1. Terms of Reference

The several topics discussed in the report of a meeting of this group provides general terms of reference.

Members: Frank Almeida (NEFC), Jay Burnett (NEFC), Stan Chenowith (ME-DMR), Arnie Howe (MA-DNR), Mark Gibson (RI-DEM), Penny Howell (CT-DEP), Raoul Castaneda (NY-DEC)

5.6.2. Report

An ad hoc group was organized on winter flounder assessments and met to review research plans and priorities. Each of the states of New York, Connecticut and Massachusetts as well as the Northeast Fisheries Center have produced reports on the status of the winter flounder stocks under their management purview in the last few years, however, there are several areas where additional research is needed. Major areas of discussion in the Working Group, are described below:

1. Stock Identification - This topic was considered the most important component of any winter flounder assessment program. It was the consensus of the Working Group that more tagging studies to determine movements and stock structure were probably not necessary, but a review of the past studies (some 20-30 years old) is appropriate. Meristic studies of young-of-the-year flounder, similar to the study conducted in Massachusetts waters (Pierce and Howe, 1977), but utilizing samples

collected from the entire northeastern US coast may provide important information on the stock identification of this species. Other methods, such as optical pattern recognition, electrophoretic studies, and elemental composition of otoliths should also be explored as tools for defining stock boundaries.

2. Ageing - The second important topic discussed by the Working Group were concerns involving ageing in both estuarine and coastal waters. Preliminary results of an NEFC funded study of the daily growth increments in winter flounder otoliths were presented to the Working Group. While publication of the results of the study may not be for several months, an important component of the research was the simple fact that there is now a complete year's worth of daily growth information available for analysis. Large collections of ageing material (both scales and otoliths) are currently available in most states, however, different ageing techniques are being employed (some using scales while others use otoliths). The Population Biology Branch of the NEFC will be conducting age validation studies in the coming year, and this analysis, coupled with the results of the daily growth research and ageing expertise in the states, should provide a definitive technique for ageing winter flounder in the northeast.

3. Bottom Trawl Surveys - The NEFC and the states of Massachusetts, Rhode Island, and Connecticut have been conducting bottom trawl surveys to determine the relative population abundance of winter flounder for several years. There has been some ad hoc exchange of data between the states and the NEFC but no formal analysis of a combined time series has been attempted. Descriptions of the specific details of each of the surveys are also not available under one cover. These details, including vessel size, design, horsepower, etc., trawl gear specifications, station selection and sampling designs, time series frequency and duration, data formats, etc. will be collected and organized to provide researchers with the information required for the analysis of the individual and collective use of the data. Thought must also be given to the location of the datasets. The MA state bottom trawl survey resides on the NEFC VAX computer system, while data from the other surveys are located in the individual states. Should they all be on one system? Further discussions concerning these topics will be held in the future.

4. Recreational Fishery Catch Statistics - The availability and adequacy of recreational catch data was discussed, with the general feeling that the NMFS MRFSS data were "questionable" with regard to winter flounder. Each of the states has begun to supplement the broad-scale survey with statewide surveys (utilizing S-K, D-J or other funding). Another concern with the MRFSS data involves the separation of flounder catches between areas north and south of Cape Cod. This separation is crucial since the Cape appears to be a boundary between southern stocks and the Massachusetts Bay/Cape Cod Bay stocks. A formal request for this additional breakdown is necessary.

5. Catch-per-unit-effort Data - The calculation of reliable CPUE indices for winter flounder has been complicated by the fact that a definition of

"directed effort" for species which make up less than 100% of the total trip catch is currently not available. The Working Group discussed this topic only in general since a definition of directed effort has also been identified as a research need for other species (i.e. yellowtail flounder and summer flounder) and was to be discussed as part of the review of terms of reference of the SAW.

5.6.3. Discussion

More specific terms of reference were requested but could not be produced at this time. The group was asked to report on areas of progress at the 6th SAW, and to develop more specific terms of reference for consideration then. The enthusiasm of the members was noted and commended.

5.7 WORKING GROUP 17: CONSERVATION ENGINEERING NEEDS

5.7.1. Terms of Reference

Review informational requests and identify priorities and appropriate organizations and resources for addressing them, working closely with the Councils and other agencies, to generate a report to be considered in during the 6th SAW.

Members: Eric Smith (Chair), other members to be determined.

5.8. WORKING GROUP 18: ECONOMIC RESEARCH NEEDS

5.8.1. Terms of Reference

Review informational requests and identify priorities and appropriate organizations and resources for addressing them, working closely with the Councils and other agencies, to generate a report to be considered in during the 6th SAW.

Members: Philip Logan (Chair), Chris Kellog (NEFMC), Lou Goodreau (NEFMC), Tom Hoff (MAFMC), Dick Seamans (NERO), Jack Terrill (NERO)

5.9. WORKING GROUP 19: BIOLOGICAL RESEARCH NEEDS

5.9.1. Terms of Reference

Review informational requests and identify priorities and appropriate organizations for addressing them, working closely with the Councils and other agencies, to generate a report to be considered in during the 6th SAW.

Members: Tim Smith (Chair), Arnie Howe (MA), Tom Hoff (MAFMC), Howard Russell (NEFMC), Paul Perra (ASMFC)

5.10. WORKING GROUP 20: DATA NEEDS

5.10.1. Terms of Reference

Review informational requests and identify priorities and appropriate organizations for addressing them, work closely with the Councils and other agencies, to generate a report to be considered in during the 6th SAW.

Members: Darryl Christensen (Chair), Tom Hoff (MAFMC), Guy Marchesseault (NEFMC), Jack Terrill (NERO), William Emerson (NEFC), Tim Smith (NEFC), Paul Perra (ASMFC).

6. TERMS OF REFERENCE FOR FUTURE WORKSHOPS

6.1. REVIEW ASSESSMENT INFORMATION NEEDS

An extensive listing of informational needs contributed by the New England and Mid-Atlantic Fishery Management Councils was provided (WP2-SAW5). The Chairman expressed his appreciation for this information and suggested that state agencies might contribute to such lists in the future. The intent of this discussion was to review informational requests in four categories (Conservation Engineering, Economics Research, Biological Research and Stock Assessments, and Data Needs), to examine what is currently being done on an item by item basis, and to identify priorities and magnitude and type of resources needed for accomplishing them. The desired product was a realistic set of "Terms of Reference" for the future SAWs. It was clear at the outset that time requirements might pose problems, since the list was extensive.

Initial discussion centered on gear research, which has not been a high NEFC priority because of other commitments and because of the ability of other organizations or industry to do it equally as well. Topics considered and reviewed in this phase of the discussion included past work and current research needs on gear selectivity for butterfish, current NEFC studies on scallop and surf clam gear efficiency, culling mortality, gear-induced mortality and selectivity and shell height - meat weight relationships. Other activities (e.g. square mesh selectivity studies, work on biodegradable panels in lobster traps, and mobile gear impacts on the lobster resource and habitat) were mentioned; opinions differed as to their relevance and the degree of attention which they should receive.

Given time limitations, the issue was raised at this point, as to whether the list of topics could be covered effectively. Several participants noted that in-depth discussions would be needed on many issues not as yet covered and that a review of needs for each major item (e.g. by working groups reporting back at the next SAW) might be more appropriate. This might take the form of creating a "straw-man" list, distributing it to participants and other appropriate individuals with a request for comments and suggestions. A revised list would then be integrated into a report for presentation at an all-day session during the 6th SAW. After some discussion it was decided to develop this concept as a term of reference, with the provision that other terms of reference for the next SAW would also be identified to the extent possible during the current meeting.

The following possible terms of reference for the 6th SAW were identified:

1.) Four working groups will be formed before the conclusion of the present SAW to review informational requests and to identify priorities and appropriate organizations and resources for addressing them. Each working group will work closely with the Councils and other agencies to generate a report to be considered during the 6th SAW. The following working groups and chairmen were identified:

WG-17	Conservation Engineering Needs	Eric Smith

WG-18	Economic Research Needs	Philip Logan
WG-19	Biological Research Needs	Tim Smith
WG-20	Data Needs	Darryl Christensen

Biological research and data needs were identified as being high-priority items for the next SAW. Chairmen were instructed to select members of their respective working groups prior to the conclusion of the workshop. The chairman of the 5th SAW was asked to request further information from the two Fisheries Management Councils on priorities for and additions to the needs summarized in the lists presented in WP2-SAW5. It was noted following the workshop that ASFMC was reviewing priorities for data needs at this time, the results of which may be useful to these Working Groups.

2.) An updated assessment should be presented for scup; Penny Howell (CT) agreed to update previous work presented during the 4th SAW. An assessment of black sea bass is needed by the MAFMC in the near future, and an update on research progress should be presented at the 6th SAW. These are high priority requirements for the Mid-Atlantic Council because of the upcoming need for management plans for these species.

3.) Current studies on shell height - meat weight relationships for sea scallops should be continued, and appropriate individuals should be invited to review progress of this work at the 6th SAW. It was noted that the Data Needs Working Group should consider the priority of this need.

4.) Estimates of fishing mortality for American shad resources might be reviewed based on work underway under ASMFC auspices.

5.) An assessment of weakfish is needed by the ASMFC, and Rich Seagraves (DE) and Jess Hawkins (NC) are interested in working with NEFC staff in Woods Hole during the summer of 1988 to prepare an assessment for possible presentation at the 7th or 8th SAW.

6.) Butterfish mesh selectivity studies need to be completed; NEFC staff were requested to describe the current status of these studies at the 6th SAW. The possibility of including the results of some informal studies of the selectivity of square mesh cod ends conducted at Point Judith was suggested but felt not to be appropriate. Rather, the item was referred to the Data Needs Working Group for consideration.

7.) Preliminary results of studies of fisheries technical interactions focusing on mixed species effort definition and changes were presented at the 4th SAW. The value of discussing current research directions at the 6th SAW was noted, especially with the goal of encouraging coordination among NEFC and NEFMC staff. The possible involvement of NEFC and French biologists in joint studies was noted, and it was suggested that a recent report reviewing such studies be distributed to SAW participants in advance of the 6th SAW. It was noted in WP2-SAW5 that in the NEFMC description of informational needs

projects currently underway were not re-identified, but were assumed to be continuing. NEFMC representatives noted that this was one of those projects.

8.) The need for updates for the two squid, mackerel, and butterfish for MAFMC quota setting processes was noted. The amount of time necessary to present and review these updates is expected to be small given that they were unlikely to involve new approaches or to be particularly controversial. However, a more sophisticated assessment of mackerel involving the results of some studies of density dependent processes was in preparation. Because this could provide a substantially new basis for management advice, its review at a SAW prior to its being used for management advice would be useful. MAFMC representatives suggested that the MAFMC needs might be met without formal review during the SAW; NEFC representatives noted that further discussion of this point would be needed.

9.) A revised assessment of yellowtail flounder and of cod were noted to be of interest to the NEFMC. An assessment of cod is important because it has been a main focus of the mixed species trawl fishery. An assessment of yellowtail should include evaluation of the effects of management measures such as large mesh and closed areas. It was noted that an assessment of yellowtail may be available by the 6th SAW, but that both assessments could be handled during the 7th SAW. A revised assessment of summer flounder was noted to be of interest to the MAFMC, but given other needs a revised assessment including a VPA would not likely be available until the 7th SAW. Review of the priorities for updated and revised assessments of the many stocks of interest was referred to the Biological Research Needs Working Group.

10.) There was some discussion of whether the SAWs could provide detailed peer review of assessments and new research results. Some participants noted that there were generally too many items on the agenda to allow consideration of the details in many cases. The need for developing other approaches to obtaining detailed review was noted, especially when issues were controversial and where the conclusions may be sensitive to the specific assumptions made. The role of the NEFC annual Status of the Fishery Resources report in providing routine stock assessment updates was discussed, and it was suggested that the document would be more useful if it were completed in a more timely manner. Constraints on data availability were noted.

11.) The need for an evaluation of lobster escape vent size by the end of 1988 has been identified, and the recent action by the ASMFC to establish a committee to review available data was seen as meeting that need. It was suggested that ASMFC be invited to present the conclusions of that group at the 6th or 7th SAW.

Formal terms of reference were requested for other issues, e.g., single species assessment issues for groundfish and options for cooperative economic research involving Council, Region, and NEFC staff. Further discussion on this latter possibility did not occur, but the Economic Research Needs Working Group might consider this issue.

6.2. CONSERVATION ENGINEERING RESEARCH NEEDS

The purpose of the conservation engineering session was to expose fishery scientists in state agencies and NMFS to recent efforts to improve efficiency and selectivity of fishing gear. There have been a variety of approaches used, including:

(1) new technology in making undersea observations,
(2) continuing analyses of conventional methods of altering the selectivity of fishing gear (e.g., mesh sizes), and
(3) newer technology in gear design (e.g., separator trawls)

6.2.1. Fishery Management Council Needs

Conservation engineering (gear research) was described as attempting to make fishing gear work better to meet various goals stated by fisheries managers. The NEFMC has based much of its fishery management efforts on attempts to focus fishing mortality on older age-classes. Conservation engineering needs of NEFMC and MAFMC were outlined. Most important for the multispecies fishery was selectivity of square mesh codends/extension pieces, selectivity of alternative gear designs, mortality of dredges on uncaught scallops, bycatch of other species by scallopers, and the impact of dredges on benthic habitat. Lobster fishery research includes impacts of mobile trawl gear on cull formation, mortality of uncaught hard and softshell lobster, and biodegradable clips for trap panels. The MAFMC offered as priority needs improved selectivity work on trawls used in the butterfish fishery and selectivity work on trawls used in scup, and black sea bass summer flounder fisheries.

A problem noted in recent research on butterfish gear was a need for increased coordination. While the industry has been a welcome participant, the information generated to date has not been entirely useful from a scientific basis. Future projects would benefit from improved design work.

The NEFMC noted that several years ago there was no longer a conservation engineering program directly funded by the federal government; however, there were institutional players (states, universities, and NEFC) and funding resources (NURP, Sea Grant, S-K, state, NMFS, and NEFMC programmatic funds). Coordination and prioritization of research itself was needed. A group of interested colleagues evolved into a gear research section of the Marine Technology Society but there has been a lack of an institutional structure to turn this into a program within the Northeast region. Hence, the NEFMC Fishing Industry Conservation Engineering Support Program was developed using 1987 programmatic funds. Technical support by a group of experts and a coordinator will contract with industry associations (helped by Council seed money) to undertake specific studies. Resulting data will go back through the support group to be analyzed before it is routed to the Council. Immediate priorities are net selectivity in the sea scallop net fishery and net selectivity in multispecies fishery.

Two principal needs identified were 1) good sampling design for gear

technology studies, and 2) an institutional structure for coordination of conservation engineering.

6.2.2. TUGOS - Towed Underwater Gear Observation System

The Towed Underwater Gear Observation System (TUGOS) was described. In comparison to previous systems (e.g., Manta II), it is made of "off-the-shelf" components so is expected to be relatively inexpensive ($40,000). It will allow researchers and fisheries managers to better understand the fishing process and solve gear related problems.

The cylindrical shaped vehicle mounted under a "V" fin is compact in size and light enough (138 lbs.) for use on even the smallest of commercial fishing vessels. Pan and tilt cameras placed fore and aft are controlled by one of two joy sticks, the other controlling the maneuvering of TUGOS itself. One hundred and twenty-five volt AC power, most of which is required for lighting is provided through a 9/16" tow cable. A low-light, black and white camera will allow observing fish as they react to moving fishing gear at depths of 10 - 1,000'. TUGOS has been undergoing field tests. Modes of handling include hand tending, power block and storage reel (under development), and full winch system.

Among the gear development efforts in which TUGOS is expected to play a part in the near future are improved scallop dredges, selective whiting trawls, and shrimp separator trawls. TUGOS will also be useful as a controllable platform for underwater instruments, for seabed searching, pipeline and cable survey, naval mine countermeasures, in pollution surveys, and the study of the flow and wake of ships.

6.2.3. Winter Flounder Mesh Selectivity Experiments

Mesh selectivity experiments in Connecticut were described for codends of five meshes (3" diamond, 4" diamond, 4" square, 4 1/2" diamond, 5" diamond). Forty-five tows were made (26 experimental, 19 control) of generally one hour duration (1 hour and 2 hour for 4 1/2" mesh) from a 42', 365 hp research vessel. The net was a 60' Wilcox highrise with 4' steel V-doors.

Twelve thousand winter flounder were sampled in paired tows using a zipper attachment for easier exchange of codends. For 4 1/2" mesh, one control tow was made for every two experimental tows. Selection factors and size at 50% retention were calculated for each mesh and a logistic curve was fitted to the data using non-linear least squares method (Table 6.1, Figure 6.1.).

It was noted that at the 11" minimum length in Connecticut, 70% of the commercial catch would be lost at a 5" codend mesh.

There was generally good agreement between observed commercial catches using 3, 4, and 4.5 inch codend mesh and those predicted by applying the selection ogive to the length frequency distribution in the population (as determined from trawl survey cruises). Predicted commercial catches tended to

be more knife-edged than that observed in the fishery. A systematic bias in predicted catches using 4.5 inch mesh was noted and attributed to extensive "mudding" which occurred in 2 of 4 observed commercial tows.

Q: It was noted that the logistic model did not appear to fit well for smaller fish and perhaps other models should be investigated.
A: The Gompertz and Weibull models were also investigated but didn't fit any better.

Q: It was observed that since a 4 1/2" - 5" mesh released fish of about 11", then many small fish were either being landed or discarded. Which is it?
A: Discarded since there is a fair amount of law enforcement coverage and relatively few vessels in Connecticut so sustained landings of short fish would not be likely.

Q: It was suggested another line of research would be to determine the survival of fish which are forced through prevailing mesh and suffer scale loss or other impact which might increase mortality.
A: In lieu of research confirming the extent of this mortality, assessment advice should be conservative.

Q: It was noted that this type of work has been conducted before; what prompted the current investigation?
A: Both a lack of confidence in available studies and a need to provide information in support of mesh size management proposals.

Q: It was noted that 4" square mesh retained fish approximately 1 cm smaller than 4" diamond mesh, which is contrary to the square mesh experience in other investigations.
A: This is related to the fact that flounder are compressed in body form and fit through diamond mesh at larger size, rather than through square mesh of equal mesh measurement.

Table 6.1. Parameter estimates for logistic model[1] of percent retention (PR) as a function of total length (TL) and selectivity factors for alternate mesh sizes and configurations.

MESH SIZE (inches)	A	B	Y	r^2	SELECTIVITY FACTOR
3	100	13.98	-0.794	0.96	2.3
4SQ[2]	100	11.00	-0.511	0.78	
4	100	14.92	-0.664	0.92	2.2
4.5	100	12.84	-0.524	0.83	2.1
5	100	12.41	-0.444	0.88	2.2

1 $PR = A / (1+e^{(B+Y*TL)})$
2 Square mesh

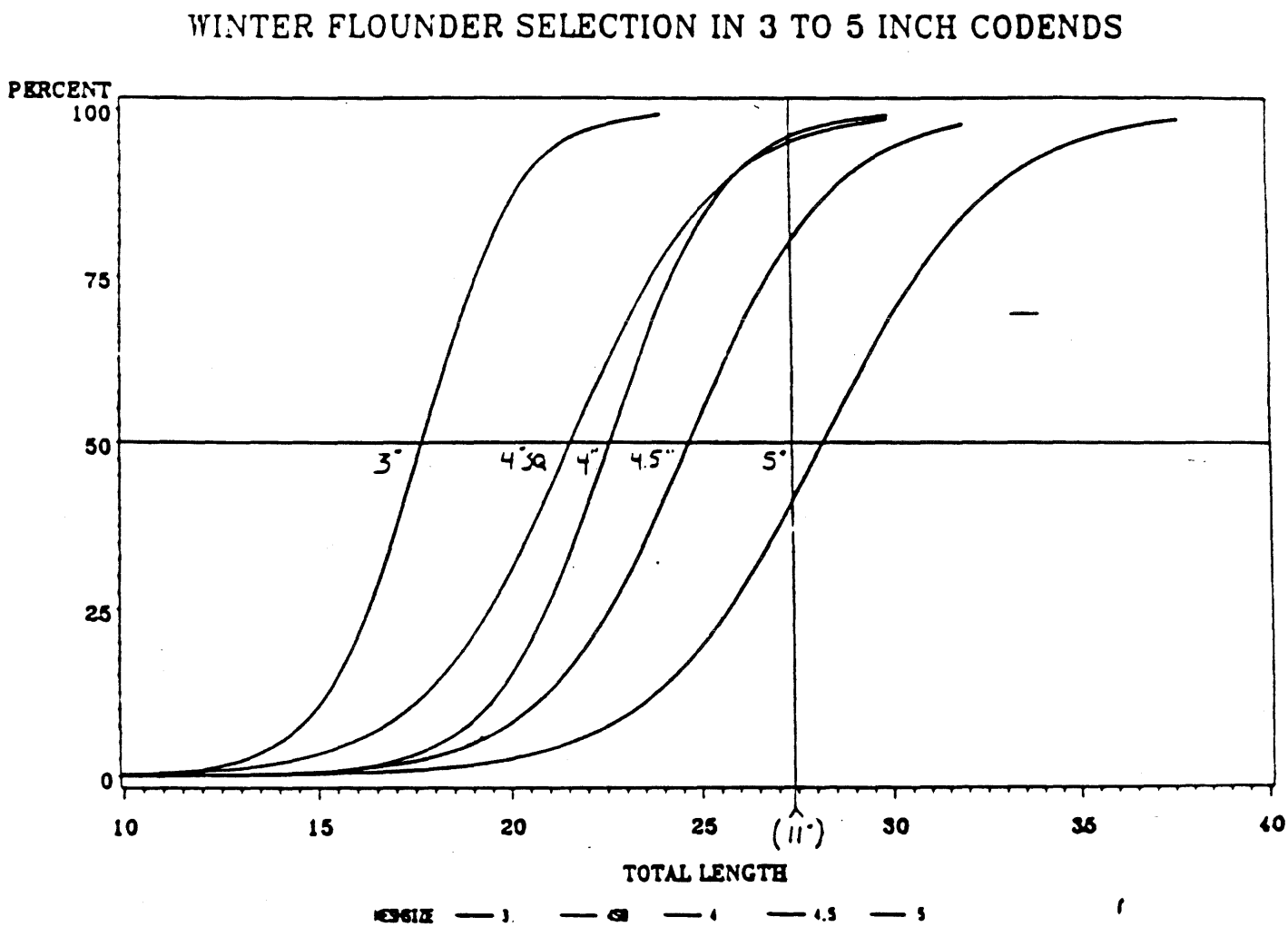


Figure 6.1. Winter flounder selection in 3 to 5 inch codends.

6.2.4. Separator Trawl Testing in the Gulf of Maine

The Maine Department of Marine Resources has experimented with shrimp separator trawl gear for several years. This work was initially undertaken in response to industry concerns over juvenile flatfish mortality. Until recently efforts have focused on a design incorporating a 5 1/2 inch mesh extension piece from the upper belly which retains marketable flatfish while releasing smaller individuals. An interior 3-inch mesh panel guides finfish upwards to this extension, while shrimp are swept through the panel mesh openings and into the codend. This design has been shown to release 90-95% of the juvenile flatfish entering the net. Unfortunately, it is difficult to construct, use and repair, and so consequently, work on this design has been discontinued. The need is for a simpler, more reliable design which can be used over a range of conditions. It is hoped that some form of separator trawl meeting these design criteria will soon be available for general use in the Gulf of Maine fishery.

Industry has shown considerable support for solving this problem and has come up with a number of possible designs which are now being tested. One type of gear which offers considerable promise incorporates a radial escape section in the extension piece similar to those used successfully in Norwegian fisheries. Here an interior funnel design guides shrimp past a cylindrical section consisting of rope for very large mesh or twine into the codend, while finfish, being more mobile can escape by swimming through the large meshes.

SAW members felt that it would be desirable if the study would also evaluate mesh selectivity for shrimp of any shrimp separator trawl that is developed.

6.2.5. A Review of Problems and How Conservation Engineering is Attempting to Address Those Problems

Management problems that might be resolved by conservation engineering studies were described. It was suggested that we seem to look for technological solutions to our problems when those problems become more difficult to solve. Fisheries in New England appear to be in that position at the present time.

A variety of problems facing fishery managers were identified:

1) non selective fishing gear
   - undersized fish
   - by catch

2) gear conflict
   - commercial vs. commercial
   - commercial vs. recreational

3) habitat
   - gear related destruction
   - enhancement (i.e. reefs)

The current management approach was characterized as "control of current harvest to increase future yield". It was suggested that, instead, we should be considering resource enhancement to create greater yields.

A variety of technology issues were identified:

1) fisheries development
   - non traditional alternatives
   - management perspectives

2) marine mammal entanglement

3) vessel safety
   - gear related injuries
   - vessel design

4) marine plastics pollution
   - derelict gear

An integrated program was suggested, made up of staff of NMFS, Councils, Foundations, States, Sea grants, Industry. Necessary activities in developing such a program include:

- memoranda of understanding
- a 5-year research plan
- a Technical Advisory Panel
- a Regional Coordinator
- TUGOS development

It was noted that various opinions have been expressed on where a Regional Coordinator for conservation engineering ought to be located and how such a program ought to be funded. However, this issue was noted to be outside the terms of reference of the meeting.

It was asked how this area of research can help in fisheries management. It was answered that it's not the entire answer to fishery management problems but, as an example, gear engineering and improved selectivity can aid in fine-tuning gear performance to resolve problems such as retention of small fish.

It was noted that the inactivity of the Northeast Fisheries Center in this field is not due to lack of desire but because other priorities are higher. Also, it was recommended that the literature be searched and experiences of European nations explored since a lot of this has been done during the past 20 years. Some of this has been done, and would be an ongoing part of the anticipated research.

7. PLANNING FOR FUTURE SAWS

7.1. TIMING

The 4th SAW recommended that the 6th SAW be held from March 28 to April 1, 1988. This timing was adopted by the 5th SAW. The timing for the 7th SAW was assumed to be fall, 1988, but the best time was not discussed.

7.2. TERMS OF REFERENCE

Several sources of terms of reference were noted, including the report of the 4th SAW and the discussions described in Section 6 of the present report. The items noted in the rightmost column of Table 7.1 were recommended as most useful to discuss during the 6th SAW.

Table 7.1 SUMMARY OF SPECIES AND TOPICS ADDRESSED IN NEFC STOCK ASSESSMENT WORKSHOPS 1 TO 5, AND POSSIBLE TOPICS FOR THE 6TH AND 7TH SAWS. R=REVISION, U=UPDATE, ST=SPECIAL TOPIC, WG=WORKING GROUP.

	WORKSHOP					POSSIBLE	
SPECIES/TOPIC	1ST JUL 85	2ND MAY 86	3RD SEP 86	4TH MAR 87	5TH NOV 87	6TH MAR 88	7TH FALL 88
ATLANTIC COD	FALL		R				R
HADDOCK	SPRING	U		U			
REDFISH	SPRING	U					
SILVER HAKE	SPRING	U		R			
RED HAKE	SPRING	U					
POLLOCK	FALL		R				
YELLOWTAIL FLOUNDER	SPRING	U					R
SUMMER FLOUNDER	ASMFC?		U	WG			R
AMERICAN PLAICE	SPRING	U		U			
WITCH FLOUNDER	SPRING	U					
WINTER FLOUNDER (GB)	FALL		R				
WINTER FLOUNDER (ESTUARY)	ASMFC?		R		ST		
SCUP				U		U	
WHITE HAKE	SPRING	U					
CUSK	FALL						
WOLFFISH	FALL						
ATLANTIC HERRING	ASMFC?				U,ST		
ATLANTIC MACKEREL	FALL	R		U		R	
BUTTERFISH	SPRING	U		U		U	
BLUEFISH	ASMFC?		U	ST	R		
RIVER HERRING	ASMFC?						
BLACK SEA BASS	ASMFC?				ST	ST	
STRIPED BASS	ASMFC?			ST			
SPINY DOGFISH	FALL						
SKATES	FALL						
ILLEX SQUID	SPRING	U		U		U	
LOLIGO SQUID	SPRING	U		U		U	
AMERICAN LOBSTER	FALL		R				
NORTHERN SHRIMP	ASMFC?		U		U		
SURF CLAMS	FALL		R		ST		
OCEAN QUAHOG	FALL		U				
SEA SCALLOP	SPRING	U					
SCIAENIDS	ASMFC?		U				
WINDOWPANE FLOUNDER							
SHAD						ST	
WEAKFISH							R

Table 7.1. Continued

	WORKSHOP						
						POSSIBLE	
	1ST	2ND	3RD	4TH	5TH	6TH	7TH
SPECIES/TOPIC	JUL 85	MAY 86	SEP 86	MAR 87	OCT 87	MAR 88	FALL 88
TRAWL SURVEY REVIEW		ST	ST				
BLUEFISH AGEING METHODS			ST				
LONG TERM POTENTIAL CATCH			ST	WG		WG	
MIXED SPECIES EFFORT				ST		ST	
SHELLFISH GEAR DISCARD, SELECTIVITY				ST			
RECREATIONAL SURVEY DATA				ST			
EXPERIMENTAL MACKEREL FISHERY				WG			
CATCHABILITY COEFF. CHANGES				WG			
ICHTHYOPLANKTON ASSESSMENT OF MACKEREL				ST			
NEFC INSHORE RESEARCH PLAN				ST			
MANAGEMENT MEASURE IMPACT							
SSB/R ESTIMATES					ST		
CONSERVATION ENGINEERING DIRECTIONS					ST		
SCIENTIFIC GOALS OF SEA SAMPLING					WG	WG	
ADEQUACY OF PORT AGENT INTERVIEW SYSTEM					WG	WG	
SQUID AVAILABILITY				WG	ST		
MANAGEMENT TRIGGER MECHANISMS					WG		
RESEARCH NEEDS, PRIORITIES IN 4 AREAS						WGs	
LOBSTER ESCAPE VENTS						ST	
BUTTERFISH SELECTIVITY						ST	
SCALLOP MEAT WT - SHELL HEIGHT						ST	

8. REFERENCES

Anderson, E.D., and F.P. Almeida. 1977. Distribution of atlantic mackerel in ICNAF subarea 5 and statistical area 6 based on research vessel spring bottom trawl surveys. ICNAF Selected Papers. 2: 33-44.

Alexander, M.S. 1981. Population response of the sequential hermaphrodite black sea bass, Centropristis striata, to fishing. MS. thesis SUNY, Stony Brook, NY. 104p.

Brennan, J.A. and J.E. Palmer. 1978. Estimates of variance of age composition of mackerel catches in ICNAF subarea 5 and statistical area 6. ICNAF select. papers #3. p.79-91.

Huntsman, G.R. and W.E. Schaaf 1981. Simulation of the impact of fishing on reproduction of the protogynous grouper, Epinephelus cruentatus. Ms.(unpubl.)

Low, R.A. Jr. 1981. Mortality rates and Management Strategies for Black Sea Bass off the Southeast Coast of the United States. No. Am. J. Fish. Manage. 1: 93-103.

Mercer, L.P. 1978. The reproductive biology and population dynamics of black sea bass, Centropristis striata. Ph D. thesis, College of William and Mary, Williamsburg, VA. 196p.

NEFC. 1986a - Report of the second NEFC Stock Assessment Workshop. US Dept. of Commerce, NMFS, NEFC, Woods Hole, MA. Lab. Ref. Doc. No. 86-09. 114p.

NEFC. 1986b - Report of the third NEFC Stock Assessment Workshop. US Dept. of Commerce, NMFS, NEFC, Woods Hole, MA. Lab. Ref. Doc. No. 86-14. 98p.

NEFC. 1987a. Status of the fishery resources off the northeastern United States for 1987. U.S. Dept. of Commerce, NOAA, Technical Memorandum NMFS-F/NEC-50. 132p.

NEFC. 1987b - Report of the fourth NEFC Stock Assessment Workshop. US Dept. of Commerce, NMFS, NEFC, Woods Hole, MA. Lab. Ref. Doc. No. 87-07. 102p.

NEFC. 1987c - Status of mixed species demersal finfish resources in New England and scientific basis for management. US Dept. of Commerce, NMFS, NEFC, Woods Hole, MA. Lab. Ref. Doc. No. 87-08. 105p.

Olla, B.L., A.L. Studholme, A.J.Bejda, C.Samet, and A.D.Martin. 1975. The effect of temperature on the behavior of marine fishes: a comparison among Atlantic mackerel; bluefish; and tautog. In: Proceedings of symposium on the combined effects of radioactive, chemical and thermal releases to the environment. 2-5 June 1975. Stockholm. International Atomic Energy Agency. Vienna. p.299-308.

Olsen, K. 1969. Directional responses in herring to sound and noise stimuli. ICES C.M./1969/B:20.

Ona, E., and O. Chruickshank. 1986. Haddock avoidance reactions during trawling. ICES C.M./1986/B:36.

Overholtz, W.J., and E.D. Anderson. 1976. Relationship between mackerel catches, water temperature, and vessel velocity during USA spring bottom trawl surveys in SA 5-6. ICNAF Research Document. 7p.

Pierce, D.E. and A.B. Howe. 1977. A further study on winter flounder group identification off Massachusetts. Trans. Amer. Fish. Soc. 106(2): 131-139.

Sette, O.E. 1950. Biology of the Atlantic mackerel Scomber scombrus of North America. Part 2. Migrations and habits. U.S. Fish Bulletin. 50(38): 251-358.

Shepherd, G. 1986. Evaluation of the river herring by-catch in the mackerel fishery. Woods Hole Laboratory Reference Document No. 86-10. 15p.

Shepherd, J. G. 1982. A versatile new stock-recruitment relationship for fisheries, and the construction of sustainable yield curves. J. Cons. int. Explor. Mer, 40:67-75.

Sims, S.E. 1985. Selected computer programs in Fortran for fish stock assessment. FAO Fish. Tech. Pap., (259): 183p.

Wenner, C.A., W.A. Roumillat, and C.W. Waltz. 1986. Contributions to the life history of black sea bass, Centropristis striata, of the southeastern United States. Fish. Bull. 84(3): 723-741.

9. APPENDICES

9.1. APPENDIX 1: AGENDA

DRAFT AGENDA FOR 5th NEFC STOCK ASSESSMENT WORKSHOP

NOVEMBER 16-20, 1987

SWOPE CENTER, MARINE BIOLOGICAL LABORATORY
WOODS HOLE, MASS

MONDAY NOVEMBER 16:

PRELIMINARIES
CHAIR: Tim Smith

1300 INTRODUCTIONS
WELCOME BY CENTER DIRECTOR
IDENTIFICATION OF WORKING PAPERS

1330 REVISION AND ADOPTION OF AGENDA (WP 9)

COASTAL AND ESTUARINE RESOURCES
CHAIR: Wendy Gabriel

1400 UPDATED NORTHERN SHRIMP ASSESSMENT (WP 5) Steve Clark

1430 REVISED ATLANTIC HERRING ASSESSMENT (WP 7) Mike Fogarty

1530 SPECIAL TOPIC: HERRING ASSESSMENT METHODS Dave Stevenson
Review recent work on stock identification.
Review needed improvements in assessment methods

1630 WORKING GROUPS MEET AS NEEDED:
WG-9, WG-12, WG-13, WG-14, WG-15

TUESDAY NOVEMBER 17:

0830 RAPPORTEURS' REPORTS DUE: PRELIMINARIES, SHRIMP, HERRING, HERRING ASSESSMENT METHODS

COASTAL AND ESTUARINE RESOURCES: CONTINUED
CHAIR: Wendy Gabriel

0900 REVISED BLUEFISH ASSESSMENT (WP 12, WP 13) Vic Crecco

1000 SPECIAL TOPIC: ESTUARINE WINTER FLOUNDER Frank Almeida
Status of EPA Estuary Initiative results relevant to stock assessment.

5th SAW AGENDA, TUESDAY, NOVEMBER 17, CONTINUED

1030 SPECIAL TOPIC: BLACK SEA BASS — Gary Shepherd
Review approaches to assessment that account for the unique life history pattern of this species.

1130 BREAK FOR LUNCH

TERMS OF REFERENCE FOR SAW
CHAIR: Vaughn Anthony

1300 Review Management and Scientific Terms of Reference (WP 2)

1430 SPECIAL TOPIC: Conservation Engineering Research Needs — Eric Smith

Fishery Mgmt Council Needs	Guy Marchessault
TUGOS	Chuck Byrne
Inshore Mesh Selectivity	Dave Simpson
Separator Trawls	Phil Averill

REVIEW DRAFT REPORT SECTIONS
CHAIR: Session Chairs

1600 PRELIMINARIES
SHRIMP
HERRING
HERRING ASSESSMENT METHODS

WEDNESDAY NOVEMBER 18:

0830 RAPPORTEURS' REPORTS DUE FOR TYPING: BLUEFISH, WINTER FLOUNDER, BLACK SEA BASS, TERMS OF REFERENCE FOR SAW

NEW ENGLAND FISHERY RESOURCES
CHAIR: Fred Serchuk

0900 SPECIAL TOPIC: SPAWNING STOCK BIOMASS PER RECRUIT ESTIMATES (WP 3, WP 4, WP 6) — David Pierce

0900 REVIEW OF SSB/R CONCEPT AND THEORETICAL BEHAVIOR [Russell, Gabriel, Polacheck]

1030 REVIEW OF WP 3 [NEFC staff]

1200 BREAK FOR LUNCH

1330 DISCUSSION WITH TECHNICAL MONITORING GROUP [Pierce et al]

5th SAW AGENDA, WEDNESDAY, NOVEMBER 18, CONTINUED

WORKING GROUP REPORTS
CHAIR: Fred Serchuk

1530 WG 9: LONG TERM POTENTIAL CATCH Brian Rothschild

1545 WG 12: SEA SAMPLING NEEDS John Mason

1600 WG 13: FISHING TRIP INTERVIEW DATA (WP 11) Darryl Christensen

REVIEW DRAFT REPORT SECTIONS
CHAIR: Session Chairs

1615 BLUEFISH
WINTER FLOUNDER
BLACK SEA BASS
TERMS OF REFERENCE FOR SAW

1730 SOCIAL HOUR IN SWOPE CENTER

THURSDAY NOVEMBER 19:

0830 RAPPORTEURS' REPORTS DUE FOR TYPING: SPAWNING STOCK BIOMASS PER RECRUIT ESTIMATES, WG-9, WG-12, WG-13

WORKING GROUP REPORTS
CHAIR: Fred Serchuk

0900 WG 14: MACKEREL AVAILABILITY

0930 WG 15: TRIGGER MECHANISMS

SPECIAL TOPICS
CHAIR: Steve Murawski

1000 SPECIAL TOPIC: SQUID AVAILABILITY Anne Lange

Review progress on analyses defined in report of working group 11 during 4th SAW. (WP 10)

Review research required for predicting squid availability.

1200 BREAK FOR LUNCH

1330 SPECIAL TOPIC: LONG TERM POTENTIAL CATCH OF Steve Murawski

SURF CLAMS AND OCEAN QUAHOGS (WP 8)
5th SAW AGENDA, THURSDAY, NOVEMBER 19, CONTINUED

TERMS OF REFERENCE FOR SAW
Chair: Tim Smith

1430 Finalize terms for 6th SAW

1530 Review draft report Sections not already completed

1630 RAPPORTEUR'S REPORT DUE FOR TYPING: SQUID AVAILABILITY, SURF CLAMS AND TERMS OF REFERENCE FOR 6TH SAW.

REVIEW DRAFT REPORT SECTIONS
CHAIR: Session Chairs

1630 SPAWNING STOCK BIOMASS PER RECRUIT
WG-9
WG-12
WG-13

FRIDAY NOVEMBER 20:

REVIEW DRAFT REPORT SECTIONS
CHAIR: Session Chairs

0900 SQUID AVAILABILITY
LONG TERM POTENTIAL CATCH OF SURF CLAMS AND OCEAN QUAHOGS
TERMS OF REFERENCE
WG-14
WG-15

1130 **FINALIZE WORKSHOP REPORT**
CHAIR: Tim Smith

DEFINITIONS OF TERMS AND ABBREVIATIONS USED:
REVISED ASSESSMENT: Substantially revised stock assessment
UPDATED ASSESSMENT: Catch and survey data brought up to date
WG: Working group established by SAW
SPECIAL TOPIC: Discussion organized around specified topic
WP: Working Paper for meeting, labeled 5-SAW-#, or WP #

9.2. APPENDIX 2: WORKING PAPERS FOR 5TH SAW; THOSE DESIGNATED "MS" NOT TO BE CITED WITHOUT PRIOR REFERENCE TO THIS REPORT.

WP1-SAW5 NEFC. 1987. Summary Status of the Fishery Resources. Section from "Status of the Fishery Resources Off the Northeastern United States for 1987," NOAA Technical Memorandum NMFS-F/NEC-50, pages 24-29.

WP2-SAW5 Smith, T.D. ms. Summary of stock assessment informational needs identified by the Fishery Management Councils.

WP3-SAW5 NEFC. 1987. Status of Mixed Species Demersal Finfish Resources in New England and Scientific Basis for Management. NMFS, NEFC, Woods Hole Lab Reference Document No. 87-7, 105 pp.

WP4-SAW5 Sissenwine, M.P. and J.G. Shepherd. 1987. An alternative perspective on recruitment overfishing and biological reference points. Can. J. Fish. Aquat. Sci. 44: 913-918.

WP5-SAW5 Northern Shrimp Technical Committee. 1987. Gulf of Maine Northern Shrimp, 1987. Report presented to Northern Shrimp Section, Atlantic States Marine Fish Commission, Oct. 23, 1987, 15 pp.

WP6-SAW5 Polacheck, T. ms. A computer program for exploring the behavior of fisheries management under spawning stock biomass per recruit concepts. Northeast Fisheries Center, Woods Hole, Mass., 6 pp.

WP7-SAW5 Not used.

WP8-SAW5 Murawski, S. ms. A probabilistic approach to definition of maximum sustained yield in the Atlantic surf clam fishery. Northeast Fisheries Center, Woods Hole, Mass.

WP9-SAW5 NEFC. ms. Draft Outline of the Report of the 5TH Stock Assessment Workshop. Northeast Fisheries Center, Woods Hole, Mass.

WP10-SAW5 Lange, A. ms. Survey statistics to predict relative availability of the long-finned squid to the USA fishery. Northeast Fisheries Center, Woods Hole, Mass.

WP11-SAW5 Chang, S., D. Christensen, and R. Schultz. ms. An overview of Fisheries Statistics Collection Programs in the Northeast Fisheries Center. NMFS, NEFC, Woods Hole, MA (title uncertain).

WP12-SAW5 Crecco, V., M. Terceiro and C. Moore. 1987. A Stock Assessment of Atlantic Coast Bluefish. Special Report Prepared for the Atlantic States Marine Fisheries Commission, 86 p.

WP13-SAW5 Terceiro, M. 1987. Status of Atlantic Coast Bluefish - 1987. NMFS, NEFC, Woods Hole Laboratory Reference Document No. 87-10, 54 pp.

WP14-SAW5 Smith, T. MS. Spawning Stock Biomass per Recruit Questions and Objectives. Special report prepared for the 5th Stock Assessment Workshop. NMFS, NEFC, Woods Hole, MA., 3pp.

9.3. APPENDIX 3: PARTICIPANTS

The participants who registered with the secretarial staff during the workshop were:

NMFS - Washington
Edith McClure

NERO
Harold Mears
Richard Seamans

NEFC
John Boreman
Anne Lange
Ronald Schlitz
Janice Forrester
Ronnee Schultz
Barbara Pollard
Joan Palmer
Steve Edwards
Carol MacMurray
Susan Wigley
Vaughn Anthony
Thomas Azarovitz
Kevin Friedland
Thurston Burns
Bridget Mansfield
Eric Teal
Najih Lazar
Loretta O'Brien
Kelly Kress
Al Blott
Ed Dyer
Vaughn Silva
Steve Clark
Marty Jaffe
Tom Polacheck
Jack Terrill
Darryl Christensen
Jay Burnett
John Ropes
Phil Logan
Fred Serchuk
Ray Conser
Frank Almeida
Sukwoo Chang
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Howard Russell
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