Woods Hole Fisheries Laboratory Centennial Public Forums

On August 15th the Woods Hole Laboratory sponsored two Public Forums, a morning session addressing "Fishery Research for the Future" and an afternoon session addressing "Fishery Management for the Future." These forums, conducted under a large tent, erected for a variety of outdoor activities on the Fisheries Dock, were well attended and popular. As with other events which included vocal discourse, the proceedings were documented on audio tape for later transcription and inclusion in the published Centennial Proceedings. However, although the day was balmy, it was rather breezy, and that, coupled with harbor and aircraft activities, and the poor acoustics of tents, resulted in very poor tape quality which rendered the recordings almost useless for the purpose of accurately reporting the dialogues which took place.

That which follows is our attempt at salvaging what transpired at those forums, some of which was highly provocative and sometimes controversial.

Forum on Fishery Management for the Future

Panel of Experts:
C. R. Sullivan, Executive Director, American Fisheries Society, (moderator); J. L. McHugh, Professor of Marine Resources; W. F. Royce, Fishery Scientist; P. A. Larkin, Professor, Institute of Resource Ecology; and G. C. Radonski, President, Sport Fishing Institute.

Fortunately, two panel members, J. L. McHugh and G. C. Radonski, had prepared formal statements to be delivered at this forum. Both are included here in their entirety since each touched upon the major topics that were discussed and which fishery scientists will need to address in the modern era.

Topics considered at this forum by participants, both panelists and audience, were wide ranging and, although research was the main theme, some aspects of management were also necessarily included in the discussions. The two papers presented at the outset set the tone for this forum. Laurie McHugh's paper prompted spirited discussion in the management sphere, centering on the concepts of the use of quotas based on total biomass, disincentive and incentive taxes, and limited entry as management tools. The improvement of fisheries resource management based on research-generated inputs was the overall consensus of this forum. Discussions centered on which areas and types of research and strategies could best achieve this basic goal.

Gil Radonski's opening remarks provided the initial fuel to fire the discussions which covered a broad range of subjects, among which were research designed to: Determine Total Allowable Catch (TAC); determine Maximum Sustainable Yield (MSY); determine Optimum Sustainable Yield (OSY); refine stock identification; determine migratory patterns and other population and harvest parameters; improve the collection, quality, and refinement of ecological, social, and economic data, especially with regard to recreational species; institute more restrictive harvest regulations; study habitat alteration, including artificial reef construction, location, and management; and improve and expand fish propagation and hatchery production. Other areas explored included: How to resolve resource allocation problems, improvement in sampling methodologies and techniques of stock assessment, broadening ecosystem studies, expansion of larval ecology studies, increasing efforts expended on population genetics and mariculture, and exploring the potential of remote sensing (satellites, electronics, etc.) tools.

This forum formally lasted 2 hours, but spirited discussions continued in small groups during the seafood luncheon, featuring dishes of underutilized species, which separated the two forums.

Can We Manage Our Atlantic Coastal Fishery Resources—II?

J. L. McHUGH

Introduction

In 1959, a little more than a quarter of a century ago, I published a paper with the same title as this (McHugh, 1959), in which I said that the conventional approach to fishery management, by methods designed to foster management for optimum sustained yield for each important species, held little promise for the middle Atlantic region. I suggested that more attention should be paid to the possibility of management of the biomass of the entire resource. Those remarks applied to the inshore fisheries of the middle Atlantic bight, but it is clear that the fisheries of New England and areas to the north are equally, if not more, important. The reason is that most species of food finfishes and some invertebrates are taken by gears that are not single species oriented, but rather take a wide variety of species of widely different values.

For example, in 1983 the fisheries of Massachusetts took 11.4 million pounds of sea scallops, *Placopecten magellanicus*, worth \$5.59 per pound; 12.6 million pounds of American lobster, *Homarus americanus*, worth \$2.34 per pound; 22.4 million pounds of haddock, *Melanogrammus aeglefinus*, worth \$0.59 per pound; 42.8 million pounds of yellowtail flounder, *Limanda ferruginea*, worth \$0.52 per pound; 92.8 million pounds of Atlantic cod, *Gadus morhua*, worth \$0.34 per pound; 4.9 million pounds of ocean perch, *Sebastes marinus*, worth \$0.28 per pound; 9.6 million pounds of silver hake, *Merluccius bilinearis*, worth \$0.13 per pound; 9.0 million pounds of Atlantic herring, *Clupea harengus harengus*, worth \$0.05 per pound; and varying amounts of other species worth various amounts per pound.

Moreover, when different ports have different demands for particular species or sizes of fish, the problem is further exacerbated. If fishermen are not willing to cooperate, and in fact falsify their landings records in various ways, such as reporting catches as having been taken in places where they were not caught, or giving false records of a variety of kinds, the situation becomes virtually unmanageable.

Herbert Graham (1970), then Director of the Woods Hole Fisheries Laboratory, published a paper describing management of the groundfish fisheries of the northwest Atlantic, principally haddock and cod, later herring, silver hake, red hake, *Urophycis chuss*, and mackerel, *Scomber scombrus*. He pointed out that total landings of all species from the ICNAF Convention area had been rising since 1953, but he considered it unlikely that these increases could long be sustained. He pointed out further, that although ICNAF provided only for maximum sustainable physical yield, wide fluctuations in the success of spawning from year to year made this extremely difficult to achieve. He also pointed out that some governments were interested in maintaining the maximum economic yield, and that this could be achieved best not only by reducing fishing mortality rate by as much as 30-40 percent, but also by reducing the number of vessels by a substantial amount. This would reduce excessive capital and manpower in the fleet, and would bring very definite economic benefits to vessel owners and crews, since each vessel would be landing more fish per year and crews would receive a higher annual gross income. Two complicating factors were variable recruitment, which meant that adjustments to the quota must be made from time to time, perhaps annually; and the fact that a number of species figured prominently in the catch, so that inevitably some would be overfished, and some would be underfished, if quotas were placed on the most desirable species.

Edwards and Hennemuth (1975) pointed out that recovery time is required

ABSTRACT—A number of authors have pointed out the difficulty of managing multispecies fisheries that take a variety of species at various times and places. None is more resistant to management than an international trawl fishery, where by-catch and interactions between species are complicated by differences between countries in desires for kinds of species and sizes of fish. Moreover, when fishermen do not cooperate, and falsify locations and amounts of landings, management becomes virtually impossible. Yet governments have a responsibility to avoid overfishing of stocks of fish if the ecological balance is to be maintained at optimum levels. Too much management is just as bad as too little. The best method, or combination of methods, of management probably is a total biomass quota, with some attention to the advantages of disincentive and incentive taxes, and limited entry. Above all, we must avoid discounting future generations and must preserve their options to continue to harvest the living resources of the sea wisely and fully.

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when a stock of fish has been reduced below the point of maximum or optimum yield, for variations in recruitment must be averaged out. At this stage of development of a fishery management plan, the credibility of biologists may be seriously questioned. Fishermen see a bonanza ahead, but the scientist is advising caution and curtailment of catches. Fisheries often expand because fleets are attracted by short-term high abundance, but yield curves drawn through these points of catch and effort will produce overestimations of potential long-term yield. In mixed fisheries like trawl fisheries it has been shown that when yield curves are fitted to total catch of all species and total effort of all fleets, a certain level of MSY results, but the sum of individual species assessments indicates a considerably higher MSY. Obviously, by-catches and interactions between species must be given adequate consideration. Thus, again caution is required.

Larkin (1977) anticipated all of these problems, and some others, when he gave an epitaph for MSY. He described the definition of "optimum yield" as given by the Congress of the United States in the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA) as the amount of fish:

"(a) which will provide the greatest overall benefit to the nation, with particular reference to food production and recreational opportunities; and

(b) which is prescribed as such on the basis of the maximum sustainable yield from such fishery, as modified by any economic, social, or ecological factor."

In short, he said, it is a recipe for obtaining heaven or hell, and what is achieved will depend on how the definition is variously interpreted.

The Canadian approach is equally ambivalent, stating the goals to be "to maximize food production, preserve ecological balance, allocate access optimally, provide for economic viability and growth, optimize distribution and minimize instability in returns, ensure prior recognition of economic and social impact of technological change, minimize dependence on paternalistic industry and government, and protect national security and sovereignty," it being kept in mind that there is no priority implied in the order things are listed; that there are interactions in the objectives; and that trade-offs and compromise will be necessary. These goals, Larkin says, are striking because they imply that there is no single optimum policy; and they are humorous because they so accurately reflect the real difficulties of managing human affairs.

Larkin concluded that he did not have an inspired personal vision for the future. His personal preference put the fish first, economics second, and social problems a distant third. He made it clear that our first obligation is to our grandchildren; that we should be quite stern about abusing resources, and almost equally stern about being efficient economically, if only to save on energy resources.

In 1973, ICNAF proposed a unique management plan for the fisheries of subareas 5 and 6 (Edwards, 1976). Individual quotas (total allowable catches) were set for major species, and on top of this, a second-tier quota, substantially less than the sum of individual quotas, was imposed to make allowance for unavoidable incidental catches of the major species, and for energy changes between stocks. Such a two-tier quota was put into effect in 1974 at 924,000 metric tons, 825,000 metric tons in 1975, and 650,000 metric tons in 1976. Individual quotas for major species totalled 815,000 metric tons (1.8 billion pounds) in 1976, but the second-tier quota for all finfishes and squids combined was only 650,000 metric tons (1.4 billion pounds). This arrangement lasted only through 1976, for the FCMA superseded it, and no equally promising arrangement has replaced it during the ensuing 9 years. This total ecosystem quota approach was not dissimilar to the biomass technique suggested by McHugh (1959).

Edwards (1976) also showed that between 1963-65 and 1972-74 the estimated biomass of selected species (the major ones) had decreased from 14.2 billion pounds to 8.8 billion pounds, a drop of about 38 percent. In the same period average landings had actually increased slightly, from 2.6 billion to 2.8 billion pounds. Thus, in 1963-65, average landings were about 18.5 percent of average standing crop, but by 1972-74 they had increased to about 31.8 percent. As already pointed out, ICNAF subsequently set second-tier quotas. This recognized the by-catch problem, which in trawl fisheries is considerable and unavoidable, and is made even more difficult when the size of meshes in trawls varies between areas. It also offered the best approach for maintaining the ecosystem in its most productive and useful state to man in the long run.

It was estimated that the second-tier quota for 1976 would have restored the stocks to reasonable levels in about 7 years, in other words by 1983. This was never put to the test because the FCMA took over in 1977. Later, Edwards pointed out (personal commun., 1985) that this last modus operandi in ICNAF was not bad, although it had its faults. He doubted that the form of dictatorship that was possible in the international arena would be acceptable now that national interests had assumed control. From a purely economic point of view, future yields are discounted each year into the future, so that eventually there is no economic gain at all. From a living natural resources point of view this makes no sense. As Edwards said "we must stop discounting the future." Future generations must have the same or better options than we do.

Clark and Brown (1977) made it clear that since the early 1960's the fraction of the biomass harvested annually had increased significantly. In the 1960's only about one-fifth of the total was taken, but by 1974 it was between one-third and one-half. This implied that a significant degree of overfishing had occurred and that stock size had been reduced below the level corresponding to MSY. They estimated that a stock level of about 4.0-4.5 = 10^6 tons should be maintained for subareas 5 and 6 if MSY was to be achieved. However, estimates of fishable biomass were only about 2.0 = 10^6 tons at the start of 1975. Thus, the total allowable catch of 650,000 tons adopted for 1976 was reasonable if the stocks were to be rebuilt to the MSY level.

Sissenwine and Marchesseault (1985)

have concluded that even though foreign fishing is now under some form of control, there is still more fishing effort operating than is necessary. Since the FCMA began in early 1977, fishing effort in the New England trawl fleet has nearly doubled. The interim fishery management plan of the New England Fishery Management Council has emphasized minimum fish size and minimum mesh size regulations, using also closed seasons and closed areas to protect spawning fish. Little consideration has been given to catch quotas, perhaps not surprising in light of past experience, but unfortunate in light of increasing effort. It also appears that the New England Council has specifically exempted limited entry from consideration. Fishery management regulations must be acceptable to industry and must be enforceable. These are major hurdles at present, and the future of fishery management on Georges Bank is not at all optimistic.

Appolonio (1987) has emphasized these points. He sees vast differences in legal frameworks and management policies and objectives between Canada and the United States, both of whom will now be harvesting the resources of Georges Bank now that the World Court has rendered its decision. He also sees great difficulty in managing a mixed-species fishery. Not only are management objectives for each species different, and each interacting with all other species in the fishery, but also different depending on which port in New England fish are delivered to. He concludes that the stocks of fish on Georges Bank will continue to remain unstable, and in the absence of an agreed upon management purpose, that uncertainty, frustration, and crisis will continue to be the major problems. He believes that another crisis comparable to the entry of foreign fleets onto Georges Bank in the middle 1960's will be necessary to crystallize the issues and force a consensus on management. What that crisis might be, other than virtual collapse of the fishery, is anybody's guess.

Alexander (1985) believed that the whole Georges Bank dispute was unnecessary, and he questioned whether the results justified the expense.

The Fisheries of the New England Region

In 1983 the trawl fisheries of the New England region (John P. Doll, personal commun.) landed 179,990 metric tons (about 396.8 million pounds) valued at about $154.7 million. In 1977, 134,890 metric tons (297.4 million pounds) were landed, worth $74.9 million. Expressed in 1967 dollars, to cancel out the effects of inflation, these values were, respectively, $51.8 and $41.3 million. If the increase in effort is considered, then effort in days fished rose from 25,562 in 1977 to 40,131 in 1983, an increase of about 57 percent. Thus, the catch per days fishing dropped from about 11.6 thousand pounds in 1977 to about 9.9 thousand pounds in 1983, and the total return to fishermen dropped from $51.8 to $41.3 million, a distinct loss.

Considering the major species in the trawl fishery (Thompson, 1929-84; Hodder, 1984; Barbara O'Bannon, personal commun.), haddock landings have declined from about 349.3 million pounds in 1965 to about 77.8 million pounds in 1980; cod has declined from about 145.4 million pounds in 1945 to about 136.4 million pounds in 1980 (cod landings in 1887 may have been considerably higher, but that figure is not certain); Atlantic herring has declined from about 961.7 million pounds in 1968 to 184.0 million pounds in 1980; Atlantic mackerel has declined from about 855.2 million pounds in 1972 to about 6.8 million pounds in 1980; silver hake or whiting has declined from 703.0 million pounds in 1965 to 38.6 million pounds in 1980; ocean perch has declined from about 258.3 million pounds in 1951 to about 24.4 million pounds in 1980; alewife has declined from about 115.7 million pounds in 1969 to about 4.1 million pounds in 1980; red hake or ling has declined from about 241.9 million pounds in 1966 to about 5.9 million pounds in 1980; yellowtail flounder has declined from about 149.7 million pounds in 1968 to about 42.8 million pounds in 1980; and many other species have declined by similar amounts since peak landings were recorded in the 1960's or 1970's. Only pollock, *Pollachius virens*, of the major species landed off New England, has increased in landings from a maximum of 49.5 million pounds in 1978 to 52.0 million pounds in 1980, but has subsequently dropped. The figures since 1929 are given in Table 1. Foreign landings are not included after 1980, but they are relatively small for most species.

Thus, haddock landings had dropped by 1980 to about 22 percent of the maximum, cod dropped to about 94 percent, Atlantic herring to about 19 percent, Atlantic mackerel to less than 1 percent, silver hake to about 5 percent, ocean perch to about 9 percent, alewives to about 3 percent, red hake to about 2 percent, and yellowtail flounder to about 29 percent. The New England Fishery Management Council, despite considerable tinkering with regulations, has not yet managed to effect increases in the landings of these important resources, and in fact landings have decreased even farther for most species (Table 1).

The Middle Atlantic Fishery Management Council has done no better. In its first fishery management plan (FMP) it wisely froze the number of licenses in the surf clam, *Spisula solidissima*, fishery (McHugh, 1977), but despite this advantage the fishing week is now only 6 hours long. The ocean quahog, *Arctica islandica*, fishery, which in many respects suffers from the same weaknesses of the surf clam fishery, has not had similar treatment (McHugh, 1983). The finding recently by John Ropes of the Woods Hole Fisheries Laboratory (personal commun.) of a specimen over 220 years of age suggests that a relatively low harvesting rate might be necessary if this species is to remain a viable fishery resource. The surf clam fishery has recovered somewhat, but that may be due more to natural events than by any action of the Council. There has not been noticeable recovery in any other fishery. In fact, except for the fisheries of the Great Lakes (McHugh and Conover, In press), the fisheries of the Middle Atlantic region are in poorer condition than those of any other region around the coasts of the United States.

Is Improvement Possible?

I have not painted an optimistic picture of the future of the fisheries of the northwest Atlantic Ocean, or of fisheries in most other parts of the ocean, for that matter. My own solution, proposed more than a quarter of a century ago, and briefly tried but not tested by ICNAF, to manage by total biomass rather than species by species, has great appeal, and probably at our present state of knowledge is the best possible solution. A great deal more information about individual fishery stocks will be necessary if it is to become reasonably precise, and that probably will increase the cost of management considerably. Close cost/benefit studies probably will be necessary at an early stage. Moreover, it is not entirely clear how fishermen can be persuaded to seek species of lower value, if higher value species are determined to be threatened and must be protected. This is especially difficult in a trawl fishery, where many species are caught.

The idea has been proposed by Dykstra (1980) that on species from which effort should be reduced, the buyer would charge a tax on the purchase price. On the other hand, if effort should be increased on underutilized species, the buyer would add a certain amount to the purchase price. The system would work something like a sales tax (McConnell and Norton, 1980). Disincentive and incentive taxes would have to be very carefully chosen, and perhaps adjusted at fairly frequent intervals, to have just the right effect on catches. As already pointed out, it also would require much more information on the condition and future prospects of all stocks than we now have.

Table 1.—Weight, in millions of pounds, of major species landed from Maine to Virginia, domestic and foreign, from 1929 to 1983. Prior to 1951 landings of red hake and flounders were not separated from other species but landings were relatively small. Figures after 1980 do not include foreign landings, but these also are relatively small. Boldface data indicates greatest catch.

Year	Haddock	Cod	Herring	Mackerel	Whiting	Ocean perch	Alewife	Red hake	Yellowtail flounder	Pollock
1929	261.7	96.0		64.1	17.0		24.1			14.3
1930	267.1	112.4	83.6	51.8	14.0	0.1	30.5			17.9
1931	182.5	100.2	64.4	47.4	10.8	0.2	34.0			10.8
1932	158.1	93.8	38.8	60.8	9.9	0.1	27.3			11.3
1933	168.6	107.1	48.8	41.5	11.5	0.3	29.9			15.8
1935	195.9	122.2	54.6	65.1	23.0	17.2	20.2			33.4
1937	171.8	140.9	53.4	26.6	36.3	58.4	23.8			37.7
1938	169.0	129.2	22.2	43.2	35.5	65.0	27.5			40.7
1939	171.0	113.2	76.5	32.6	39.1	77.4	23.3			37.0
1940	148.9	85.9	46.0	40.7	49.6	85.1	19.5			37.5
1942	145.7	69.6	101.7	51.1	56.6	128.1	17.0			32.0
1944	140.6	97.4	85.1	74.2	61.0	120.2	26.6			23.1
1945	155.0	**145.4**	96.1	58.7	90.1	131.8	20.1			37.7
1947	166.4	66.8	129.9	58.8	73.7	146.6	28.3			21.0
1948	156.4	71.4	194.1	51.1	82.2	238.1	26.8			37.9
1949	135.0	62.5	170.7	42.1	91.6	237.0	32.2			28.8
1950	158.6	57.5	196.5	22.1	67.3	207.8	40.5			25.6
1951	154.1	50.0	67.2	15.7	120.1	**258.3**	44.6	5.2	18.4	22.7
1952	161.5	43.7	155.1	18.1	108.5	189.0	39.4	4.5	16.9	27.0
1953	139.6	32.7	111.2	8.6	89.6	153.9	37.3	2.9	13.7	23.9
1954	154.9	36.8	130.2	4.0	95.3	181.5	39.4	3.0	12.8	20.4
1955	135.4	35.6	105.9	3.8	118.8	157.0	34.4	7.6	14.4	23.2
1956	152.3	35.2	148.0	4.1	94.0	151.1	40.8	10.4	14.6	23.0
1957	133.7	34.1	161.6	2.4	133.1	133.9	45.5	4.0	22.5	22.0
1958	120.2	41.5	179.0	4.5	111.3	148.6	59.9	5.6	33.3	32.9
1959	113.0	46.8	121.3	4.0	115.1	136.7	35.6	4.8	29.8	24.5
1960	119.7	40.8	155.2	3.0	111.6	141.4	38.2	8.9	31.2	27.2
1961	134.0	47.3	207.2	3.0	100.7	132.2	40.7	8.7	39.4	22.2
1962	144.7	64.4	492.7	2.2	197.4	127.5	37.9	6.7	60.7	17.6
1963	147.7	71.3	369.3	4.8	329.4	110.9	41.1	14.4	83.3	17.8
1964	172.3	67.2	353.4	6.0	463.1	90.4	35.3	12.3	83.6	22.6
1965	**349.3**	95.8	163.5	9.9	**703.0**	86.0	48.7	133.1	83.4	20.7
1966	285.7	129.1	377.5	20.8	562.7	84.6	42.9	**241.9**	67.7	23.4
1967	136.6	97.1	561.0	50.4	264.8	72.3	52.1	119.0	63.3	20.0
1968	105.0	110.7	**961.7**	131.2	211.1	61.7	88.1	30.5	**149.7**	11.9
1969	59.2	104.8	800.8	248.2	209.4	56.5	**115.7**	109.9	113.0	18.2
1970	33.5	77.9	637.8	461.3	116.1	56.2	67.9	18.4	82.1	17.8
1971	29.6	81.3	701.4	768.6	235.2	68.3	66.2	82.2	67.6	34.0
1972	16.0	72.6	519.8	**855.2**	262.6	71.9	44.0	165.3	84.2	29.8
1973	14.0	78.6	517.3	841.9	298.4	65.7	28.8	140.9	67.1	30.9
1974	12.8	78.7	411.4	650.2	285.0	45.5	29.3	70.5	55.6	29.1
1975	19.5	76.2	403.3	183.1	247.6	35.9	26.0	60.7	43.1	32.6
1976	16.1	67.1	206.8	459.1	177.2	33.5	10.8	59.9	38.0	30.7
1977	35.0	90.9	116.4	121.1	166.8	35.4	5.7	15.4	36.6	36.4
1978	63.4	107.0	112.6	4.3	83.0	35.8	6.0	9.5	25.2	49.5
1979	53.9	111.8	143.4	5.2	45.2	34.1	4.3	9.2	35.3	40.9
1980	77.8	136.4	184.0	6.8	38.6	24.4	4.1	5.9	42.8	**52.0**
1981	55.3	100.5	139.1	5.9	33.4	18.6	3.1	5.3	34.1	37.3
1982	44.8	104.5	73.0	7.4	41.1	18.8	2.4	4.8	48.0	31.3
1983	32.6	112.4	51.3	6.4	37.1	13.3	3.2	4.8	72.9	30.8

About one-third of all fishes caught in the North and Middle Atlantic regions (Maine to Virginia inclusive) are taken in otter trawls. In the Georges Bank area, about 83 percent are taken in otter trawls (238.2 million pounds as against 285.4 million pounds of fishes). Otter trawls are undoubtedly the most difficult of all fishing gears to manage. They take a wide variety of important species, which fluctuate widely in abundance from time to time, and they take species of various sizes at various times. Any attempt to manage the catch of trawl fisheries species by species, by quotas, by control of mesh size, by closed areas, closed seasons, or by any other device, will inevitably underfish some species and overfish others, leading in the long run to declining catches.

The only practical way, although by no means easy, to manage trawl fisheries is by placing an overall quota on total landings, based on the hypothesis that total production of fish and some shellfish of all species remains fairly constant. This MSY or OSY of the biomass as a whole will inevitably be less than the sum of the MSY's or OSY's of individual species. Fishermen will then have to calculate their total catch rather carefully if they are to continue fishing for a whole season. A system of disincentive and incentive taxes, and some form of limited entry probably would help to ensure that this will indeed occur, but these will require more study.

There is no doubt in my mind that too much management imposed from without is just as bad as too little. We should allow as much flexibility as possible to fishermen to operate as they see fit. On the other hand, government has a responsibility to future generations to preserve their options, which means that excessive fishing of any species must be avoided, unless there is good and sufficient reason why that should be beneficial in some way. How to accomplish all that in fisheries which operate with different gears, and in different places, and at different times; or in fisheries like trawl fisheries which take many species, is not at all simple. The manager must be flexible at most times, but very firm at others, and this is a difficult and thankless task. But we must hope that the New England Fishery Management Council will eventually come out with an Atlantic demersal finfish plan that will have the essential aspects of all these features and will work. Then it must go on to deal successfully with pelagic fisheries, and shellfisheries. Among recent papers that discuss these problems are May et al. (1979) and Gulland (1984).

Literature Cited

Alexander, L. M. 1985. The Georges Bank dispute: Did anyone benefit? Sea Technol. 26(7):65.

Appolonio, S. 1987. The future for fisheries management on Georges Bank. *In* R. Backus (editor), Georges Bank, p. 508-512. Mass. Inst. Technol. Press.

Clark, S. H., and B. E. Brown. 1977. Changes in biomass of finfishes and squids from the Gulf of Maine to Cape Hatteras, 1963-74, as determined from research vessel survey data. Fish. Bull. (U.S.) 75(1):1-21.

Dykstra, J. 1980. Conference discussion. *In* R. B. Rettig and J. C. Ginter (editors), Limited entry as a fishery management tool, p. 115-116. Proc. Natl. Conf. to Consider Limited Entry as a Tool in Fishery Management. Univ. Wash. Press, Seattle.

Edwards, R. L. 1976. Middle Atlantic fisheries: Recent changes in populations and outlook. Am. Soc. Limnol. Oceanogr., Spec. Symp. vol. 2:302-311.

________ and R. Hennemuth. 1975. Maximum yield: Assessment and attainment. Oceanus 18(2):3-9.

Graham, H. W. 1970. Management of the groundfish fisheries of the Northwest Atlantic. *In* N. G. Benson (editor), A century of fisheries in North America. Am. Fish. Soc., Spec. Publ. 7:249-261.

Gulland, J. A. 1984. Fisheries: Looking beyond the golden age. Mar. Policy 8(2):137-150.

Hodder, V. M. 1984. Northwest Atlantic Fisheries Organization. Stat. Bull. 30. Fish. Stat. 1980 (Rev.). Dartmouth, N.S., Can., 278 p. [and previous numbers in this and other series].

ICNAF. 1974. Annual Report 24 for the year 1973/74. Int. Comm. Northw. Atl. Fish., Dartmouth, N.S., Can., 128 p.

Larkin, P. A. 1977. An epitaph for the concept of maximum sustained yield. Trans. Am. Fish. Soc. 106(1):1-11.

May, R. M., J. R. Beddington, C. W. Clark, S. J. Holt, and R. M. Laws. 1979. Management of multispecies fisheries. Science 205(4403):267-277.

McConnell, K. E., and V. J. Norton. 1980. An evaluation of limited entry and alternative fishery management schemes. *In* R. B. Rettig and J. C. Ginter (editors), Limited entry as a fishery management tool, p. 188-200. Proc. Natl. Conf. to Consider Limited Entry as a Tool in Fishery Management. Univ. Wash. Press, Seattle.

McHugh, J. L. 1959. Can we manage our Atlantic coastal fishery resources? Trans. Am. Fish. Soc. 88(2):105-110.

________ . 1977. Atlantic sea clam fishery: A case history. *In* K. M. Jurgensen and A. P. Covington (editors), Extended fishery jurisdiction: Problems and progress, 1977, p. 69-89. Proc. N.C. Gov. Conf. on Fish. Manage. under Extended Jurisdiction. Univ. N.C. Sea Grant Rep. UNC-SG-77-19.

________ . 1983. Jeffersonian democracy and the fisheries revisited. *In* B. J. Rothschild (editor), Global fisheries - perspectives for the 1980's, p. 73-96. Springer-Verlag, N.Y.

________ and D. Conover. In press. History and condition of food finfisheries in the United States: A comparison of the Middle Atlantic region with other coastal regions and the Great Lakes. Fisheries.

Sissenwine, M. P., and G. D. Marchesseault. 1985. *In* T. Frady (editor), Fisheries management: Issues and options, p. 255-278. Univ. Alaska Sea Grant Rep. 85-2.

Thompson, B. G. 1929-84. Fishery statistics of the United States. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Stat. Dig. (var. years, pagin.).