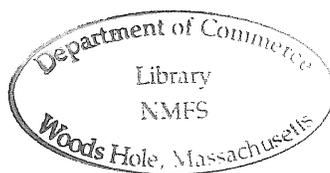


Implications of Yellowtail Flounder Stock Assessment Information For
Management Strategies.

by

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Introduction

Yellowtail flounder off the coast of the northeastern United States has been one of the most intensively studied and recorded fisheries. From almost the onset of this fishery critical fishery statistics were collected. The early years are described in the studies of Royce et. al (1959). Lux continued the work in the 1960's and records of these studies are given in Lux (1963, 1969a, b, and Lux and Nichy 1969). During the latter part of the 1960's and early 1970's efforts to record this fishery continued and these years are reviewed by Brown and Hennemuth (1971). Sissenwine studied the Southern New England yellowtail fishery intensively based on available data in the literature (Sissenwine 1974, 1977). Recent assessment documents (Sissenwine et al. 1978; McBride and Sissenwine 1979; and McBride et al. 1980) review the current status of information on the yellowtail flounder stocks. This extensive background literature provides considerable information which is useful in developing and evaluating management strategies. Unfortunately, the recent data on the commercial fishery, due to the confounding of regulation and adherence to regulations, makes the evaluation of the most recent data very difficult. Therefore, the information which is useful for strategy determinations is much better than that useful for tactical considerations. This discussion will then attempt to highlight from the entire body of yellowtail studies, implications for strategies.

Southern New England

The Southern New England yellowtail flounder fishery began in the 1930's and increased fairly rapidly during the early 1940's, collapsed to very low levels

in the 1950's, expanded again to very high levels in the 1960's, dropped down in the 1970's, and is now apparently on the beginning of an upswing. Beginning in the early 1940's catch and effort statistics were collected through interviews primarily in the port of New Bedford. These collections began just after the peak years of the fishery and followed the decline into the 1950's. Although this comprises a long history of catch statistics it is confounded by the practice in the fishery of discarding significant quantities of yellowtail which are smaller than desired under market conditions. Discard has been estimated for many of these years but on a minimum of information. The implication from discards does not effect general trends although differing year classes could shift abundance peaks from one year to an adjacent one; however, it does distort the total magnitude of the catches. Catches in the 1940's were supported by a series of relatively strong year classes. During the 1950's year class strength was considerably lower. During this period vessels left the yellowtail flounder fishery and effort was reduced considerably. Strong year classes began to reoccur in the late 1950's. As fishing effort was not concentrated on this fishery these year classes rebuilt the population to the peaks in abundance that were observed in the 1960's. Again, interpretation of the catches during the 1960's is difficult because of the discard. Furthermore, the entry of distant water fleets in the late 1960's confounded the problem. We are aware of these years of intense fishing effort, but the absolute magnitude is still a question. Following this event there was a precipitous drop in the fishery. The strength of incoming recruitment in the 1970's was much less than that in the 1960's. Furthermore, fishing mortality was maintained at very high levels, not dropped as happened in the 1950's. Thus, even the small recruitment that did occur was not available for stock rebuilding. Fishing regulations entered the picture in the early 1970's and while they were initially

not extremely restrictive they became more so as the stocks began to increase slightly and more vessels entered the yellowtail fishery. The change in fishing practices related to regulations makes the interpretation of the catch per unit effort data extremely difficult in the latter 1970's.

Resource survey cruises began in 1963 and have continued to the present day. These cruises have mirrored the commercial catch per unit effort indices throughout most of this period. Furthermore, they have provided information on the relative strengths of recruiting year classes. Traversing most of the history of the stock assessment research, commercial information provided the bulk of the assessment data; the survey information was input primarily estimates of recruiting year classes and corroboration of commercial abundance indices. However, in the last few years sufficient information to compare commercial and survey observations has not been available. The first indications of significant discrepancies came when reports for the 1976 year class in the commercial fishery indicated a higher level of abundance than did the survey. This was followed with the fall survey in 1979 in which the recruiting 1977 year class and the 1976 year class provided the bulk of the catches. In that survey, total abundance remained low. Indications from other surveys conducted by the ALBATROSS IV in the summer of 1979 and the fishing vessel FREISLAND in the winter of 1980 indicate that the Southern New England population has recovered significantly.

Age composition data from all 1979 surveys and the FREISLAND 1980 survey combined with the available age and length composition samples of the commercial fishery in 1979 point out that the present population consists primarily of fish of two year classes, the 1976 year class and the 1977 year class.

Furthermore, there are indications that the 1976 year class has been harvested very heavily as is indicated by the low numbers of four year olds in the population compared to the 1940's and the 1960's when the fishery was at higher levels. The relative survey catches of the 1978 year class indicate that it is not as large as that of 1977; it may be about the same size as the 1976 year class. The fishery in the earlier days had significant proportions of four and five year olds as well as three year old fish in the catch and two year olds primarily made up the discard. Currently, the fishery depends mainly on two and three year old fish with most of them being two year olds by the end of the year. This may have significant impact on the reproductive potential as the number of eggs produced by a four year old yellowtail flounder is 2.3 times that produced by a two year old flounder and each becomes more fecund with age. Furthermore, fecundity is related more so to size than to age, it is unusual to have a two year old produce more than a million eggs, whereas, a large four year old will produce three million eggs. It should be also be noted that the yield per recruit is increased by reducing fishing mortality on two year olds relative to three year old individuals.

Estimates of recruitment based on the work of Brown and Hennemuth (1971) and Sissenwine (1974) indicate that even during the best years recruitment to this stock ranged between 60 and 80 million fish. Overall estimates of maximum sustainable yield based on an average of all of the years in the fishery were 16,000 metric tons. Estimating equilibrium yield on an annual basis Sissenwine (1974) found the highest value to be 26,000 metric tons occurring in the early 1960's. The average equilibrium yield during the period 1944 to 1965 estimated by Sissenwine (1974) was 9,000 metric tons. Assuming a year class of 60 million

fish entering as two year olds, a fishing mortality rate of $F=1.0$ (which might be slightly lower than at present), the maximum yield from that year class would be 15,000 metric tons. If there were 80 million fish it would be 20,000 metric tons. This of course can be interpreted as a yearly catch only if all year classes are of approximately the same strength and in the fishery as ages 2 through 6. If one harvests them at a relatively younger age the yield is, of course, reduced in as much as a 4 year old at the beginning of the year is roughly twice the weight of a two year old entering the fishery during the middle of the year. Other indices of the total catch that might be removed can be gathered from the fact that the fishery collapsed quite quickly when there were catches exceeding 30,000 metric tons, both in the early 1940's and again in the late 1960's. These, however, were removals from populations consisting of several strong year classes. To indicate what might be left of the year classes in the population now it is necessary to estimate what has already been removed. Unfortunately, the present catch statistics leave a great deal to be desired. The reported catch would indicate about 6,000 metric tons from Southern New England. However, of the 4,500 metric tons from Cape Cod grounds and the 6,000 metric tons from Georges Bank one should undoubtedly include some fish which were caught in the Southern New England area. The total for all of the areas is about 15,000 metric tons. If one were to assume that half to two-thirds of this were taken in Southern New England then a Southern New England catch would be between 7,500 and 10,000 metric tons. If the 1977 year class is of like strength to those of the 1960's and fishing mortality is essentially at the same levels as then, then one would expect that about 10,000 tons both discard and landings would be taken from that year class in 1980 and

and another 10,000 tons before it was passed through the fishery. This presumes that only about 3,500 tons had been taken from this year class in 1979. The remainder of the 1979 catch being 1976 and earlier year classes. If one were to harvest at even higher rates then part of the remaining 10,000 tons to be taken from such an extremely good year class would be taken this year at the cost of less catch (wt) in the future and of course reduced spawning stock. One must recognize the fact that there are older as well as younger fish than the 1977 year class in the population and the landings would of course be above 10,000 MT. However, these are not solid estimates of the size of the incoming year classes or of how much is left from the 1976 year class. It is known that those larger than 1976 are virtually gone from the fishery. However, a conservative estimate would indicate that another 5,000 tons of landings could come from the other ages in the population. Fishing at this level, however, places the rebuilding of the spawning stock in possible jeopardy. It should be noted that while favorable environmental conditions is in most fish stocks considered to be the primary factor in achieving an abundant year class, the likelihood of good year classes occurring under similar environmental conditions is considered to be more favorable when spawning stock is more abundant. A conservative approach might be to utilize a figure assuming that the current population to be the yield from a single good year class to allow the new recruits and older fish to absorb part of this level of catch and to allow the remainder to accrue to the spawning stock size.

Middle Atlantic Area

The information available on the Middle Atlantic stock is relatively minimal as is the extent that this intermingles with the major body of fish in Southern New England. Catches from these stocks have been low recently compared to much

larger catches both in survey and in commercial data in earlier years. Currently much of the fishery is operating under by-catch regulations which essentially means an unregulated fishery with landings reflecting population abundance. Catches in the Middle Atlantic have been minimal in recent years (considerably less than 1,000 metric tons) and there are no indications that this will be greatly exceeded during the present situation. A value of approximately 1,000 tons in this area would not encourage entry of directed fishing, nor likely would it be exceeded so significantly so as to effect the fishery in the other areas. It should be noted that for a very brief period in the late 1960's and early 1970's landings exceeded 5,000 metric tons in this area. Peak catches of 8,000 or greater metric tons that occurred in 1972 may have been confounded by area reporting difficulties and some of these may have been taken from the Southern New England stock. Recovery in this area needs to be monitored carefully to avoid difficulties with the other areas.

Cape Cod Grounds

The Cape Cod stock appears to be relatively abundant at the present time. This has been reflected in certain trawl surveys by the Northeast Fisheries Center, reports of fishermen and in the inshore surveys by the State of Massachusetts. The Cape Cod stock has shown a very steady catch level of around 2-3,000 metric tons throughout most of its history and has been able to do this while maintaining relatively satisfactory catch per unit effort for the vessels involved. Since 1976 landings have approached 4,000 metric tons with the 1979 figure reaching 4,600 MT. However, it is difficult to interpret these recent values because reporting problems may have resulted in a portion of them being taken in either the Southern New England or Georges Bank stock areas. Therefore, to expect catches

close to 5,000 tons even with abundant year classes entering the fishery is probably unlikely. However, the current abundance would indicate a likelihood of sustained catches of 3,000 MT.

West of 69°

It should be noted that present management of these stocks is done through combining all catches west of 69°. This includes the Middle Atlantic stock, the Southern New England stock, the Cape Cod stock, and any fish from the Georges Bank stock which moves into this area during the wintertime. If one adds various figures given in the above three sections one would then conclude that a catch between 14,000 and 19,000 tons would be the best approximation of current production leaving relatively little to accumulate to the spawning stock size and make future catches greatly dependent on the entry of the 1978 year class which does not appear at the present (although the evidence is limited) to be as strong as the 1977, being more like that of 1976.

Georges Bank Stock

The Georges Bank yellowtail flounder fishery has been predominantly a by-catch fishery through much of its early history. Beginning with minimal landings in the late 1930's and early 1940's, it increased to something more significant in the 1950's (i.e., about 4,000 or 5,000 metric tons). The Georges Bank catch was incidental to catches of other species although some of it undoubtedly reflects certain directed efforts. In the 1960's the fishery expanded rapidly and reached catches of around 20,000 metric tons before tapering off slowly to a period in the late 1970's when catches dropped. In the period in the middle 1970's when the population appeared to be decreasing, effort increased maintaining the level of catch. The catch on Georges Bank in 1979 is reported to be 6.1 metric

tons. There remains a possibility that some portion of this may have been misreported (removals from the area might be less than reported catch). As with Southern New England, the current catch per unit effort remains relatively low although somewhat improved in 1979 over 1977 and 1978. Due to the confounding of regulatory measures this is an extremely difficult value to interpret now as opposed to the ability to interpret it in previous years.

Survey cruise catches for both fall and summer indicate relatively low abundance for Georges Bank. We do not have the equivalent measures as in the FREISLAND 1980 Southern New England survey for Georges Bank. Georges Bank catches being similar in the summer and fall surveys contrast with the differences in summer and fall Southern New England catches. The difference may be partially explained by the relatively greater abundance of 1976 year class fish in Southern New England. Examination of Georges Bank survey catch per tow values indicate the dominance of the 1977 year class which at the time of the summer survey would have been quite small. It is also true that age compositions from the Georges Bank commercial landings samples showed 75% by number were of the 1977 year class. In peak earlier periods this would only have been about 5% of the landings of an entering year class. Even considering a discarded proportion one would not have had up to 75% of the catch being 2 year old fish in any except an extraordinary year. The difficulty of interpreting this revolves around the factors of how much of this year class has been removed as well as how large it is.

The Georges Bank stock has generally had somewhat less potential than the Southern New England. Estimates of maximum sustainable yield on the average are about 9,000 metric tons according to the Schaeffer model. Examining yield per recruit at a fishing level of $F=1.0$ and the average year classes during the

period of the early 1960's is a value of about 10,000 metric tons. If in fact the 1977 year class is of that level the question then remains as to how much has been taken out. As is fairly obvious, the older fish are not well represented. There is also indication that the 1978 year class is less than that of 1977. The spawning stock size on Georges Bank based on the age composition is poorer than that of Southern New England at this moment, and thus increases the desirability of maintaining the 1977 year class and the population as long as possible. Based on the optimistic assumption that the 1977 year class is as abundant as the good year classes of the early 1960's and assuming that perhaps 2-3,000 tons may have been taken from this population, then one would expect at best another 7-8,000 tons to be taken throughout its lifespan in 1980, 1981, and 1982. After that they would contribute considerably less to the fishery though they would still indicate a noticeable amount of weight as 6 year olds in 1983. If in fact the 1977 year class is considerably smaller than those of the 1960's, the catch at 5,000 would not greatly lower current abundance as it would be harvesting 3 year old fish. The 10,000 ton catch from a given year class mentioned earlier would have expected to have had about 2,000 as 2's, about 4,000 as 3's, and 3,000 as 4's.

A catch of 5,000 tons gives about the incidental catch level that occurred during the 1950's and thus is potentially a limited minimal fishery. In conclusion then the current OY would allow for rebuilding of the stock if the 1977 year class is equivalent to those of the early 1960's. If it is not, and or is indeed lower then it will essentially be the incidental catch level maintaining stock at approximately the same abundance.

Conclusions

The strategies discussed in this document are obviously judgemental as specific hard estimates based on correlated survey and commercial data are not available for the present year. They do, however, draw on extensive studies concerning yellowtail flounder populations and thus are within the general bounds of probable expectations.

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