Assessment Information for Stocks in ICNAF Subarea 5 and Statistical Area 6 Not Considered in Preliminary Management Plans

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INTRODUCTION

The following document provides background information and basic details of current assessment studies for all stocks hitherto not considered in draft PMPS. Without exception, these stocks have been depressed below former levels of abundance, and some (notably the Georges Bank haddock stock and yellowtail stocks off southern New England and in ICNAF Statistical Area 6) have been seriously depleted due to overfishing and recruitment failure. Other stocks (e.g., redfish in Subarea 5 and silver hake in Division 5Y) have also been seriously reduced in abundance in recent years but show more promise for recovery and increased productivity due to improving recruitment if fishing mortality is kept at low levels.

Available estimates of maximum sustainable yield (MSY), stock biomass at the MSY point, and current biomass levels are given in Appendix I, together with optimal yield figures for 1977 generated from assessments studies and socioeconomic considerations as negotiated by the USA ICNAF Commissioners. In all cases, TACs were recommended by the ICNAF Assessments Subcommittee that would provide lower rates of instantaneous fishing mortality (F) than those providing maximum yield per recruit (F_{max}) so as to maintain a larger stock biomass. In the majority of cases, however, the Commission opted to set TACs at a somewhat higher fishing mortality rate.

Haddock in Subarea 5

Assessment studies for Subarea 5 haddock have been confined primarily to the Georges Bank (Subdivision 5Ze) stock, but historical trends in abundance for this area as a whole have paralleled trends on Georges Bank. Tagging studies, research vessel survey data and other information indicate that the Georges Bank stock is relatively discrete from small groups found elsewhere in Subarea 5.

The Georges Bank haddock fishery provides a classical example of the adverse effects of overexploitation on biological and economic yield. From the mid-1930's to the early 1960's, this fishery was a relatively stable one, with landings fluctuating around 47,000 tons[1] annually (the approximate MSY point). Recruitment of the outstanding 1963 year-class in 1965, however, attracted greatly increased effort by foreign nationals (primarily USSR and Canada) and as a result landings increased dramatically to a peak of 150,000 tons in 1965; landings in the following year totalled 121,000 tons. Since that year landings declined steadily to 22,100 tons in 1969, the final year of unrestricted fishing. Since 1970, nominal catches have averaged 7,100 tons under ICNAF total allowable catch (TAC) regulation. A complete summary of landings for Subarea 5 by nation from 1965 to 1975 and TACs and national allocations from 1970 to 1975 is given in Appendix II.

Sport fish catches for Subarea 5 have been significant on occasion, as salt-water angling surveys indicate catches of 800, 9,700, and 1,100 tons for 1960, 1965 and 1970, respectively. The NMFS 1974 regional survey indicated a catch of 200 tons. Almost all of the above catches were taken in SA 5.

The ICNAF Assessments Subcommittee has consistently advised a TAC of zero for Subarea 5 since 1972 (no directed fishery for haddock), and this recommendation was adopted by the Commission for 1974. However, the TACs for 1975 and 1976 were set at 6,000 tons to provide for by-catches up to that level. Provisional statistics for 1975 indicate a nominal catch of 6,700 tons.

Current Assessment

Both commercial catch/effort data and USA autumn bottom trawl survey data indicate a pronounced decline in abundance since 1967. Recruitment

[1] Tons in this paper refers to metric tons.

has been generally poor. The 1972 and 1975 year-classes were the strongest since that of 1967, although strength of the 1975 year-class is based only on one research survey and additional data will be required for a more definitive estimate. Both stock size estimates (Table 1) and survey data indicate a decline in abundance in the late 1960's and early 1970's followed by an increase.

Table 1. Stock abundance, removals and recruitment estimates for Georges Bank haddock, 1968-77.

	Yearly estimates in millions of fish										
	1935-60[1]	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Stock size (age 2+	145	70[2]	36	21	24	16	27	55	50	48	66
Removals											
-total	63	35	16	8	9	5	8	12	12	12	14
-fishing[3]	41	25	11	5	5	2	3	3	3	4	4
-natural[3]	22	10	5	3	4	3	5	9	9	8	10
Recruits (age 2)	54	15	1	1	11	1	16	36	7	10	30

[1]Average of yearly estimates during this period.
[2]Estimated assuming F = 0.5 and M = 0.2 during 1968.
[3]Values computed on the basis of mean weight at age in USA data.

Projections for 1976 and 1977 indicate that, if recruitment continues at the average level observed during 1972-75 (approximately 15 million fish), maintaining the existing TAC level of 6,000 tons would lead only to a stabilization of stock size in the late 1970's at about one-half of the pre-1960 level, while an increased TAC could lead to a substantial reduction in abundance. Even with better than average recruitment, by-catches would be expected to increase, thereby delaying somewhat the projected improvement in stock size. Accordingly, the Assessments Subcommittee recommended that removals in 1977 be kept to the lowest possible level to allow for the most rapid recovery of the stock to the MSY level, and the Commission again adopted a TAC of 6,000 tons to allow for incidental by-catch.

Yellowtail Flounder in Subarea 5 (east of 69°W)

Tagging studies, meristic data and other information indicate this stock (Georges Bank) to be relatively discrete from other yellowtail flounder groups in SA 5 and 6. Historically, the fishery has been conducted primarily by the USA; landings averaged under 10,000 tons prior to 1963 but then rose to 16,000 tons in 1970, the last year of unrestricted fishing. A summary of landings for this stock from 1970 - 1975 and TACs and national allocations from 1971 - 1976 is given in Appendix III. Few, if any, yellowtail are taken by marine sport fishermen.

A TAC of 16,000 tons (including landings and discard) was imposed from 1971 - 1976 to control fishing at F_{max} = 0.8; under this limitation, landings averaged 14,900 tons from 1973 - 1975.

Current Assessment

Stock abundance (as measured by autumn bottom trawl surveys and commercial catch rates) declined considerably from 1963-1970 but appeared to stabilize from 1971-1973 under the above TAC limitation. Since 1973, however, commercial and survey abundance indices have again declined. Furthermore, abundance indices of Age 1 fish (from autumn bottom trawl surveys) are considerably below levels observed in former years and indicate that year-classes which will support the fishery in 1976-1977 are less abundant than those which supported it in recent years. Data are as follows:

Year-class	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
No./tow	11.60	2.64	1.29	9.76	6.96	10.59	7.64	4.75	3.82	2.42	2.71	3.50	4.05
Log_e (No./tow+1)	1.774	0.760	0.586	1.344	1.492	1.451	1.322	1.074	0.970	0.641	0.670	0.839	0.617

Age compositions of catches in 1975 indicate a large contribution of Age II fish, although survey data did not show the increased abundance of this year-class. In view of the abundance of this age-group in the catches, it can be assumed that fishing mortality on it approximately

doubled. This is the age-group that the mesh regulation (130 mm, manila) was intended to conserve, because yellowtail double their weight between Age II and Age III. If higher yields are desired from this fishery, the fishing mortality on two-year-old fish must be reduced.

Utilizing available data on age composition and estimated mortality for 1975, stock sizes in 1975 and 1976 were estimated and projections made for 1977 (Table 2). Using the same F-values for 1976, a catch of 12,500 tons is predicted, a reasonable figure based on the experience of the 1975 fishery and provisional figures for the 1976 catch. The level of recruitment assumed for 1976 and 1977 (42 million fish at Age II) is equal to the lowest level since 1962, as estimated from preliminary virtual population analysis (the mean value of 1962-72 is 56 million fish).

If fishing is conducted at the level of F_{max} in 1977 for a predicted yield of 12,4000 tons, the stock size would be maintained at about the relatively low level existing in 1975 and 1976. Fishing at $F_{0.1}$ = 0.4 for a projected catch of 7,000 tons would result in increasing the stock size by about 10%. If fishing is continued in future years at the $F_{0.1}$ level and recruitment remains at about the current level, annual yields should increase to about 12,000 tons in 5-6 years and the stock size (age 3 and older) should increase to about 61 million fish, a level similar to those which prevailed in the 1962-73 period. Accordingly, the ICNAF Assessments Subcommittee recommended a TAC of 7,000 tons for this stock to allow recovery to former levels of abundance. At the June meeting,however, the Commission set a TAC of 10,000 tons.

Table 2. Yellowtail in Subarea 5 (east of 69°W): catch and stock size projections, 1975-77.

Year	Age	Stock numbers[1]	F	Catch Numbers	Catch Weight	Residual stock[2]
		(10^{-3})		(10^{-3})	(tons)	(10^{-3})
1975	2	40,000	0.4	12,030		
	3	20,900	0.8	10,450		
	4	12,198	0.8	6,099		
	5	4,150	0.8	2,125		
	6	1,060	0.8	530		
	7	542	0.8	271		
	8+	212	0.8	106		
	Total	79,162		31,611		
1976	2	42,000	0.4	12,600	3,037	
	3	21,979	0.8	10,987	4,582	
	4	7,689	0.8	3,845	2,284	
	5	4,487	0.8	2,243	1,671	
	6	1,527	0.8	763	658	
	7	392	0.8	196	188	
	8+	277	0.8	139	140	(age 3 and older)
	Total	78,341		30,773	12,568	
1977	2	42,000	0.4	12,600	3,034	-
	3	23,100	0.8	11,505	4,797	23,100
	4	8,084	0.8	4,042	2,400	8,489
	5	2,829	0.8	1,415	1,054	2,974
	6	1,660	0.8	830	716	1,040
	7	565	0.8	282	270	611
	8+	248	0.8	186	187	301
	Total	88,486		30,860	12,458	36,515
1977	2	42,000	0.2	7,140	1,721	-
	3	23,100	0.4	6,576	2,742	28,153
	4	8,084	0.4	2,425	1,440	12,678
	5	2,829	0.4	849	504	4,610
	6	1,660	0.4	498	430	1,552
	7	565	0.4	170	163	911
	8+	248	0.4	166	167	446
	Total	88,486		17,824	7,176	42,050

[1]Stock numbers refer to beginning of the indicated year.
[2]Residual stock (age 3 and older) at the start of the following year.

Yellowtail Flounder in Subarea 5 (west of 69°W) and Statistical Area 6

Three yellowtail populations are located in this management area. In the 1950's and 1960's, separate stocks were identified off southern New England and Cape Cod, and more recently populations further west (in Statistical Area 6) have been assessed as a unit stock for management purposes. The southern New England and Cape Cod stocks have been under a collective TAC regulation since 1971; the Statistical Area 6 stock has been included since 1975.

The yellowtail fishery in this area has been conducted primarily by USA vessels; for the most part, foreign landings have been of minor consequence except in 1969 when USSR landings totalled 17,300 tons for the southern New England stock. USA landings from the Cape Cod grounds have fluctuated at about 2,000 tons in recent years with no clear trends. However, USA landings from the southern New England stock have fluctuated considerably and in recent years have declined steadily from a peak of 22,300 tons observed in 1963. In 1970 (the last year of unrestricted fishing) landings totalled 17,900 tons. Landings for 1971-1973 (all countries) averaged approximately 9,400 tons. Similarly, landings from Statistical Area 6 have declined very sharply in recent years (from 8,900 tons in 1972 to 1,900 tons in 1974). Landings from this entire complex of stocks totalled approximately 5,800 tons in 1975. A complete summary of landings from 1970-1975 and TACs and national allocations from 1971-1976 is given in Appendix IV.

The TAC for this stock complex was originally set by the Commission at 13,000 tons (excluding Statistical Area 6) for 1971. Due to accumulating evidence indicating declines in stock abundance, this figure was reduced to 10,000 tons for the 1972-1974 period, and it was further reduced to 4,000 tons for 1975-1976 (Statistical Area 6 included).

Current Assessment

Studies have been directed primarily towards the southern New England and Statistical Area 6 stocks, as these groups appear to have been severely reduced in comparison to the Cape Cod stock. In the case of the southern New England group, TAC regulations have greatly decreased removals, but commercial and survey abundance indices have continued to decline. Abundance indices from autumn bottom trawl surveys indicate a drastic decrease (90% since 1969) in both prerecruits (Age I) and stock abundance, with the catch per tow in 1974 being among the lowest observed during the entire series of years for which data are available (Table 3). Assuming that the 1976 prerecruit index is equal to that for 1975, the stock size index will

have decreased by about 80% between 1970 and 1977, and it is obvious that the current stock is extremely low. The catch per day fished by USA vessels has declined from well over 3.0 tons in each year during 1957-72 to 1.9 tons in 1974 and to 1.4 tons in 1975.

Table 3. Catch per tow (Age I) of prerecruits and associated stock abundance indices for yellowtail in southern New England and Statistical Area 6 from USA autumn bottom trawl surveys.

	Southern New England		Statistical Area 6	
Year	No. per tow (Age I)	Abundance index	No. per tow (Age I)	Abundance index
1963	16.3		11.1	
1964	18.6		5.3	
1965	11.5		19.2	
1966	35.5		14.2	
1967	20.0	102.5	12.5	64.4
1968	10.0	119.2	11.6	67.3
1969	12.8	92.6	0.6	59.0
1970	7.3	71.9	1.9	36.8
1971	6.3	53.6	11.0	11.7
1972	4.3	40.0	0.6	22.4
1973	1.9	30.8	0.7	21.6
1974	1.1	20.1	0.04	7.5
1975	1.7	11.9	0.46	2.7
1976		8.1		1.2
1977		7.8		1.6

In the case of Statistical Area 6, abundance indices indicate a 90% decrease in stock size between 1970 and 1975 (Table 3). If the 1976 year-class is assumed to be about the same size as that of 1975, stock size in 1977 is projected to be extremely low in contrast to earlier levels.

Recognizing the depressed condition of the latter two stocks, the ICNAF Assessments Subcommittee advised that the 1977 TAC for this complex be set at 0, noting that incidental catches might approach 4,000 tons. It was also noted that even this level of removal would prevent the stocks from recovering unless recruitment improved. Accordingly, the Commission set a TAC of 4,000 tons for 1977.

Flounders, Except Yellowtail, in Subarea 5 and Statistical Area 6

This group of flatfishes (including American dab, witch, summer and winter flounder, windowpane, and American and Greenland halibut) is currently considered within ICNAF as a management unit. In the case of summer and winter flounder, lack of adequate sport fish data complicates the assessment picture and it may be some time before truly accurate analytical assessments can be made for these species.

Although commercial landings averaged 25,500 tons from 1965-1974, landings decreased continually from 1971-1974. However, provisional statistics indicate that the nominal catch was about 26,500 tons in 1975, considerably higher than the 1974 catch of 21,200 tons. A summary of landings from 1965-1975 and TACs and national allocations from 1973-1976 is given in Appendix V.

Sport fishing statistics indicate that the combined recreational catch of summer and winter flounder for this stock approximated 23,900, 26,500, and 25,800 tons in 1960, 1965 and 1970, respectively, while the NMFS 1974 regional survey indicated a catch of 24,400 tons for that year. Other species appear to have been of little importance during this period.

During the 1973-1975 period, this stock was regulated under a TAC of 25,000 tons, but for 1976 this figure was reduced to 20,000 tons on the basis of declines in commercial landings and research vessel survey catches and decreases in modal length.

Current Assessment

Bottom trawl surveys indicate a pronounced decline in biomass during the mid-1960's, but no significant changes were detected between 1974 and 1975. Similarly, examination of length-frequency data for this group of species indicates declines in modal lengths since 1963 but not in the most recent years. An assessment of summer flounder prepared in 1975 indicated that a sustainable catch of 20-22,000 tons might be possible for this species, but due to high sport fish catches this level is apparently being exceeded at present.

Noting the implications of high sport fishing mortality on this group, the ICNAF Assessments Subcommittee recommended that the existing

TAC of 20,000 tons be maintained for 1977, stressing that every possible effort should be made to reduce by-catch of these species. Accordingly, the Commission established a 20,000 ton TAC for 1977.

Cod in Division 5Y

Stock identification studies have indicated the existence of 3 or possibly 4 separate groups of cod in Subarea 5 and Statistical Area 6, one of which occupies the Gulf of Maine. Accordingly, cod in Division 5Y have been treated as a unit stock for assessment purposes.

Nominal catches for this stock have fluctuated between 2,700 and 14,500 tons since 1932 and have averaged 7,100 tons over the past 10 years (1966-1975); almost all of this catch has been taken by the USA. In 1975, the provisional catch approximated 9,400 tons. (A complete summary of landings for 1965-1975 and TACs and national allocations from 1973-1976 is given in Appendix VI.) In addition, this stock has supported undetermined, but apparently increasing, levels of recreational fishing for some time. Data from 1960, 1965, and 1970 surveys indicate sport fish catches of 14,000, 13,600, and 16,300 tons, respectively from Maine to Cape Hatteras, while the NMFS 1974 regional survey indicates a catch of 12,400 tons from Maine to Virginia. Although exact data are not available, a considerable amount of the total sport fishing effort appears to have been exerted in Div. 5Y. Acquisition of additional sport fishery data for this stock should be given high priority, as such data will be essential if existing assessments are to be made more precise.

This stock was regulated under a TAC of 10,000 tons from 1973-1975. For 1976, this TAC was reduced to 8,000 tons in view of declines in indices of relative abundance in USA autumn bottom trawl surveys, catch levels, and mortality rate studies indicating that in recent years F levels (averaging 0.48) had considerably exceeded F_{max} (0.30 with M = 0.20).

Current Assessment

Although an update of the survey data suggest that the declining trend has stabilized since 1973, knowledge of the component of mortality caused by sport fishing is needed to interpret the relationships between catches and associated fishing mortality rates.

In the absence of interaction between stocks supporting commercial and recreational fishing, the average commercial catch of 7,400 tons in 1970-74 generated an F of 0.48. If recruitment remains stable, fishing at F_{max} = 0.30 would result in a catch of approximately 5,000 tons, and fishing at $F_{0.1}$ = 0.18 would produce a catch of about 3,200 tons.

Accordingly, the Assessments Subcommittee recommended that the TAC for 1977 be set at 3,200 tons. The Commission, however, established a TAC of 5,000 tons, the level corresponding approximately to F_{max} = 0.30.

Cod in Division 5Z

In addition to the Gulf of Maine (Division 5Y) stock, studies have indicated the presence of 2 or 3 other groups in Subarea 5 and Statistical Area 6, these being (1) a Georges Bank group, (2) a southern New England group, and (3) a New Jersey coastal group which spends part of the year mingled with cod off southern New England. As affinities between these groups are somewhat uncertain, cod throughout Division 5Z have been assessed as a unit stock in recent years.

During the period 1932-1960, nominal (USA) commercial catches for this stock complex fluctuated between 8,100 and 32,300 tons. With increased Canadian fishing and the advent of distant water fleets, landings rose very sharply to 52,900 tons in 1966; subsequently, landings declined sharply and then stabilized around 26,000 tons annually during 1970-1975. The 1975 nominal catch approximated 24,000 tons. A summary of landings from 1965-1975 and TACs and national allocations from 1973-1976 is given in Appendix VII. Sport fish catch statistics for the northeastern and middle Atlantic states are given in the preceding section.

From 1973-1976, a TAC of 35,000 tons has been set for this stock; this figure represents the approximate MSY point as determined from previous surplus-production model studies.

Current Assessment

Catch data from USA autumn bottom trawl surveys indicate a stable level of abundance since 1963, with good recruitment since 1970. A

strong 1971 year-class became fully recruited to the fishery by 1974 and the 1975 year-class appears to be about equal in size to that of 1971. Although an analytical assessment (virtual population analysis) has not yet been completed for the stock, preliminary analyses suggest that the very high catches in the late 1960's may have generated F-values in the range of 0.55-0.65, which are considerably above the calculated value of F_{max} = 0.3, with M = 0.2. Catches averaging about 26,500 tons during 1970-74 generated F-values which averaged 0.36.

If recruitment remains stable, fishing at a level associated with F_{max} would result in a catch of about 24,000 tons. If fishing is conducted at $F_{0.1}$ = 0.18, the corresponding catch would be approximately 15,000 tons. Accordingly, the Assessments Subcommittee recommended that the 1977 TAC be set at 15,000 tons. The Commission, however, opted to set the 1977 TAC at 20,000 tons, a compromise level between the F_{max} and $F_{0.1}$ figures.

Pollock in Divisions 4V, 4W, 4X, and Subarea 5

Previous tagging studies, commercial landings data, and information relative to distribution of ripe adults and larvae all suggest that pollock in this area constitute a unit stock. Accordingly, pollock in this region have been considered as a discrete stock in the current assessment.

The pollock fishery has historically been dominated by the USA and Canada, although distant-water fleets have on occasion made significant catches in recent years. USA landings fluctuated between 10,000 and 20,000 tons between 1955 and 1960, while Canadian landings increased more or less continually from 4,000 tons to 29,500 tons during the same period. Total landings subsequently stabilized at 39,000 tons from 1960-1964, declined to 22,800 tons in 1968, and then rose to a peak of 43,200 tons in 1973. The provisional catch for 1975 was approximately 39,100 tons. A summary of commercial landings from 1965 to 1975 and TACs and national allocations from 1973-1976 is given in Appendix VIII. Sport fish statistics indicate catches of 9,800, 4,200, and 2,500 tons for 1960, 1965, and 1970, respectively, for the northeastern states, while the NMFS 1974 regional survey indicated a catch of 500 tons from Maine to Massachusetts.

In 1973, a 50,000 ton TAC was approved for Division 4X and Subarea 5. This was subsequently revised to 55,000 tons for Division 4V, 4W, 4X, and Subarea 5 for 1974-1976.

Current Assessment

Estimates of fishing mortality from both research survey and commercial data indicate tha F has increased beyond the level of F_{max} = 0.4 (M = 0.2) since 1973. USA autumn bottom trawl surveys indicate a declining trend in abundance in the 1970's, and indices of relative abundance for Canadian surveys, which had been increasing, dropped sharply in 1975. The surveys indicate that the 1972-1974 year-classes are weaker than those of 1968, 1969 and 1971 and that recruitment prospects for 1977 are less favorable than during 1968-73. If it is assumed that fishing mortality in 1975 was at F = 0.5, then the stock size was about 110,000 tons. Assuming a modest decline in stock size to a level of 100,000 tons for 1977, a catch of 30,000 tons would result from fishing at F_{max} = 0.40 and a catch of 20,000 tons would result from fishing at $F_{0.1}$ = 0.24. No information is available on the effects of these catches on stock size, but fishing at F_{max} in 1977 would probably result in a lower stock size in 1978 than in 1975.

Accordingly, the Assessments Subcommittee recommended a TAC of 20,000 tons for 1977. However, the Commission opted to set the 1977 TAC at 30,000 tons, the level corresponding to F_{max}.

Redfish in Subarea 5

Redfish in Subarea 5 are assessed as a unit stock although the species is known to be very localized in distribution and probably several relatively discrete groups occur within this area. The bulk of the population is confined to the Gulf of Maine.

Prior to 1971, the redfish fishery in Subarea 5 was prosecuted almost exclusively by the USA, although other countries have taken significant amounts since that date. Commercial landings for this stock averaged less than 100 tons until 1934 and then increased dramatically to 1941, when 59,800 tons were landed. Landings subsequently declined gradually to 6,800 tons in 1968 and then increased sharply to 20,000 tons in 1971; since that year, landings have again declined. Provisional statistics indicate a 1975 catch of approximately 10,600 tons. A complete summary of landings data from 1965-1975 and TACs and national allocations from 1973-1976 is given in Appendix IX. No data are available relative to sport fish catches of redfish, but amounts involved would appear to be small.

During 1973 and 1974, this stock was regulated under a TAC of 30,000 tons; for 1975, this figure was reduced to 25,000 tons. A 1975 surplus-production model assessment indicated an MSY figure of approximately 17,000 tons, and accordingly the TAC for this stock was reduced to 17,000 tons for 1976.

Current Assessment

Catch rates of USA commercial vessels, whose catches consisted of 50% or more of redfish, continued the declining trend which has been evident since 1968. USA autumn bottom trawl survey length frequency data indicate an increase in abundance of prerecruit fish which began to enter the commercial fishery in 1974, and recruitment of these fish will continue over the next few years. The survey length frequencies also indicate that lower recruitment will prevail for a period of years thereafter. Projections from surplus-production model studies indicate that fishing at a level of effort associated with F_{MSY} in 1977 would result in a catch of about 10,000 tons, which is below the long-term MSY estimate of 17,000 tons.

Accordingly, the Assessments Subcommittee recommended a TAC of 9,000 tons for 1977, to ensure controlling fishing effort at a level below F_{MSY}. This recommendation was adopted by the Commission.

Silver Hake in Division 5Y

The Gulf of Maine (Division 5Y) silver hake stock represents one of the three stocks of this species in Subarea 5 and Statistical Area 6 which has been under ICNAF management in recent years. The fishery has been conducted almost exclusively by the USA; catches by foreign nationals have for the most part been minor, although the USSR did take 3,700 tons in 1963. Total landings averaged 28,500 tons from 1955 through 1966 but subsequently declined to 6,700 tons in 1972, the last year of unrestricted fishing. The provisional catch in 1975 totaled approximately 9,100 tons. A summary of landings from 1965-1975 and TACs and national allocations from 1973-1976 is given in Appendix X. Sport fish catches are only available for the combined northern and middle Atlantic areas for 1960, 1965, and 1970, and are estimated to be 1,800, 2,700, and 1,000 tons respectively. In 1974, 1,100 tons is estimated to have been caught but only 3 tons is assumed to have been caught from the Division 5Y stock.

During 1973-1974, this stock was managed under a TAC of 10,000 tons; this figure was increased to 15,000 tons for 1975 in anticipation of strong recruitment from the abundant 1971-1973 year-classes. A 1975 assessment, however, indicated excessive mortality on these year-classes and accordingly the TAC was reduced to 10,000 tons for 1976.

Present Assessment

While USA commercial catch per unit effort increased by 24% from 1974 to 1975, fishing effort increased by 41%. Catch per tow data from both spring and autumn surveys indicate an increase in stock abundance in 1975. Also, survey data show that the 1971-75 year classes were stronger than those produced during 1966-70.

Virtual population analyses indicate that stock biomass decreased to a low in 1971 as the result of catches exceeding recruitment during the 1960's. Stock size has since begun to increase as a result of improved recruitment and in 1975 was about twice the 1971 level. However, capture and discarding of undersized silver hake in the USA trawl fisheries for silver hake and shrimp has been high in recent years and has thus been detrimental to the recovery of the adult stock.

Fishing mortality, estimated from the relationship between fishing mortality and fishing effort in previous years, was 0.50 in 1975, compared with F_{max} = 0.60 and $F_{0.1}$ = 0.30. Full utilization of the 1976 TAC of 10,000 tons would generate an F of about 0.55. If fishing mortality is reduced to $F_{0.1}$ (0.30) in 1977, a catch of about 5,000 tons would be taken.

Bearing in mind the current low level of this stock and the desirability of rebuilding the stock to a higher level of abundance, the Assessments Subcommittee recommended a TAC of 5,000 tons for 1977. The Commission, however, opted to set the TAC at 9,000 tons, corresponding to a level between $F_{0.1}$ and F_{max}.

Appendix I. Stock biomass, maximum sustainable yield (MSY) and optimal yield estimates for stocks previously managed under ICNAF but not considered in Preliminary Management Plans. (All estimates in thousands of metric tons.)

Species	Stock area	Stock biomass at MSY	Stock biomass in 1976	MSY	Optimal yield in 1977
Haddock	SA 5[1]	140	<70	50	6[2]
Yellowtail	SA 5 (E69°)	>30	30	16	10[3]
	SA 5 (W69°) and SA 6	?	very low	23	4[2]
Flounders	SA 5 and 6	?	?	25	20
Cod	Division 5Y	?	?	8	5[4]
	Division 5Z	150	<150	35	20[5]
Pollock	Divisions 4VWX and SA 5	?	110	?	30[6]
Redfish	SA 5	110	<110	17	9
Silver Hake	Division 5Y	135	38	17	9[7]

1 SA 5 and 6 refer to ICNAF Subarea 5 and Statistical Area 6.
2 By-catch only (no directed fishery).
3 7,000 tons recommended by Assessments Subcommittee.
4 3,200 tons recommended by Assessments Subcommittee.
5 15,000 tons recommended by Assessments Subcommittee.
6 20,000 tons recommended by Assessments Subcommittee.
7 5,000 tons recommended by Assessments Subcommittee.

Appendix II. Nominal and provisional catches (in metric tons) of haddock in Subarea 5 by country, 1965-1975, with TACs and national allocations (in parentheses) for 1970-1976. (Source: ICNAF Summary Doc. 76/VI/41.)

Country	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Canada	15048	19417	13629	9443	4049	2016	1715	632	1612	660	1432 (1200)	- (1200)
Poland	28	29	0	1286	458	15	1	1	0	0	0	-
Romania	730	449	12	402	66	0	225	14	0	0	0	-
Spain	10	1111	1355	3014	1431	845	1336	1098	386	764	64 (300)	- (300)
USSR	81882	48409	2316	1397	65	103	374	141	602	109	8	-
UK	0	29	3	0	0	0	0	0	0	568	0	-
USA	57027	57497	39635	28906	18879	9872	8500	4778	3286	3018	5170 (4450)	- (4450)
Others[1]	0	37	15	32	17	11	17	5	3	0	3 (50)	- (50)
Total	154725	126978	56965	44480	24965	12862 (12000)	12168 (12000)	6669 (6000)	5889 (6000)	5119 (0[2])	6667 (6000[3])	- (6000[3])

1 Includes Bulgaria, France, FRG, GDR, and Japan .
2 Zero TAC pertains to directed fishery.
3 TACs and allocations pertain to by-catch only with no directed fishery.

Appendix III. Nominal and provisional catches of yellowtail in Subarea 5 (east of 69°W) by country[1], 1970-1975, with TACs and national allocations (in parentheses) for 1971-1976. (Source: ICNAF Summ. Doc. 76/VI/41.)

Country	Year 1970	1971	1972	1973	1974	1975	1976
Bulgaria	0	131	298	44	0	0	-
Canada	82	111	9	12	5	8	-
USSR	393	586	3809	204	186	83	-
USA[2]	15502	11881	14157	15899 (15000)	14604 (15000)	13709 (15900)	- (15900)
Others[3]	0	3	35	0 (1000)	0 (1000)	0 (100)	- (100)
Total	15977	12712 (16000)	18308 (16000)	16159 (16000)	14795 (16000)	13800 (16000)	- (16000)

1 Catches for all countries except USA are as reported from Div. 5Y and Subdiv. 5Ze.
2 USA landings only (discards excluded).
3 Includes landings for Japan and Romania.

Appendix IV. Nominal and provisional catches of yellowtail in Subarea 5 (west of 69°W) and Statistical Area 6 by country[1], 1970-1975, with TACs and national allocations (in parentheses) for 1971-1976 (Source: ICNAF Summ. Doc. 76/VI/41).

Country	Year 1970	1971	1972	1973	1974	1975	1976
Bulgaria	80	125	275	46	0	4	-
USSR	2623	1168	1067	332	78	0	-
USA[2]	16418	10216	9919	9155	8458	5762 (3990)[4]	- (3990)[4]
Others[3]	3	7	44	0	0	0 (10)[4]	- (10)[4]
Total	19124	11516 (13000)	11305 (10000)	9533 (10000)	8536 (10000)	5766 (4000)[4]	- (4000)[4]

1 Catches for all countries except USA from Subdivision 5Zw+6.
2 USA landings only (discards excluded).
3 Includes landings for Japan and Romania.
4 TACs and national allocations include SA 6.

Appendix V. Nominal and provisional catches of flounders, except yellowtail[1] in Subarea 5 and Statistical Area 6 by country, 1965-1975, with TACs and national allocations (in parentheses) for 1973-1976 (Source: ICNAF Summ. Doc. 76/VI/41.)

	Year											
Country	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Canada	557	586	747	486	369	242	181	82	100 (100)	85	93	-
Cuba	0	0	0	10	52	0	0	118	0	0	160	-
Japan	0	0	23	43	394	300	34	13	65	73	0	-
Romania	3	0	0	0	8	795	523	0	0 (500)	0	0	-
USSR	961	872	1703	1713	8869	1561	6141	5931	2616 (2600)	530 (2600)	947 (1000)	-
USA	23816	28448	25607	20252	20734	22139	20709	17373	18944 (21700)	20513 (21700)	25317 (23900)	- (19500)
Others[2]	2	3	21	19	18	39	2	10	1 (100)	39 (700)	30 (100)	- (500)
Total	25339	29909	28101	22523	30444	25076	27590	23527	21726 (25000)	21240 (25000)	26547 (25000)	- (20000)

1 All flounders except yellowtail (i.e. A. plaice, witch, winter flounder, summer flounder, A. halibut and G. halibut are included).

2 Includes landings for Bulgaria, Cuba, France, FRG, GDR, Poland, Spain and the UK.

Appendix VI. Nominal and provisional catches of cod in Division 5Y, by country, 1965-1975, with TACS and national allocations (in parentheses) for 1973-1976. (Source: ICNAF Summ. Doc. 76/VI/41).

	Year											
Country	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Canada	148	384	297	61	59	26	119	53	68 (100)	120	85	- (175)
FRG	0	0	0	0	100	11	4	13	5	0	0	-
Spain	0	0	0	0	152	375	159	0	0	4	25	-
USA	3780	4008	5676	6360	8157	7812	7380	6776	6069 (9400)	7639 (8677)	9252 (9000)	- (7800)
Others[1]	0	0	0	0	16	37	0	75	4 (500)	1 (1323)	0 (1000)	- (25)
Total	3928	4392	5973	6421	8484	8261	7662	6917	6146 (10000)	7764 (10000)	9362 (10000)	- (8000)

[1] Includes landings for the GDR, Japan, USSR and the UK.

Appendix VII. Nominal and provisional catches of cod in Division 5Z, by country, 1965-1975, with TACs and national allocations (in parentheses) for 1973-1976 (Source: ICNAF Summ. Doc. 76/VI/41).

Country	Year											
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Bulgaria	0	0	0	0	5	0	10	74	40	0	-	-
Canada	10598	15601	8232	9127	5997	2583	2979	2545	3220 (4000)	1374 (4820)	1845 (4820)	- (4519)
Cuba	0	0	0	15	115	0	0	2	0	0	157	- (400)
GDR	0	0	99	2	34	65	0	68	49	11	21	-
Japan	0	0	2	2	30	15	20	96	3	0	0	-
Poland	1851	269	0	2544	640	641	155	174	380 (400)	479 (487)	275 (487)	- (457)
Romania	0	0	0	0	0	129	6	0	0	1	0	-
Spain	59	8375	14730	14622	13597	6874	7460	6701	5980 (5800)	6370 (7088)	4044 (7088)	- (6645)
USSR	14415	16755	511	1459	646	364	1270	1826	2935 (2900)	449 (2468)	2391 (2468)	- (2314)
USA	11410	11794	12742	14967	16356	14535	15795	13140	15933 (19600)	17870 (16590)	15239 (19000)	- (20000)
Others[1]	0	69	18	19	4	3	0	4	0 (2300)	138 (3547)	24 (1137)	- (665)
Total	38333	52863	36334	42757	37424	25209	27695	24630	28540 (35000)	26692 (35000)	23996 (35000)	- (35000)

[1] Includes landings for France, FRG, Iceland and the UK.

Appendix VIII. Nominal and provisional catches of pollock in Divisions 4V, 4W, 4X, and Subarea 5 by country, 1965-1975, with TACs and national allocations (in parentheses) for 1973-1976. (Source: ICNAF Summ. Doc. 76/VI/41).

	Year											
Country	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Canada	27316	18271	17567	18062	15968	10753	11757	18022	26990 (21760)	24975 (34000)	26547 (33500)	- (33500)
Cuba	0	0	0	0	0	0	0	0	0	0	54	- (1200)
FRG	71	0	0	0	1188	3233	633	475	1124 (1125)	149 (1600)	237 (1600)	- (1600)
GDR	0	0	4	0	2195	4295	5963	4793	930	- (4000)	96 (3500)	- (3500)
Japan	0	0	0	0	0	40	15	8	1570	40	1	-
Spain	1361	2384	1779	1128	1515	532	912	616	3113 (450)	1500 (1200)	708 (1200)	- (1200)
USSR	2667	9865	644	372	227	527	2216	3495	3092 (2970)	2301 (2100)	2004 (2100)	- (2100)
USA	5301	3743	3310	3276	3943	3976	4885	5728	6300 (11275)	8726 (12000)	9328 (11500)	- (11500)
Others[1]	11	12	1	7	7	0	3	58	36 (12420)	62 (100)	78 (1600)	- (400)
Total	36727	34275	23305	22845	25043	23356	26384	33195	43155 (50000)[2]	37753 (55000)	39053 (55000)	- (55000)

1 Includes landings for Denmark, France, Poland and the UK.
2 TACs and national allocations pertain to Division 4X and SA 5 only in 1973.

Appendix IX. Nominal and provisional catches of redfish in Subarea 5 by country, 1965-1975, with TACs and national allocations (in parentheses) for 1973-1976. (Source: ICNAF Summ. Doc. 76/VI/41.)

Country	1965	1966	1967	1968	1969	1970	Year 1971	1972	1973	1974	1975	1976
Canada	68	420	194	197	260	338	269	124	35 (350)	59 (414)	58	-
GDR	0	0	6	2	13	783	1	127	40	23	5	-
Japan	0	0	7	0	62	19	4	15	30	1	19	-
Poland	25	6	215	0	56	30	84	1	28 (100)	2	1	-
Romania	10	0	0	0	0	35	0	14	0	0 (412)	0 (343)	- (343)
USSR	968	939	0	0	15	0	3994	5639	5240 (4500)	1705 (1725)	1368 (1438)	- (1438)
USA	6986	7204	10442	6578	12041	15534	16267	13157	11954 (24550)	8677 (27747)	9075 (20622)	- (13000)
Others[1]	0	0	0	0	8	2	15	18	33 (500)	4 (2702)	38 (2597)	- (2219)
Total	8057	8569	10864	6777	12455	16741	20034	19095	17360 (30000)	10471 (30000)	10564 (25000)	- (17000)

[1] Includes landings for Bulgaria, Cuba, and the FRG.

Appendix X. Nominal and provisional catches of silver hake in Division 5Y by country, 1965-1975, with TACs and national allocations (in parentheses) for 1973- 1976. (Source: ICNAF Summ. Doc. 76/VI/41).

	Year											
Country	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
FRG	0	0	0	0	0	0	0	131	29	0	11	-
GDR	0	0	0	0	0	0	0	93	34	0	0	-
Poland	0	0	0	0	0	0	0	0	0	0	243	-
USSR	0	0	0	0	0	0	53	857	483	578 (600)	845 (900)	-
USA	22676	21495	14653	24706	14632	11384	8263	5570	8347 (9300)	4635 (8380)	8042 (13000)	- (9500)
Others[1]	0	0	0	0	1	0	0	0	3 (500)	0 (1020)	0 (1100)	- (500)
Total	22676	21495	14653	24706	14633	11384	8316	6651	8896 (10000)	5213 (10000)	9141 (15000)	- (10000)

[1] Includes landings for Bulgaria and Japan.