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Assessment and status of the Georges Bank and Gulf of Maine Atlantic cod stocks-1981

by

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SUMMARY

The Georges Bank and Gulf of Maine Atlantic cod fisheries have become increasingly important in recent years in terms of landings and revenue. During 1977-1979, USA commercial landings increased 32% and averaged 38,960 metric tons per annum. In this same period, annual USA commercial ex-vessel revenue increased 67.3%, averaging 22.4 million dollars per year. In 1980, the total domestic cod catch was 51,042 metric tons, the highest domestic catch since 1907. Estimated recreational landings in 1979 (the latest available data) were 3,857 metric tons. The present report provides an evaluation of current resource conditions in the Georges Bank and Gulf of Maine cod stocks based on commercial, recreational, and research data.

Five surveys of recreational landings of cod in the Northwest Atlantic have been conducted since 1960. The most recent 1979 survey, considered the most reliable in terms of landings estimates, indicated that 2.63 million cod weighing 3.9 thousand metric tons were taken in the 1979 USA recreational fishery. Landings data were not apportioned to stock area and hence represent catches from both stocks. The 1979 recreational catch was lower than previous annual estimates (1960, 1965, 1970, and 1974), although the accuracy of prior survey estimates is considered less than adequate because of methodological weaknesses in survey designs. The estimated 1979 catch was probably underestimated due to relatively low sampling intensity of the winter-spring New York Bight party boat cod fishery, and application of an unusually low average weight per fish in deriving the total catch weight. Approximately two-thirds of the total recreational landings were taken in the Fishery Conservation Zone (>3 miles from shore), primarily by anglers using private and rental boats (71.6%). Massachusetts landings accounted for 70% of the recreational catch.

Provisional 1980 commercial landings of cod from the Georges Bank and South stock totaled 45,681 metric tons, 18% higher than 1979, and the highest annual catch in 14 years. Reported USA landings were 39,045 metric tons, 20% higher than 1979, and the highest yearly harvest since commercial catches have been maintained by stock area (1932). As in previous years, the 1980 reported domestic landings are believed to underestimate the actual catch due to misreporting and non-reporting. Composition of the 1980 Georges Bank catch was dominated by "market" and "large" cod suggesting that the strong 1975 year class is still important in the fishery. Otter-trawl landings accounted for 84.3% of the USA catch. Gill-net catches increased sevenfold from 1979 and comprised 12% of the 1980 domestic catch. Tonnage Class 3 vessels (51-150 gross registered tons) accounted for 72% of the total 1980 USA otter-trawl effort (days fished) and 62% of the otter-trawl catch. Commercial catch per effort indices remained high in 1980 but recent fishing performance data are difficult to interpret because of management restrictions on allowable catch per trip. Research vessel catch per tow indices in 1980 for the Georges Bank stock showed disparate patterns; spring and summer offshore and inshore survey indices were generally higher than in 1979 but all of the 1980 autumn survey values were significantly lower than in the previous year. Prior to 1980, spring and autumn indices generally exhibited similar trends. Survey age composition data indicated that the 1978 year class is above average in strength,

although less than the 1975 year class. Both the 1977 and 1980 year classes appear to be average in size while the 1979 year class appears relatively weak. Since 1978, relative exploitation rates for the Georges Bank fishery have annually increased; the 1980 rate was about twice as large as in 1977 or 1978, and was the highest since 1970. The 1980 value was within the range of relative exploitation rates observed during 1964-1970 when high fishing levels contributed to declines in stock biomass. The increased 1980 exploitation rate and the sequential annual decline in autumn survey indices since 1978 imply that continuation of current catch levels in the near future will be accompanied by discernible stock size reductions in the Georges Bank cod population.

Total provisional 1980 Gulf of Maine cod landings were 12,135 metric tons, the fourth highest ever, and the fourth consecutive year in which total commercial landings have exceeded 12,000 metric tons. USA reported catches (11,997 mt) accounted for 98.9% of the 1980 commercial harvest (the remaining 1.1% was Canadian), and were the fourth highest since domestic commercial landings have been classified by stock removal area. As for Georges Bank landings, the 1980 reported Gulf of Maine commercial catches are considered to underestimate actual fishery removals due to underreporting. The 1980 domestic commercial catch composition was similar to those in 1978 and 1979 in indicating continued emphasis on "market" and "large" cod. The percentage of "scrod" landings increased from 1979 but was not as large as expected implying that the strength of the 1977 year class may be more modest than previously thought. Otter-trawl landings accounted for 67.6% of the 1980 USA catch; gill-net landings comprised 29.3% of the USA total, the highest annual percentage in the 1965-1980 period. Total domestic otter-trawl effort (days fished) was the highest observed in the 1965-1980 time series. Class 2 otter-trawl vessels (5-50 gross registered tons) continued to dominate the USA fishery during 1980 accounting for 59% of the total days fished and 49% of the otter-trawl catch. USA commercial catch per effort indices declined slightly in 1980 from 1979. Since 1978, however, these indices have not mirrored relative population abundance as they did formerly because of the imposition of trip landings limitations. Research vessel survey weight per tow indices in 1980 were among the highest ever observed in both spring and autumn offshore and inshore surveys. Survey age composition data, particularly those from inshore surveys, indicated that the 1979 and 1978 year classes are above average and may be relatively strong. The 1980 and 1977 year classes appeared to be of at least average strength. Since 1975, annual relative exploitation rates for the Gulf of Maine fishery have sequentially declined. The 1980 rate was the lowest since 1972. Even if the 1980 value is conservative because of unreported catches, fishing mortality in 1980 did not generate a reduction in population biomass from the relatively high 1979 level. Recruitment of the 1978 and 1979 year classes into the commercial fishery as "scrod" in 1981 and 1982, respectively, should result in increased harvestable biomass, if these year classes are as strong as present survey indices imply. Given this incipient good recruitment, continued short-term harvests of about 12,000 metric tons appear sustainable.

INTRODUCTION

The Atlantic cod (Gadus morhua) supports one of the most important U.S. groundfish fisheries in the Northwest Atlantic. During 1977-1979, annual domestic commercial landings increased from 33,564 metric tons (mt) to 44,318 mt (32% increase), and averaged 38,960 mt. Total ex-vessel revenue from these catches increased 67.3% between 1977 and 1979 (17.1 to 28.6 million dollars), and averaged 22.4 million dollars per annum. The reported 1979 U.S. commercial cod landings exceeded the combined 1979 domestic landings of haddock and yellowtail flounder by 29% (Pileggi and Thompson, 1980), and generated 62% more ex-vessel revenue than either of these species. Additionally, important recreational fisheries for cod exist along the Northeast coast from Maine to New Jersey. In 1979, an estimated 3,857 mt of cod were taken by marine recreational anglers (United States Department of Commerce 1980).

Three major groups of cod have been recognized in U.S. Atlantic coast waters: (1) Georges Bank; (2) Gulf of Maine; and (3) Southern New England-Middle Atlantic. Strong affinities are evident between the Georges Bank and Southern New England-Middle Atlantic populations (Serchuk and Wood 1979) while the Gulf of Maine group appears to be generally distinct from either of the two more southerly cod groupings. Since 1977 and the inception of U.S. extended jurisdiction, the Atlantic cod fisheries in the Fishery Conservation Zone (FCZ) have been managed under a Fishery Management Plan for Atlantic Groundfish (FMP) as two distinct units: (1) Gulf of Maine: FCZ north of 42°20'N latitude which is west of 70°00' longitude and is bounded on the south by the northern shore of Cape Cod; and (2) Georges Bank and Southward: FCZ other then the Gulf of Maine (Figure 1).

Under the FMP, U.S. cod fisheries have been regulated by annual and quarterly quotas, weekly and/or trip landings restrictions by vessel tonnage category and gear type (mobile or fixed), minimum mesh size limitations, closed fishing areas and seasons, and incidental catch allowances under fishery closure conditions. Licensing, via vessel permits, and record keeping and reporting provisions for both vessel owner/operators and dealer/processors have also been required. To date, the FMP has been amended four times although emergency regulations and adjustments in optimum yield (OY), quarterly quotas and trip limitations have frequently occurred as well. A fifth amendment to the FMP, which would establish a mechanism for timely adjustments in allowable catch levels in response to current stock assessment information, has been prepared by the New England Regional Fishery Management Council (NERFMC) and is currently under administrative review and revision.

The Georges Bank and Gulf of Maine cod stocks were last assessed in February 1980 (Serchuk et al. 1980). The present report is an update and amplification of this latter and other previous assessments. Analyses presented herein include data on commercial (USA and Canada) and recreational (USA) landings statistics, USA commercial catch composition; USA commercial abundance indices; NMFS research vessel bottom trawl survey data; and Massachusetts Division of Marine Fisheries inshore research bottom trawl survey data. Evaluation of relative year-class abundance and relative exploitation rates are also provided.

NORTHWEST ATLANTIC RECREATIONAL FISHERY LANDINGS

Estimates of recreational landings of cod from the Northwest Atlantic by U.S. marine anglers are available from national saltwater angling surveys conducted in 1960, 1965, and 1970 (Clark 1962; Deuel and Clark 1968; Deuel 1973), a regional marine recreational fishing survey conducted in the northeastern coastal United States in 1974 (Ridgely and Deuel 1975; Pileggi and Thompson 1979; Deuel, personal communication), and the 1979 NMFS Marine Recreational Fishery Statistics Survey (United States Department of Commerce 1980). The first three surveys were conducted by household interviews which required fishermen to recall and report for a 1-year period the number and average weight of each species caught. In the 1974 survey, a combination mail-telephone sampling design was utilized which reduced the recall period to 2 months, but still required fishermen to report the numbers and average weight of all species caught. In all of these surveys, the catch estimates have been considered tentative due to memory bias errors, small sample sizes, lack of precise information on area of capture, and methodological weaknesses and differences in survey procedures (Pileggi and Thompson 1979: p. 21). The 1979 survey is considered the most reliable relative to catch data since the collection approach involved a combination household telephone survey and an intercept (on-site creel census) survey to obtain total catch distribution at the species level.

The 1960, 1965, 1970, and 1974 surveys indicated recreational cod landings of 14,016 mt, 13,565 mt, 16,292 mt, and 12,368 mt, respectively. The 1979 estimated catch was 3,857 mt (Table 1). Among the surveys, the

estimated number of cod caught varied by less than a factor of two, from a high of 5,032,000 fish in 1965 to 2,627,000 fish in 1979. The mean weight per fish in 1979, determined from whole fish weighed during on-site interviews, was 1.5 kg (3.3 lbs) (Table 2), about 2-3 times less than in the 1960-1974 surveys. This large difference suggests three possibilities: (1) the average size of cod caught in the recreational fishery has recently decreased; (2) angler memory recall weight estimates in earlier surveys were overestimated; and/or (3) the average size of cod derived from on-site measurements in the 1979 recreational survey was not truly representative of the size composition of the catch.

Informal reports on the size distribution of recreational cod catches (The New England Fisherman; The Long Island Fisherman; The New Jersey Fisherman) indicate wide variability in the average weight of fish landed, presumably a function of fishing area and season. Two NEFC recreational sea sampling trips on party boats from Gloucester and Newburyport, Massachusetts during the summer of 1978 recorded average weights of cod of 3.48 kg and 1.10 kg, respectively (Clark MS, 1978; Serchuk MS, 1978). A 1978 survey of marine recreational fishing in Rhode Island, conducted in identical fashion to the 1979 NMFS National Recreational Survey, found that the mean weight of cod varied between 3.1-3.3 kg/fish during February to July (McConnell and Smith 1979a, 1979b; McConnell et al. 1979). A survey of recreational cod landings in the offshore party boat fishery based out of Montauk, Long Island (Christensen et al. MS 1979) revealed that during August-September 1977, the average weight per fish was 3.21 kg. Moreover, it was noted that cod caught in the summer Montauk recreational fishery

were smaller then those taken in the preceding winter New Jersey fishery. Based on these reports, it appears unlikely that the smaller-sized mean weight per codfish derived from the 1979 NMFS survey is indicative of a recent change in the composition of the recreational landings. More likely, it may be an artifact of the limited intercept survey coverage allotted to party and charter boats during January-April 1979 (particularly in Southern New England and the New York Bight), and the fact that weights were taken from only those fish that were brought ashore in whole form (for cod, this represented only 19% of the estimated total number caught). Since most cod caught on party/charter and private boats are headed, gutted, and/or filleted before returning to port, these fish were not used in calculating estimated body weights. In terms of the estimated 1979 catch, these "processed" fish accounted for 66% of the total number of cod taken by recreational anglers (Table 1). These problems are acknowledged in the report on the 1979 NMFS survey (United States Department of Commerce 1980: pp. 12 and 17), and imply that the 1979 results underestimated the total weight of cod landed. Ristori (1981) noted that recreational codfishing substantially improved west of Block Island during 1979 and 1980, as it had done in New England over the past few years, and that the summer 1980 Coxes Ledge cod fishery was, according to a respected Montauk party boat captain, the "best in a decade." The tenuous nature of the 1960-1974 recreational cod landings estimates, however, offer little guidance as to the degree of underestimation of the 1979 survey landings values.

Most of the recreational cod landings in 1979 were taken in FCZ waters (>3 mi from shore) using private and rental boats (Tables 3 and 4). Greater

than 70% of the total recreational cod catch was accounted for by anglers using private and rental boats; party and charter boat landings comprised only 25% of the total estimated catch. These patterns are similar to those observed in the 1965 saltwater angling survey. In the 1970 recreational survey, private and rental boats accounted for 52% of the recreational cod catch, while party and charter boats took about 45% of the annual landings. Distributions of the recreational cod catch, by fishing mode, for the 1960 and 1974 surveys are not available.

In an earlier assessment analysis (Serchuk et al. 1977), recreational cod landings from the angler surveys were apportioned to the Georges Bank and Gulf of Maine stocks on the basis of the catch distribution, by state, reported in the 1974 survey (Table 5). Ratios were derived between the U.S. commercial cod catch and the recreational cod catch in 1960, 1965, 1970, and 1974 (i.e., the recreational survey years), and used in estimating recreational harvests, by stock area, for years without angler surveys. Since 1977, however, recreational landings have not been estimated using this procedure due to uncertainties associated with the domestic commercial catch statistics. Accurate commercial landings data are requisite for this estimation technique (Serchuk et al. 1977).

The distribution of recreational cod landings, by state, in the 1979 survey differed markedly from that obtained in 1974 (Table 5). The 1979 results indicated that 70% of the total Northwest Atlantic recreational catch was taken in Massachusetts, and less than 30 thousand cod were landed by anglers south of Rhode Island. In contrast, the 1974 survey results showed Rhode Island to be the leading state in terms of number of recreational cod landings (33% of the total), and significant landings of cod in

New York and New Jersey (combined total of 617,000 fish or 21% of the total estimated harvest). As previously noted, the relative paucity of landings data in the New York and New Jersey fisheries in 1979, given accounts of improved recreational conditions in recent years, is probably a reflection of sampling difficulties and inadequacies in the 1979 survey.

The licensing and record-keeping provisions of the Atlantic Groundfish FMP require all party and charter boats fishing for cod in the FCZ to maintain and submit logbook records on recreational cod catches to the National Marine Fisheries Service. Preliminary examination of logbook records submitted in 1980 indicated a total catch of 669 mt of cod (Thomas D. Morrissey, NMFS Regional Office, pers. comm.). In 1979, reported recreational cod landings derived from logbook submissions totaled 423 mt. The logbook data grossly underestimate actual party and charter boat cod catches due to incomplete compliance with the logbook record keeping and submission requirements. Moreover, since only cod caught in the FCZ are required to be reported, even complete compliance would not account for landings within territorial waters (Nicholson and Ruais 1979; Serchuk and Wood 1979).

GEORGES BANK STOCK

Reported Commercial Landings

Provisional commercial landings for 1980 from the Georges Bank and South cod stock were 45,681 mt, 18% higher than in 1979 (38,650 mt), and the highest total annual commercial catch reported since 1966 (Table 6). USA 1980 landings totaled 39,045 mt, a 20% increase from the 1979 domestic catch of 32,639 mt, and the highest annual domestic catch since fishery records have been separately maintained by stock area (1932). Provisional Canadian landings in 1980 were 6,636 mt, a 625 mt increase from 1979(+10%).

Under the Atlantic Groundfish FMP, the 1979-80 OY (fishing year: 1 October 1979 - 30 September 1980) for the Georges Bank and South management unit was formally established on 1 October 1979 as 26,000 mt (Table 7). The USA commercial allocation was 22,000 mt; 4,000 mt were allocated to Canada. Regulation of landings, however, proceeded under the provisions of Amendment No. 4 to the FMP which did not gain approval by the Secretary of Commerce until 1 October 1980. This amendment specified a 1979-80 OY of 35,000 mt (29,620 mt, USA commercial; 5,380 mt, Canadian commercial which included an undetermined USA recreational allocation), and established quarterly USA commercial vessel class quota guidelines commensurate with this OY level (Table 8). Except for the first quarter (Oct-Dec 1979) of the 1979-80 fishing year, total quarterly landings exceeded the quarterly allocations from between 16% to 60% (Table 9). Overall, reported domestic commercial landings during the 1979-80 fishing year were 39,586 mt, 33.6% more than the allocated quota and 13% above the total OY.

During October 1, 1980 - December 31, 1980 (first quarter of 1980-1981 fishing year), the fishery was formally regulated under Amendment No. 4, and hence the quarterly quota established was identical to that used in regulating landings during Oct-Dec 1979 (i.e., 7,595 mt). Domestic first-quarter commercial landings totaled 6,557 mt, 86% of the allocation (Table 9).

For calendar year 1980, the resultant effective annual USA commercial quota was 29,620 mt, the same as for fishing year 1979-80 (Table 8). The 1980 reported USA commercial landings (39,045 mt) thus exceeded the allocation by 32% (Table 9).

USA commercial vessel class trip catch limitations were only revised once during fishing year 1979-80 (Table 7); these revisions only lasted for 14 days. At all other times, weekly landings limitations were as follows (in pounds/week/vessel): 0-60 gross registered ton (GRT) vessels: 7,000; 61-125 GRT vessels: 14,000; over 125 GRT vessels: 20,000; and fixed gear vessels: 16,000. Identical weekly vessel class catch limitations were in effect during the first quarter of the 1980-81 fishing year. No vessel class or fishery closures occurred either during the fishing year or the calendar year.

Reported USA commercial landings during 1977-1979 are believed to underestimate the actual domestic catch due to alleged widespread discarding of fish at sea and misreporting of landings. In 1980, discarding did not appear to be as prevalent as in previous years. In fact, during the latter quarter of the calendar year, industry sources indicated a relative scarcity or reduced availability of Georges Bank cod. It is likely, however, that during the earlier parts of the year that unreported and misreported catches were landed due to the large quarterly quota overruns evident from the reported statistics. As in prior years, no basis exists for quantifying the actual amount of cod caught.

Commercial Catch Composition

Market category distribution of the 1980 USA reported commercial Georges Bank and South landings indicated that "market cod" (2.5-10.0 lbs; 1.1-4.5 kg) comprised 47% of the catch by weight (Table 10). This is a decrease in the proportional representation of this category from 1979 (55%). "Large" cod (10.0-25.0 lbs; 4.5-11.3 kg) landings in 1980 increased

from 1979, as a percentage of the reported annual catch (42% vs 37%), and imply that many of the cod from the strong 1975 year class have achieved sufficient body weight to appear as "large" cod rather than in the "market cod" category.

The 1980 market category distribution is similar to that for 1971 in which the strong 1966 year class is presumed to have comprised a large component of the "large" cod landings. In this latter instance, the percentage of "large" landings peaked five years after the 1966 year class was spawned. Based on this pattern, it is likely that the proportional representation of "large" cod in 1981 will decline from 1980 as the 1975 year class is further reduced in abundance and importance in the fishery.

The percentage of "scrod" (1.5-2.5 lbs; 0.7-1.1 kg) landings in 1980 increased slightly from 1979 (11% vs 8%) and approximates the median annual percentage value of scrod observed in the 1964-1979 time series. Since Georges Bank cod normally recruit to the commercial fishery as "scrod" at age 2, the 1980 "scrod" percentage suggests that the 1978 year class is of average abundance compared with previous year classes in the recent time series. This evaluation of the relative strength of the 1978 year class differs, however, from research survey catch per tow at age trends of this cohort which indicate that the 1978 year class is above average in strength (see Stratified Mean Number Per Tow By Age Group).

Distribution of USA Commercial Landings by Gear

During 1965-1979, otter-trawl landings accounted for between 81.6% and 94.7% of the annual domestic commercial catch of cod from Georges Bank (Table 11). In 1980, otter trawl catches comprised 84.3% of the Georges

Bank landings, a slight decline from 1979 (85.9%). Line trawl and handline landings, which accounted for 10.3% and 2.6%, respectively, of the Georges Bank cod catch during 1965-1979, decreased to their lowest percentage levels in 1980; only 3% of the landings were taken by line trawl and no handline landings were recorded. The absence of handline landings in 1980 was a result of a shift to gill nets from handlines in vessels fishing out of Chatham, Massachusetts. In 1979, the Chatham-based cod fishery accounted for 99% of the Georges Bank handline catches, while in 1980, this same fishery accounted for 93.2% of the domestic gill-net landings. As a result, Georges Bank cod gill-net landings increased over sevenfold between 1979 and 1980 (620 mt vs 4,441 mt). The 1980 Georges Bank gill-net catch is larger than any of the annual gill-net landings in the Gulf of Maine cod fishery in which gill netting has historically (1965-1980) accounted for 21% of the northerly cod landings.

USA Commercial Effort and Catch Data

Effort statistics (number of trips; days fished) and individual trip landings data for the Georges Bank (area 5Ze) domestic otter-trawl fishery for cod, derived from NMFS interview and weighout records, were examined for recent trends in USA commercial fishing patterns. Individual trip records were aggregated, by year and vessel tonnage category (Class 2: 5-50 GRT; Class 3; 51-150 GRT; Class 4: 151-500 GRT). Both total effort (trips in which any cod were landed) and "directed" effort (defined as trips in which cod comprised 50% or more of the total reported trip landings, by weight) were analyzed. The reported days fished was reported estimated fishing time with net on the bottom recorded to the nearest tenth of a day.

During 1965-1979, Class 3 vessels dominated the fishery accounting for 61% of total trips, 72% of total days fished, and 62% of the otter-trawl landings (Tables 12, 13, and 14). In 1980, Class 3 vessels continued in dominance accounting for 71% of total trips, 73% of total days fished, and 66% of the catch. Between 1968 and 1976, annual effort and landings of cod, within each vessel category, exhibited only moderate fluctuations. Prior to 1968, cod were generally taken as by-catch in the offshore haddock fishery which collapsed after 1967. The pronounced reduction in effort among all vessel classes between 1967 and 1968 is indicative of this precipitous decline in haddock abundance. Subsequently, the otter-trawl fishery became much more dependent on cod; total cod landings from directed effort increased from 25.8% of the annual Georges Bank otter trawl in 1968 to 55.9% in 1974. The percentage of directed effort (days fished) and landings within Class 3 vessels has continued to increase through the present, although directed landings in Class 2 and 4 vessel categories peaked in 1978 and 1974, respectively (Tables 13 and 14). In 1980, directed trips accounted for only 28.3% of total trips in the fishery but resulted in 55.8% of the total cod landings. The directed fishery may even be more significant than the 1980 values indicate since trip limitations on cod landings, in effect for all otter-trawl vessel classes during the year, often curtailed trip landings of cod once vessel catch quotas were obtained. Hence, the importance of the directed fishery (using the 50% catch criterion) would appear less than might have otherwise been the case.

Commercial Abundance Indices (USA Catch Per Effort)

Annual commercial indices of catch per unit effort (metric tons of cod landed per trip and per day fished), 1965-1980, were derived for both

total and directed trips for vessel classes 2-4 otter trawlers from 77,295 individual trip records.

Yearly catch per effort indices of Class 2 and 3 vessels exhibited similar trends between 1965 and 1980 (Table 15). Total landings per day fished remained relatively constant between 1968-1976 (Class 2: 0.56-0.95; Class 3: 0.69-1.01), after which annual indices increased to the highest values in the time series (Class 2: 1.27-1.63; Class 3: 1.40-1.99). These patterns are also generally reflected in the "directed" indices within each vessel group, although these average annual catch rates are substantially higher because of the 50% catch criterion used to identify directed trips.

Annual catch per effort indices of Class 4 otter-trawl vessels progressively increased from 1.04 mt per day fished in 1965 to 3.18 mt in 1980 (based on total effort). Directed indices remained relatively stable between 1967-1972, increased to a peak in 1977 (7.77 mt/day fished), and declined during 1978 and 1979. The 1980 index (5.27) was similar to that for 1979 (5.08) (Table 15). The lowered directed fishery catch per effort values during 1979 and 1980 are probably reflective of the imposition of restrictive trip catch limits on Class 4 vessels rather than marked declines in the relative abundance of cod. This is further implied by an obvious decrease in the number of days fished per trip and a concomitant increase in total trips in both the Class 3 and 4 tonnage categories during 1977-1980 (Tables 12 and 14). Trip catch restrictions have more severely constrained these vessel classes than Class 2 vessels.

Overall, the commercial indices indicate that cod abundance on Georges Bank significantly increased after 1976 and has subsequently remained at a relatively high level. Interpretation and evaluation of the annual indices since 1978, however, needs to be tempered with the realization that recent changes in commercial catch per effort have been directly influenced by management measures. To the extent that these restrictions constrain actual fishing performance, the commercial indices will belie the relative abundance of Georges Bank cod.

Research Vessel Survey Catches

Research vessel bottom-trawl surveys, conducted by the Northeast Fisheries Center (NEFC), have been utilized to monitor changes in cod abundance on Georges Bank since 1963. Previous assessments used only autumn and spring offshore catch per tow indices, based on survey catches in strata 13-25 (Figure 2), to evaluate trends in relative abundance. In the present analyses, catch per tow indices from NEFC summer offshore surveys (1977-1980), NEFC spring, summer, and autumn inshore surveys (1977-1980), and the State of Massachusetts spring and autumn inshore bottom-trawl surveys (1978-1980: Howe et al. 1979, 1980; Howe, pers. comm.) have also been utilized. The inshore NEFC indices were based on cod catches in sampling strata 45-56 (Figure 3); indices of abundance for Georges Bank cod from the Massachusetts surveys were derived from catches in strata 11-21 contained within Massachusetts study regions 1-3 (Figure 4).

Spring and autumn NEFC offshore catch per tow indices for Georges Bank cod exhibited similar trends during 1968-1979 (Table 16), both in number and weight per tow. Except for 1969-70 and 1972-73, sequential annual changes in the spring stratified mean number per tow have been mirrored in

directionality of change by the corresponding autumn number per tow indices. Equally, apart from 1974-1977 when autumn and spring weight per tow indices showed disparate patterns, autumn and spring weight per tow values have sequentially varied in tandem (1969-1974; 1977-1979). Differences in magnitude of catch per tow between the two surveys are a reflection of differences in sampling gear (spring surveys since 1973 have used a "41 Yankee" trawl while all autumn surveys have employed a "36 Yankee" trawl), and seasonal distributional changes in cod between spring and autumn (Serchuk and Wood 1979; Serchuk et al. 1980).

The 1980 NEFC offshore spring and autumn survey indices, however, are incongruent in terms of similarity of trend. Spring indices of number and weight per tow (4.96 and 33.7) increased 50.3% and 46.5%, respectively, from 1979 values while the 1980 autumn indices (2.36 and 13.7) decreased by 51.0% and 59.1% from corresponding 1979 number and weight per tow values (Table 16). The spring indices approximated the median values of relative abundance during the 1973-1979 period (when the "41" trawl has been used) and were the highest since 1978. The 1980 autumn number and weight indices were among the lower third of survey values in the 18-year autumn time series, and were the lowest since 1974 (Figure 5).

Sequential annual fluctuations in NMFS offshore summer survey indices, 1977-1979, have been inconsistent with both spring and autumn survey trends (Table 16). The 1980 values increased from 1979 (10.39 vs 5.25 in number per tow; 33.1 vs 27.1 in weight per tow), and thus paralleled the changes observed in the 1979-80 spring indices. The 1980 summer number per tow value is the highest in the summer series implying that population size is

currently at its highest level in the past four years. Neither the spring or autumn data corroborate this inference.

Evaluation of trends in catch-per-tow indices from NEFC and Massachusetts inshore bottom trawl surveys is constrained by the short time series of data available, and for the NEFC inshore surveys, the low number of tows accomplished in each survey. The average number of tows per survey in the inshore Georges Bank (Strata 45-56: Figure 3) spring and autumn NEFC surveys is 9; the summer NEFC inshore cruises have averaged 13 tows per survey. The Massachusetts spring and autumn survey efforts have been much more intensive and have averaged about 53 sampling tows per survey in the areas inshore of Georges Bank (Mass. Regions 1-3: Figure 4). By design, all of the inshore surveys sampled relatively shallow waters (<15 fms) where young cod are frequently resident (Bigelow and Schroeder 1953). Hence, the inshore survey catch indices are most reflective of recent year-class success rather than changes in overall population size.

The NEFC and Massachusetts inshore autumn number and weight per tow indices (Tables 17 and 18) during 1978-1980 have generally varied in corresponding fashion to the NEFC autumn offshore indices. All three sets of relative abundance values exhibited successive annual declines from 1978 onward. The 1980 indices, in each series, are at least 2-3 times lower than the highest values observed in the three-year period.

Trends in the inshore spring NEFC and Massachusetts survey catch per tow indices also agree closely; in both survey series, mean weight per tow values sequentially increased during 1978-1980 and declines in mean number per tow occurred between 1979 and 1980. Given the variability associated

with each of the annual catch-per-tow indices, differences between the 1979 and 1980 values are probably not significant, for either survey series. In this respect, the inshore spring indices for 1979-80 agree with the 1979-80 spring offshore indices (in which overlapping confidence limits are evident: Figure 6) suggesting that no statistically detectable change in relative population size occurred between spring of 1979 and spring of 1980. Nonetheless, all of the 1980 spring survey data imply that Georges Bank cod abundance has recently stabilized or improved while all of the autumn data indicate that it has declined.

Catch-per-tow indices from the NEFC summer surveys in inshore waters adjacent to Georges Bank (Table 19) have tended to vary in conjunction with the recent spring survey indices (1979 and 1980), and, apart from 1978, with the offshore summer catch-per-tow values. Both of the 1980 summer inshore indices were the second highest in the four-year time series.

Stratified Mean Number Per Tow by Age Group

Stratified mean catch-per-tow values in numbers at age from the NEFC spring and autumn offshore surveys on Georges Bank are given in Tables 20 and 21. The 1980 autumn survey age samples are currently being analyzed, hence age composition data for this survey are not included in Table 20. The young-of-year index (age 0) from this cruise was estimated from the autumn survey length-frequency distribution of stratified mean number per tow by length group. Cod $\leq$20 cm in length were considered to be young of year.

Both the spring 1980 and autumn 1979 offshore survey age data indicate that the 1977 year class has replaced the 1975 year class as the dominant year class in the population. The 1977 year class comprised 35% of the

spring total number per tow and 29% of the autumn total number per tow index. Compared with previous year classes, the 1977 year class appears to be above average in strength based on the spring time series and of at least average strength based on the autumn data.

The 1978 year class appears to be above average in strength on the basis of successive catch-at-age values in both of the offshore survey series. This cohort accounted for 29% of the total number per tow in the spring 1980 survey, and 27% of the autumn 1979 total index. In spring surveys since 1978, sequential age 0 to age 2 values for the 1978 year class have been higher than corresponding catch-at-age values for the 1977 cohort (Table 20).

Catch-at-age indices for the 1979 year class indicate that it is relatively poor in strength. The spring 1980 age 1 value (0.025) is the second lowest age 1 index in the survey series. The autumn 1979 age 0 index (0.096) is also the second lowest value in the autumn series.

The catch per tow of age 0 cod (1980 year-class) in the offshore 1980 spring survey (0.067) is slightly above the median age 0 index observed during 1973-1980. The autumn 1980 age 0 value (0.210) is slightly below the average young-of-year index during 1970-1979 (median:0.260; mean: 0.362). Hence, both surveys suggest the 1980 year-class to be about average in relative abundance. Normally, better than average year classes can be identified on the basis of age 0 indices in the autumn surveys as evinced by the relatively high young-of-year indices for the 1975 and 1978 year classes.

Age composition data from NMFS offshore summer surveys agree with the spring and autumn indices in showing the 1978 year class to be fairly strong (Table 22). The 1980 age 2 index (4.135) accounted for 39.8% of the total number per tow, and was only exceeded by the very strong 1975 year class age 2 index (5.121) observed in the 1977 survey. The summer survey catch-per-tow-at-age values for the 1977 year class have been less than those for the 1978 year class and correspond with the trends noted in the spring surveys for these cohorts. The 1980 summer age 3 value (1977 year class), however, is the highest in the summer series, eclipsing even the 1975 year class age 3 index (2.371 vs 1.542). Apart from this value, previous catch indices for the 1977 year class are indicative of only average relative year-class strength.

Unlike the 1980 spring and autumn results, the 1980 offshore summer data indicate the 1980 year class to be very strong. The summer 1980 age 0 index (2.646) is 3.5 times greater than the highest age 0 value during 1977-1979 (1978 age 0 value of 0.755). The summer survey time series, however, is not really long enough to assess whether age 0 catch indices are reflective of year-class strength and recruitment.

The 1977-1980 Massachusetts inshore spring and autumn survey catch at age data (Tables 23 and 24) are similar to the offshore survey data in suggesting a very strong or above average 1978 year-class strength. The 1978 cohort was dominant in both the 1978 and 1979 surveys comprising between 57% and 100% of the total mean number per tow indices. The 1980 survey data indicate a diminished importance for this year-class in the "population," although this is probably an artifact since very few cod age 2 and older are

normally taken in these surveys. In the autumn series, fish older than age 1 only appeared in the 1979 survey and comprised but 0.52% of the total number per tow index; in the 1978 and 1979 spring surveys, 2+ cod accounted for 0.24% and 1.27%, respectively, of the total catch per tow values. These findings intimate that cod leave the inshore regions sampled by the surveys as they grow older and become "scrod."

Evaluation of relative year-class strength for the 1977, 1979, and 1980 year classes from the Massachusetts surveys is more difficult to accomplish than for the 1978 cohort because of inconsistencies in trend between successive catch-at-age values and the limited three-year time series. This is equally true for the NEFC summer inshore survey surveys (Table 25) because of the relatively low survey sampling intensity. Tentative assessment of relative strength for the 1977 and 1980 year classes, based on these inshore survey series, is that both are approximately average in size. The 1979 year class also appears to be of average strength as deduced from the Massachusetts spring surveys and the NEFC summer inshore data; the Massachusetts autumn age distributions, however, suggest that the 1979 year class is a relatively poor one.

Spring and autumn NEFC inshore survey catch-at-age data were not used to evaluate recruitment success because of the short duration of these time series (i.e. only 2 years for the autumn surveys) and limited annual sampling efforts.

Overall, a relatively consistent pattern of relative year-class strength abundance for the 1977-1980 year classes is evident among all of the various survey series (Table 26). The 1978 year class seems to be much better than the rest; it appeared as above average or better in strength in

all but one of the survey series. The 1978 year class, however, does not appear to be nearly as strong as the 1975 year class which has sustained the fishery in recent years. The 1977 and 1980 year classes appeared to be of at least average strength in all survey sets, and above average and very strong, respectively, in one survey series. The 1979 year class is probably relatively weak; half of the survey series indicated that it was poor in strength and in the other half it appeared no better than average.

Relative Exploitation Rates

Mean annual relative exploitation rates were derived for 1964-1980 by dividing total reported landings (commercial and commercial and estimated recreational) by the NEFC autumn offshore surveys stratified mean weight per tow index (Table 27). To elucidate general trends, the time series of annual catch and survey values were smoothed by calculating three-year averages. Estimated recreational landings have not been utilized in deriving exploitation rates since 1975 due to uncertainties in the recreational catch estimation procedure (see Northwest Atlantic Recreational Cod Fishery). Further details and rationale for calculating relative exploitation rates for cod are discussed in Serchuk et al. (1980).

During 1971-1976, annual relative exploitation rates were significantly less than those during 1964-1970 (i.e., 57% lower for "A/C" ratios - Table 27), implying that fishing mortality was much reduced during this period. Annual declines in exploitation rates sequentially occurred between 1975 and 1977, but subsequent annual rates have greatly increased. The 1980 value (1.79) is 41% higher than the 1979 exploitation rate, about twice as large as either the 1977 or 1978 rates, and higher than any annual rate since 1970. Because reported USA commercial landings in 1980 may seriously

underestimate actual catch (due to under-reporting, misreporting, or non-reporting), the actual 1980 relative exploitation rate may be considerably higher than that derived. This would imply that the fishing mortality in 1980 was within the range of values observed during 1964-1970 which contributed to declines in cod population biomass.

If the 1980 NEFC autumn offshore weight per tow index is considered an anomalously low value (since it differs so greatly from the spring results), the 1980 relative exploitation rate would be significantly lower than presently calculated. However, since large declines in weight per tow indices between 1979 and 1980 were observed in all autumn survey series (including Massachusetts and NEFC inshore surveys), the likelihood that the 1980 NEFC autumn offshore index is an artifact seems unlikely. Reduced availability of cod in autumn 1980, if present, should not have affected survey catches equally over the entire inshore and offshore Georges Bank region.

All of the survey series indicated the 1978 year class to be above average and the 1977 year class to be at least average in strength. Neither of these year classes, however, has appeared to be significant in the commercial fishery landings. The 1979 and 1980 "scrod" market category percentages (8% and 11%, respectively: Table 10) are not reflective of average and above-average recruitment of the 1977 and 1978 year classes as scrod at ages 2 and 3. Hence, the 1980 autumn survey total catch per tow indices may be actual indicators of the reduction in population biomass effected by increased fishery removals during the past two years, particularly of fish from the previously dominant 1975 year class.

Although there is a risk associated with using any one survey value as a point estimate of stock status, the consistent trend in all of the

autumn indices since 1978 suggests that, in the absence of realized better than average recruitment of the 1978 year class in the Georges Bank fishery, continuation of current annual harvest levels in the immediate future will be accompanied by noticeable reductions in stock biomass.

Implications of the Current Georges Bank Cod Assessment

Results of the present assessment indicate that the Georges Bank and South cod stock biomass may have begun to decline from the relatively high levels observed in 1978 and 1979. Determination of this decline is equivocal since spring and autumn survey indices in 1980 exhibit contrariant trends. Spring (and summer) offshore and inshore 1980 catch per tow values generally increased from 1979; all 1980 autumn survey indices were substantially lower than in 1979 or 1978. Prior to 1980, trends in spring and autumn indices were generally similar.

Recruitment of the 1978 year class, as evinced by catch at age data from NEFC offshore and inshore surveys and Massachusetts spring and autumn inshore surveys, appears to be above average, although not as strong as the 1975 year class. Based on age composition data from six different survey series, the 1977 and 1980 year classes appear average in strength. The 1979 year class seems to be weak or relatively poor.

The 1975 year class no longer continues to be dominant in the population being replaced by the more abundant 1978 and 1977 cohorts. The NEFC spring 1980 offshore catch-at-age distribution indicates that these year classes combined comprised 64% of the population by number; the 1980 USA commercial catch composition, however, indicated that "market" and "large" cod (cod of a body weight expected of fish from the 1975 year class) accounted for

89% of the landings by weight. "Scrod" landings in 1979 and 1980 were not reflective of either an above average 1978 year class or an average-sized 1977 year class, but rather implied that the 1978 year class was only average and the 1977 year class below average in strength.

As in previous years, otter-trawl landings dominated the domestic commercial catch, accounting for 84.3% of the 1980 landings. Gill-net catches increased sharply in 1980 from 1979 (7X), and comprised 12% of the 1980 catch. Unlike previous years, no handline landings were recorded in 1980 as the traditional Chatham-based handline fishery switched completely to gill netting.

Otter-trawl effort (number of trips and days fished) in 1980 was greater than in 1979 for all vessel tonnage categories (~+7%). Class 3 vessels accounted for 72% of the total days fished and 62% of the otter-trawl landings. Directed trips (those in which cod comprised 50% or more of the trip catch by weight) accounted for 28.3% of the total 1980 otter-trawl effort but resulted in 55.8% of the commercial otter-trawl landings.

Commercial catch per effort indices (landings per day fished) during 1977-1980 for all vessel classes are the highest in the 1965-1980 time series, and imply an increased stock abundance. Changes in commercial catch per effort values during 1979-1980, however, are difficult to evaluate relative to stock conditions since implementation of trip catch limitations has affected fishing patterns.

Relative exploitation rates since 1978 have annually increased. The 1980 rate is about twice as large as either the 1977 or 1978 values, and is the highest observed since 1970. Because reported USA commercial landings statistics are suspected to underestimate the actual 1980 catch, the

actual 1980 relative exploitation rate may be considerably higher than that calculated suggesting this recent fishing mortality has increased to the levels observed during 1964-1970 when stock declines ensued.

If recent declines in all of the autumn survey catch-per-tow indices are indicative of declines in stock biomass, continuation of current harvest levels (~46,000 mt, commercial landings) in the immediate future will further reduce population size. Amelioration of stock declines will occur, to some degree, if recruitment of the 1978 year class into the fishery is as strong as survey indices suggest. Given that the 1979 and 1980 year classes currently appear as relatively weak and average, respectively, the 1978 year class may have to sustain the fishery until at least 1983.

GULF OF MAINE STOCK

Reported Commercial Landings

Provisional 1980 reported commercial landings of Gulf of Maine cod totaled 12,135 mt (Table 28), 77 mt more than in 1979 and 5.3% less than the 1978 landings of 12,810 mt. USA landings in 1980 (11,997 mt) accounted for 98.9% of the total commercial harvest and were the fourth highest annual domestic catch since USA cod landings have been maintained by stock area (1932). Provisional 1980 Canadian landings were 138 mt, 63.6% less than in 1979 (379 mt).

Total removals from the Gulf of Maine management area during 1980 were regulated under the Atlantic Groundfish FMP. For the 1979-80 fishing year (1 October 1979 - 30 September 1980), an OY of 8500 mt was formally established (6,000 mt, USA commercial; 2,500 mt, USA recreational for FCZ charter and head boats) (Table 29). The fishery was regulated, however, under the OY provisions of Amendment No. 4 to the FMP which received final approval on 1 October 1980. This amendment assigned a 1979-80 OY of 12,000 mt (9,500 mt, USA commercial; 2,500 mt, USA recreational for FCZ charter

and head boats), and specified quarterly domestic commercial quota guidelines in accordance with the annual OY (Table 8). Reported USA commercial landings during the 1979-80 fishing year totaled 12,051 mt (Table 9), 26.9% more than the annual allocation and 0.4% larger than the Amendment No. 4 OY.

During October 1 - December 31, 1980 (first quarter of 1980-81 fishing year), the quarterly quota for domestic commercial vessels was 2,250 mt (Table 8). The effective 1980 calendar year USA commercial quota was thus 9,500 mt, the same as for the 1979-80 fishing year. Reported domestic commercial landings during the calendar year (11,977 mt) exceeded the annual calendar quota by 26.1% (Tables 8 and 9).

Weekly vessel class trip limitations were in effect throughout fishing year 1979-80 and during the first quarter of the 1980-81 fishing year. Except for a 14-day period during the end of September 1980, these limitations were as follows (in pounds/week/vessel): 0-60 GRT vessels: 2,500; 61-125 GRT vessels: 5,000; over 125 GRT vessels: 7,000; and fixed gear vessels: 5,000. During the two-week period in September, the weekly landings limitations were reduced to prevent the 1979-80 OY from being exceeded by significant amounts (Table 29).

As in previous years, the 1980 reported USA commercial landings are believed to underestimate the actual catch to an unknown degree. Unreported and misreported catches likely continued throughout the year.

Commercial Catch Composition

Distribution of the 1980 USA commercial Gulf of Maine cod landings indicated that "scrod" comprised 19% of the catch (by weight),"market" cod,

45%, and "large" cod, 36% (Table 10). The 1980 commercial catch composition is generally similar to the 1978 and 1979 distributions. As a group, these distributions differ from those in four preceding years (1974-1977) by reflecting less reliance in the fishery on "scrod" and more emphasis on "large" cod. This is presumably a result of the continued importance of the strong 1971 year class (as "large" cod) in the fishery as well as the moderately strong 1973 and 1974 year classes ("market" and "large" cod). The 1975 year class, based on research survey data, may also be significant in the fishery landings.

The percentage of "scrod" in 1980 increased by 36% (19% vs 14%) from 1979. This increase was expected (Serchuk et al. 1980: p. 16) due to recruitment of the 1977 year class into the fishery as "scrod." Based on 1979 bottom trawl survey catch per tow indices, the 1977 year class was believed to be relatively strong. More recent 1980 data, however, suggests this year class may only be of average strength. Since the 1976 year class is relatively weak, the increase in the percentage of scrod landings between 1979 and 1980 appears to reflect the differential strengths of the 1977 and 1976 year classes.

In 1981, the proportional representation of "scrod" should increase again as the 1978 year class currently appears to be above-average in strength.

Distribution of USA Commercial Landings by Gear

The principal gear used in the commercial Gulf of Maine cod fishery has been the otter trawl. Otter-trawl landings accounted for 69.9% of the total USA commercial catch during 1965-1979 (Table 30). In 1980,

otter-trawl catches comprised 67.6% of the domestic landings, a slight decline from 1979 (68.9%). Gill-net landings, which accounted for 20.4% of the 1965-1979 total catch, comprised 29.3% of the 1980 domestic harvest, the largest annual percentage in the recent time series. Line trawl landings, formerly significant during 1971-1975, have accounted for less than 5% of the annual catches in the past four years.

USA Commercial Effort and Catch Data

Effort statistics (number of trips and number of days fished) and landings data from 99,447 individual USA commercial otter-trawl fishing trips, 1965-1980, were examined for trends in the Gulf of Maine commercial fishery. Otter-trawl records were used because of the historical importance of this gear in the fishery. Trip records were grouped within years by vessel tonnage category (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT). Trips by undertonnage vessels (<5 GRT) or composite records encompassing more than one trip were excluded from the analyses. All trips in which any cod were landed, as well as directed trips (those in which cod comprised 50% or more of the trip catch by weight), were analyzed. Effort reported as days fished represents reported estimates of fishing time, net on the bottom, recorded to the nearest tenth of a day.

Class 2 vessels have dominated the fishery accounting for 73% of the total trips, 65% of the total days fished, and 51% of the total otter-trawl landings during 1965-1979 (Tables 31-33). In 1980, Class 2 vessels continued to account for the bulk of the fishery effort (66% of trips; 59% of days fished) and landings (49% of total catch).

Total fishery effort in 1980 (all vessel classes, days fished) was the highest in the 1965-1980 time series, and represented the seventh consecutive year that annual effort increased. Recent annual increases of effort within vessel classes 2 and 3 have been accompanied by a reduction of effort in the directed fishery; between 1976 and 1980, the percentage of directed effort (both trips and days fished) within both classes decreased by about 25% (Tables 31 and 32). Directed fishery landings in 1980 accounted for only 29.9% of the total landings, the lowest percentage of directed catch in the fishery since 1974. Since total Gulf of Maine cod landings have been at relatively high levels since 1977, the declines in directed cod effort appear to reflect a more opportunistic nature (in terms of major species sought) of the Gulf of Maine otter-trawl fleet. This is not unexpected for a fishery dominated by smaller vessels where availability of alternative species often dictates daily fishing patterns. Recent increases in flounder landings in the Gulf of Maine otter-trawl fishery may have resulted in fewer trips in which the cod catch met the 50% catch criterion for identification as a directed trip.

Commercial Abundance Indices (USA Catch Per Effort)

Annual catch per unit effort indices (metric tons of cod landed per day) of Class 2 and 3 otter-trawl vessels in the Gulf of Maine cod fishery have shown similar trends (Table 34). Catch rates were relatively stable during 1965-1966, but sharply increased in 1967 and remained high until 1971. During 1972 and 1973, commercial catch rates declined to the lowest values observed in the time series. Afterward until 1977, annual indices gradually increased again to the high levels observed during 1967-1971, but subsequently

declined through 1980. For the period between 1965 and 1977, trends in the commercial catch rates have generally paralleled trends observed in the NEFC autumn offshore weight per tow indices (Figure 7). The survey data indicated that population biomass was relatively high during 1968-1971, relatively low during 1973-1976, and high again in 1977.

Class 2 and 3 annual catch rate declines during 1978-1980 are difficult to interpret since vessel trip catch limitations were in effect during these years. Fishing patterns were obviously influenced as the average number of days fished per trip by Class 2 and 3 vessels during 1978-1980 was greater than at any time during 1965-1977 (Table 34). Since the Gulf of Maine cod stock biomass has been at a relatively high level since 1977, increased trip lengths and reduced catch rates appear to be inconsistent responses to increased resource abundance. Management landings constraints seem therefore to have significantly altered fishing performance.

Class 4 annual catch per effort indices exhibit the most variability of any of the vessel classes, although the high catch rates observed in the late 1960's in Classes 2 and 3 are also evident in the Class 4 data (Table 34). Class 4 landings, however, have never been of major importance in the Gulf of Maine fishery accounting for only 5.8% of the total otter-trawl catch during 1965-1980 (Table 33). The relatively low number of directed trips by Class 4 vessels (Table 31) suggests that cod is more of an incidental catch than a principal catch component. Accordingly, the Class 4 catch per effort indices may be more of a reflection of the relative abundance of cod versus other species rather than indices of cod biomass itself.

In toto, commercial catch/effort trends of Gulf of Maine cod have generally mirrored changes in stock abundance during the 1965-1977 period. More recent commercial indices, reflecting the impact to regulations, appear unreliable as indicators of relative stock conditions.

Research Vessel Survey Catches

As for Georges Bank cod, research vessel bottom trawl surveys have been used as a fishery independent method of stock evaluation for the Gulf of Maine cod populations since 1963. NEFC offshore autumn surveys have been conducted annually from 1963-1980; NEFC offshore spring surveys have been performed yearly since 1968. Additionally, summer offshore and inshore research cruises have been accomplished by the NEFC in the Gulf of Maine since 1977. More recently, the State of Massachusetts has surveyed the lower inshore Gulf of Maine, from Cape Cod Bay to the New Hampshire border, during spring and autumn from 1978 onward (Howe et al. 1979, 1980; Howe, pers. comm.). For the offshore surveys, stratified mean catch per tow indices have been derived from catches in strata 26-30 and 36-40 for the spring and autumn cruises, and for strata 26-28 and 37-40 for the summer surveys (Figure 2). Relative abundance indices for the NEFC inshore surveys were separately developed for the lower and middle northern Gulf of Maine (strata 58-66 and 68-90, respectively) so that the lower Gulf of Maine values could be directly compared to the Massachusetts catch per tow indices (Massachusetts strata 25-36 within Massachusetts sampling regions 4 and 5) from the same general area (Figures 3 and 4).

NEFC autumn offshore weight indices declined from 24.4 lbs in 1963 to 12.5 lbs in 1967, increased to 26.5 lbs in 1968, and stabilized until 1971.

Subsequently, catch per tows values dropped to 9.2 lbs in 1976, after which they sharply increased to between 20.7 and 28.9 lbs (Table 16; Figure 7). The 1980 index (28.9) is the second highest in the time series exceeded only by the 1964 value. Trends in the corresponding number per tow indices have generally been similar, although annual fluctuations have normally been less. The 1980 number index, like the 1980 weight per tow value, was the second highest observed.

Trends in the NEFC spring offshore survey indices have closely paralleled those in the autumn. Both numbers and weight values were high during 1967-1969 and have been relatively high since 1976 (Table 16; Figure 8). Since the standard sampling gear during the 1968-1972 spring surveys ("36" Yankee trawl) was different from that employed afterward ("41" Yankee trawl), it is difficult to evaluate the changes in spring catch per tow that occurred between 1971 and 1974. Although both the numbers and weight indices in spring 1980 (1.74 and 12.6, respectively) declined from 1979, they are still among the highest observed since 1974. Neither of the 1980 values was statistically different from the 1979 indices (Figure 8). Hence, the offshore spring and autumn data continue to imply that the Gulf of Maine stock remains at a relatively high level.

Catch indices from the offshore summer surveys during 1977-1979 indicated the same general improvement in resource abundance as seen in the offshore spring and autumn values (Table 16). The summer 1980 values, however, declined sharply from 1979 (3.85 vs 10.33 in numbers per tow; 18.4 vs 44.2 in pounds per tow). This reduction primarily resulted from decreased catches of cod in stratum 26, an area where previous summer catch indices had been the highest in the Gulf of Maine. If this stratum is omitted from

the 1978-1980 catch per tow calculations, the resultant 1980 offshore summer index would only be 10% less than the 1978 value and virtually identical to the 1979 index (-0.8% less). The relatively large 1980 summer inshore indices (Table 19) suggest that during summer 1980 Gulf of Maine cod may have been aggregated further inshore than in previous summers.

The NEFC and Massachusetts inshore Gulf of Maine spring and autumn survey indices in 1979 and 1980 indicate relatively high levels of cod abundance (Tables 17 and 18). The 1980 spring and autumn NEFC catch values increased from 1979 as did the autumn 1980 Massachusetts indices. Declines were observed in the spring 1980 Massachusetts catch values but the 1980 indices remained high.

Except for the 1980 summer offshore data, all of the 1980 survey indices are consistent in reflecting a high Gulf of Maine stock size.

Stratified Mean Number Per Tow by Age Group

Catch at age distributions from the offshore surveys indicate the Gulf of Maine population has had a succession of average or better year classes since 1978 (Tables 20-22). The 1979 and 1980 offshore spring and summer indices for the 1978 year class suggest that it is of at least average strength. In the spring 1980 survey, the 1978 year class (age 2 index) accounted for 20% of the total number per tow, the highest of any cohort. In the 1980 summer survey, age 2 cod comprised 19% of the total index, being exceeded only by the 1977 year class (37% of the total index) which has appeared much stronger in the summer surveys than in any of the other survey series.

The 1979 year class appears to be much better than average based on age 0 catches in spring and summer offshore surveys, but the age 1 indices were only of average size compared to previous age 1 values. Aging data are not currently available for the 1980 offshore autumn survey so evaluation of the current strength of the 1979 year class from this cruise could not be performed.

The 1980 year class seems to be very strong based on age 0 catches in the 1980 spring offshore survey. The age 0 index was 0.057, the highest young-of-year value in the spring series. The summer offshore survey 1980 index of age 0 cod was 0.350, an above average value.

Age composition data from the inshore surveys show more definite trends in relative year class strength than do the offshore surveys (Tables 23-25). The 1979 year class stands out as being very strong in two survey series (NMFS summer inshore and Massachusetts spring inshore) and above average in the Massachusetts autumn series. In all three 1980 inshore surveys, the age 1 indices were the highest ever observed. This was also true for 1980 age 2 indices (1978 year class); successive annual catch at age values for the 1978 year class, however, have been less than those for the 1979 cohort suggesting that the 1979 year class is the stronger of the two.

Inshore indices of age 0 fish in 1980 tended to approximate average young-of-year values in each of the inshore surveys implying that the 1980 year class may not be as strong as deduced from the offshore surveys.

As a group, the various offshore and inshore surveys suggest that the 1979 and 1978 year classes may be the strongest ones since the 1973 year class, and that the 1977 and 1980 year classes are probably of at least

average strength. Since offshore and inshore evaluations of relative year-class abundance were often variable (Table 26), it was difficult to assess recruitment patterns other than in a semi-quantitative fashion.

Relative Exploitation Rates

Annual relative exploitation rates for the Gulf of Maine cod fishery during 1964-1980 were calculated by dividing total reported landings by the offshore autumn survey weight per tow index. To establish a smooth series of catch and survey values, three-year averages were calculated (see Table 27).

The Gulf of Maine relative exploitation rates can be grouped into three periods: (1) 1966-1971 when exploitation values were relatively stable; (2) 1972-1975 during which relative exploitation rates increased annually; and (3) 1976-1980 during which exploitation rates have trended progressively lower.

During 1979 and 1980, annual exploitation rates have stabilized at about 0.465 ("D/F" ratio - Table 27), 41% lower than the high 1975-1976 average (0.79) but still 37% higher than the 1966-1971 mean exploitation rate (0.34). Stock biomass increases since 1976 have sustained increased annual landings due to production of the 1971 year class and the moderately strong 1973 and 1974 year classes. If the 1978 and 1979 year classes remain above in strength upon recruitment into the fishery, exploitable biomass should continue to increase.

Because USA commercial landings in 1980 underestimate actual catch, the calculated 1980 relative exploitation is also underestimated. Nonetheless, whatever the actual 1980 exploitation rate was, it did not result in declines in population biomass from the 1979 level.

Implications of the Current Gulf of Maine Cod Assessment

Results of the present assessment indicate that the Gulf of Maine cod stock biomass has continued to remain at the relatively high levels noted during 1977-1979. The 1980 NEFC offshore spring and autumn weight per tow indices were among the highest observed as were almost all weight per tow values in the 1980 NEFC and State of Massachusetts inshore surveys.

Total commercial landings in 1980 were 12,135 mt, the fourth consecutive year that total commercial catch has exceeded 12,000 mt. Domestic otter-trawl landings accounted for 67.6% of the 1980 USA commercial harvest of 11,997 mt. Total fishing effort (days fished) in 1980 was the highest in the 1965-1980 time series. Commercial USA otter trawl catch per effort indices (metric tons landed per day fished) declined slightly in 1980, although these indices have generally not been reflective of actual fishing performance since 1978 due to implementation of trip landings limitations. Prior to 1978, trends in commercial indices tended to parallel offshore survey indices of relative cod abundance. The 1980 USA commercial catch composition was similar to those in 1978 and 1979 and indicated continued fishery emphasis on "market" and "large" cod. The percentage of "scrod" landings increased in 1980 from 1979 but this increase was not as large as anticipated based on previous evaluation of the strength of the recruiting 1977 year class.

Catch per tow at age data from the various offshore and inshore surveys conducted during 1980 tended to show that the 1979 and 1978 year classes may be reasonably strong ones. The 1980 and 1977 year classes appeared to be of at least average strength, although catch at age values for the 1977 year class were variable within each of the survey series.

Relative exploitation rates in the Gulf of Maine fishery have sequentially declined annually since 1975. The 1980 rate was the lowest since 1972. Although the 1980 relative exploitation value is believed to underestimate the actual rate (due to unreported domestic catches), the actual 1980 exploitation rate has not effected an overall decline in stock biomass.

Recruitment of the 1978 and 1979 year classes into the commercial fishery during 1981 and 1982 should substantially increase harvestable biomass in the future if these year classes continue to be as strong as the survey indices indicate. Continued short-term harvests of about 12,000 mt appear sustainable given this incipient recruitment.

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Table 1. Comparison of the estimated number of Atlantic cod (thousands of fish) and the estimated weight (metric tons, live) of Atlantic cod caught by marine recreational anglers in 1960, 1965, 1970, 1974, and 1979. Data derived from Salt-Water Angling Surveys (1960, 1965, and 1970), the Northeastern United States Regional Marine Recreational Angler Survey (1974), and the 1979 Marine Recreational Fishery Statistics Survey.

	North Atlantic[1]		Mid-Atlantic		All Regions	
Year	No. of Cod	Total Weight	No. of Cod	Total Weight	No. of Cod	Total Weight
1960	3,998	11,426	793	2,590	4,791	14,016
1965	4,970	13,144	62	421	5,032	13,565
1970	3,690	16,188	154	104	3,844	16,292
1974	2,155	8,566	717	3,753	2,901	12,368
1979	2,602	3,813[3]	25	44[3]	2,627[2]	3,857[4]

[1]During 1960, 1965, 1970 surveys North Atlantic included Maine to New York; during 1974 and 1979, North Atlantic only included Maine to Connecticut.

[2]Total catch can be subdivided into:
(A) Number brought ashore in whole form: 492
(B) Number brought ashore filleted or otherwise not in whole form: 1729
(C) Number caught but released alive: 406

[3]Derived by multiplying number of cod caught by mean weight of cod landed in whole form.

[4]Sum of estimated total weight caught in the North Atlantic and Mid-Atlantic regions.

Table 2. Estimated numbers (000's) and weight (metric tons) of Atlantic cod caught by marine recreational anglers and brought ashore in whole form, January-December 1979. Mean weight per fish landed is also presented.

	Region		
	North Atlantic	Mid Atlantic	Total
Numbers (000's)	468	24	492
Metric tons	686	42	728
Weight/Fish (kgs)	1.5	1.8	1.5

Source: Marine Recreational Fishery Statistics Survey
Atlantic and Gulf Coasts, 1979
(Current Fishery Statistics No. 8065, 1980)

Table 3. Estimated total number of Atlantic cod (thousands of fish) caught by marine recreational anglers, by region and mode of fishing, January-December 1979. The percentages of the total number of cod caught is presented in parentheses.

	Fishing Mode				
Region	Man-Made	Beach/Bank	Party/Charter	Private/Rental	Total
North Atlantic	65 (2.5)	-	652 (25.1)	1,882 (72.3)	2,602 (99.9)
Mid-Atlantic	-	*	-	*	25 (100.0)
All Regions	89 (3.4)	-	653 (24.9)	1,882 (71.6)	2,627 (99.9)

- = Less than 30 thousand fish reported

* = None reported

Source: Marine Recreational Fishery Statistics Survey Atlantic and Gulf Coasts, 1979 (Current Fishery Statistics No. 8063, 1980).

Table 4. Estimated total number of Atlantic cod (thousands of fish) caught by marine recreational anglers by region and area of fishing, January-December 1979. The percentage of the total number of cod caught is presented in parentheses.

	Fishing Area			
Region	Ocean >3 mi	Ocean ≤3 mi	Inland	Total
North Atlantic	1731 (66.5)	381 (14.6)	490 (18.8)	2602 (99.9)
Mid-Atlantic	-	-	*	25 (100.0)
All Regions	1732 (65.9)	405 (15.4)	490 (18.7)	2627 (100.0)

- = Less than 30 thousand fish reported.

* = None reported

Source: Marine Recreational Fishery Statistics Survey Atlantic and Gulf Coasts 1979 (Current Fishery Statistics No. 8063, 1980).

Table 5. Estimated total number (thousands of fish) of Atlantic cod caught by marine recreational anglers by state, 1974 and 1979. Data derived from 1974 Northeastern United States Regional Marine Recreational Angler Survey and 1979 Marine Recreational Fishery Statistics Survey. The totals column also includes landings not attributed to the states listed.

	State						
Year	ME	NH	MA	RI	NY	NJ	Total
1974	162	83	951	959	410	207	2901
1979	396	99	1835	269	-	-	2627

- = less than 30 thousand fish reported

Table 6. Atlantic cod landings (metric tons, live) from Georges Bank and southward (ICNAF Div. 5Z - SA6), by country, 1960-1980.

	Country											
	USA									Total	USA	
	5Z	5NK	6	Total	Canada	USSR	Spain	Poland	Other	commercial	recreational	Grand Total
1960	10,391	443	-	10,834	19	-	-	-	-	10,853	11,395[1]	22,248
1961	13,998	455	-	14,453	223	55	-	-	-	14,731	14,838	29,569
1962	15,232	405	-	15,637	2,404	5,302	-	143	-	23,486	16,146	39,632
1963	13,904	235	-	14,139	7,832	5,217	-	-	1	27,189	13,487	40,676
1964	12,325	-	-	12,325	7,108	5,428	18	48	238	25,165	11,955	37,120
1965	11,410	-	-	11,410	10,598	14,415	39	1,851	-	38,333	11,029[1]	49,362
1966	11,794	-	196	11,990	15,601	16,830	8,375	269	69	53,134	11,440	64,574
1967	12,742	-	415	13,157	8,252	511	14,730	-	122	36,752	12,360	49,112
1968	14,967	-	312	15,279	9,127	1,459	14,622	2,611	38	43,136	13,620	56,756
1969	16,336	-	426	16,782	5,997	646	13,597	798	119	37,939	14,384	52,323
1970	14,535	-	364	14,899	2,583	364	6,874	784	148	25,652	13,246[1]	38,898
1971	15,795	-	383	16,178	2,979	1,270	7,460	256	36	28,179	14,393	42,572
1972	13,140	-	266	13,406	2,545	1,873	6,704	271	255	25,059	11,957	37,016
1973	15,933	-	269	16,202	3,220	2,977	5,980	430	114	28,923	8,922	37,845
1974	17,870	-	507	18,377	1,374	476	6,370	566	168	27,331	10,055[1]	37,386
1975	15,240	349	428	16,017	1,847	2,403	4,044	481	216	25,008	8,534	33,542
1976	14,220	272	414	14,906	2,328	933	1,633	90	36	19,926	8,115	28,041
1977	20,335	467	316	21,138[3]	6,173	54	2	-	-	27,367	-	27,367[4]
1978	25,430	885	264	26,579[3]	8,904	-	-	-	-	35,483	-	35,483[4]
1979[2]	31,708	637	294	32,639[3]	6,011	-	-	-	-	38,650	-	38,650[4]
1980[2]	39,045	-	-	39,045[3]	6,636	-	-	-	-	45,681	-	45,681[4]

[1]From angler surveys; remaining years estimated.

[2]Provisional.

[3]Reported USA landings are believed to underestimate actual commercial catch due to unreported catch and discards.

[4]Does not include recreational landings.

Source: ICNAF Statistical Bulletins 1960-1978.
NAFO SCS Document 80/IX/27 (September 1980).
NMFS Fisheries Management and Statistics Branch (1980 USA landings).

Table 7. Fishery management actions in the Georges Bank and Southward Atlantic cod fishery during fishing year October 1979-September 1980, and first quarter of fishing year October 1980 - September 1981.

Effective Date	Action	Comments
October 1, 1979	Fishing year 1979-1980 begins. Fishing year OY (same as 1978-1979): 26000 MT (22000 MT, US commercial; 4000 MT Canadian commercial). Quarterly quotas established for US mobile and fixed gear vessel classes. Catch limitations (pounds/week/vessel), implemented on 22 July 1979, continue in effect: 0-60 GRT: 7000; 61-125 GRT: 14000; Over 125 GRT: 20000; fixed gear: 16000. No overruns in catch limitations are allowed. A vessel fishing for cod in both management areas (Gulf of Maine, Georges Bank, and South) may land only the larger of the weekly catch limitation from either area (i.e., eliminates "piggybacking").	New fishing year begins.
September 17, 1980	Reduction of weekly landings limitations for all US vessel classes fishing for cod in the Georges Bank and South management area from Sept. 17 through Sept. 30,, 1980. Catch limitations (pounds/week/vessel) are revised as follows: 0-60 GRT: 4900; 61-125 GRT: 9800; over 125 GRT: 14000; fixed gear: 11200.	Adjustments necessary to provent optimum yield from being exceeded by significant amounts.
October 1, 1980	Approval of Amendment No. 4 to FMP. Fishing year 1979-1980 OY is revised: 35000 MT (29620 MT, US commercial; 5380 MT Canadian commercial which includes an unspecified US recreational allocation). Quarterly quotas revised for US mobile and fixed gear vessel classes for 1979-1980 fishing year.	Optimum yield increases and revised vessel class allocations and commercial quota guidelines are based on improved stock conditions as indicated by 1979 and 1980 resource assessments.
October 1, 1980	Weekly vessel class catch limitations established for 1980-1981 fishing year. New catch limitations (pounds/week/vessel) are: 0-60 GRT: 7000; 61-125 GRT: 14000; over 125 GRT: 20000; fixed gear: 16000.	Weekly catch limitations established for 1980-1981 fishing year to spread fishing effort throughout the year and achieve optimum yield.

Table 8. Quarterly commercial vessel class allocations (metric tons, live weight) of Atlantic cod for fishing year October 1, 1979 - September 30, 1980, and for calendar year 1980 for the Georges Bank and South, and Gulf of Maine Atlantic cod fisheries.

	Time Interval[1]						
	Oct-Dec 79	Jan-Mar 80	Apr-Jun 80	Jul-Sep 80	Annual Fishing Year 1979-80	Oct-Dec 80	Calendar Year 1980
Georges Bank and South							
Mobile Gear							
0-60 GRT	675	798	873	491	2837	675	2837
61-125 GRT	2393	2109	3006	1832	9340	2393	9340
Over 125 GRT	3983	2865	3266	3184	13298	3983	13298
Fixed Gear	544	418	1110	2073	4145	544	4145
Total	7595	6190	8255	7580	29620	7595	29620
Gulf of Maine							
Mobile Gear							
0-60 GRT	921	1106	1265	757	4049	921	4049
61-125 GRT	542	438	415	420	1815	542	1815
Over 125 GRT	285	270	88	38	731	285	731
Fixed Gear	502	401	1022	980	2905	502	2905
Total	2250	2215	2790	2245	9500	2250	9500

[1]Quarterly allocations reflect revisions contained in Amendment No. 4 to the Fishery Management Plan (FMP) for Atlantic Groundfish.

Table 9. Reported USA commercial landings (metric tons, live weight) of Atlantic cod, by vessel class and calendar quarter, for the fishing year October 1, 1979 - September 30, 1980, and for calendar year 1980 for the Georges Bank and South, and Gulf of Maine Atlantic cod fisheries.

	Time Interval						
	Oct-Dec 79	Jan-Mar 80	Apr-Jun 80	Jul-Sep 80	Annual Fishing Year 1979-80	Oct-Dec 80	Calendar Year 1980
Georges Bank and South							
Mobile Gear							
0-60 GRT	346	341	1048	570	2305	326	2285
61-125 GRT	2057	2048	3876	2926	10907	1576	10426
Over 125 GRT	4141	4431	6070	6119	20761	4107	20727
Fixed Gear	554	366	2204	2489	5613	548	5607
Total	7098	7186	13198	12104	39586	6557	39045
Gulf of Maine							
Mobile Gear							
0-60 GRT	965	337	2227	955	4984	739	4758
61-125 GRT	615	594	378	456	2543	662	2590
Over 125 GRT	291	242	238	202	973	347	1029
Fixed Gear	339	319	1704	1189	3551	388	3600
Total	2210	1992	5047	2802	12051	2136	11977

Table 10. Percentage of USA commercial Atlantic cod from Georges Bank and south, and the Gulf of Maine, by market category, 1964-1980.

Year	Georges Bank and South				Gulf of Maine				
	Large	Market	Scrod	Total	Large	Market	Scrod	Total	
1964	45	47	8	100	29	59	12	100	
1965	56	40	3	99	39	54	7	100	
1966	53	37	10	100	42	48	10	100	
1967	41	42	16	99	41	41	17	99	
1968	34	46	19	99	47	43	9	99	
1969	27	57	16	100	35	55	9	99	
1970	30	62	8	100	43	52	6	101	
1971	40	51	9	100	52	42	6	100	
1972	37	53	10	100	58	35	7	100	
1973	24	40	36	100	52	36	11	99	
1974	24	59	17	100	39	33	28	100	
1975	28	62	10	100	32	42	26	100	
1976	34	48	18	100	29	45	20	94	(6%mixed)
1977	26	39	34	99	33	42	22	97	(3%mixed)
1978	29	60	11	100	38	44	17	99	
1979	37	55	8	100	37	49	14	100	
1980[1]	42	47	11	100	36	45	19	100	

[1] Provisional (January - November)

Table 11. Distribution of USA commercial landings (metric tons, live) of Atlantic cod from Georges Bank (Area 5Ze), by gear type, 1965-1980. The percentage of total USA commercial landings of Atlantic cod from Georges Bank, by gear type, for each year, is also presented. Data only reflect Georges Bank cod landings that could be identified by gear type.

Year	Landings (metric tons, live)					Percentages of Annual Landings				
	Otter Trawl	Line Trawl	Handline	Other Gear	Total Landings	Otter Trawl	Line Trawl	Handline	Other Gear	Total
1965	10251	582	505	9	11347	90.3	5.1	4.5	0.1	100.0
1966	10206	787	757	19	11769	86.7	6.7	6.4	0.2	100.0
1967	10915	894	704	9	12522	87.2	7.1	5.6	0.1	100.0
1968	12084	936	524	<1	13544	89.2	6.9	3.9	-	100.0
1969	13194	1371	387	<1	14952	88.2	9.2	2.6	-	100.0
1970	11270	1676	404	<1	13350	84.4	12.6	3.0	-	100.0
1971	12436	2334	230	2	15002	82.9	15.6	1.5	-	100.0
1972	10179	2071	217	10	12477	81.6	16.6	1.7	0.1	100.0
1973	12431	2185	206	24	14846	83.7	14.7	1.4	0.2	100.0
1974	14078	2548	11	12	16649	84.6	15.3	0.1	0.1	100.1
1975	12069	2435	84	4	14592	82.7	16.7	0.6	-	100.0
1976	12257	1519	153	9	13938	87.9	10.9	1.1	0.1	100.0
1977	18329	912	83	32	19576	94.7	4.7	0.4	0.3	100.1
1978	20862	1569	1180	140	23751	87.8	6.6	5.0	0.6	100.0
1979	26562	2707	860	779[1]	30908	85.9	8.8	2.8	2.5	100.0
1980[2]	31218	1101	0	4712[3]	37031	84.3	3.0	0.0	12.7	100.0

[1] Of 779 tons landed, 620 tons were by sinking gill nets.

[2] January -November landings only.

[3] Of 4711 tons landed, 4441 tons were by sinking gill net and 220 tons were by Danish seine.

Table 12. USA commercial vessel trips in which Atlantic cod was landed, by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150; Class 4: 151-500 GRT), for otter trawl vessels catching cod from Georges Bank (Area 5Ze) and landing in New England ports, 1965-1980. Within each vessel class, the number of trips in which cod comprised 50% or more of the total trip catch (directed trip) is presented, and the percentage of total trips that were directed cod trips is indicated.

	Class 2			Class 3			Class 4		
Year	Total Trips	Directed Trips	% Trips Directed	Total Trips	Directed Trips	% Trips Directed	Total Trips	Directed Trips	% Trips Directed
1965	3142	25	0.8	3079	57	1.9	869	47	5.4
1966	3747	46	1.2	3424	48	1.4	979	63	6.4
1967	3955	92	2.3	3196	115	3.6	879	101	11.5
1968	508	5	1.0	2600	153	5.9	789	97	12.3
1969	330	17	5.2	2428	244	10.0	637	88	13.8
1970	412	43	10.4	2614	190	7.3	614	120	19.5
1971	680	47	6.9	2524	210	8.3	538	130	24.2
1972	628	55	8.8	2544	247	9.7	468	118	25.2
1973	412	14	3.4	2491	267	10.7	510	160	31.4
1974	606	67	11.1	2561	356	13.9	613	232	37.8
1975	471	50	10.6	2491	306	12.3	637	209	32.8
1976	359	40	11.1	2281	386	16.9	478	168	35.1
1977	561	87	15.5	3177	601	18.9	572	167	29.2
1978	845	186	22.0	3457	781	22.6	654	184	28.1
1979	577	121	21.0	4389	1227	28.0	1119	396	35.4
1980[1]	686	151	22.0	4555	1239	27.2	1209	437	36.1

[1] January-November

Table 13. USA commercial effort (days fished) for Atlantic cod, by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for otter trawl trips landing cod caught on Georges Bank (Area 5Ze) and landing in New England ports, 1965-1980. Within each vessel class the number of days fished on trips in which cod comprised 50% or more of the total trip catch weight (directed effort) is presented, and the percentage of total days fished that comprised directed effort trips is indicated.

	Class 2			Class 3			Class 4		
Year	Total Effort	Directed Effort	% Effort Directed	Total Effort	Directed Effort	% Effort Directed	Total Effort	Directed Effort	% Effort Directed
1965	2563.6	10.9	0.4	9935.5	86.2	0.9	4176.0	158.7	3.8
1966	2691.3	6.5	0.2	10748.9	88.3	0.8	4515.3	199.3	4.4
1967	2143.6	34.5	1.6	9081.2	239.7	2.6	3793.5	318.0	8.4
1968	569.9	2.7	0.5	8533.6	464.3	5.4	3397.1	327.9	9.7
1969	500.2	9.1	1.8	7952.6	773.2	9.7	2783.2	358.9	12.9
1970	534.8	24.8	4.6	8296.0	533.8	6.4	2218.3	387.7	17.5
1971	681.3	15.4	2.3	8807.9	720.9	8.2	2195.2	494.4	22.5
1972	721.1	54.1	7.5	9256.6	716.1	7.7	1766.1	444.5	25.2
1973	550.2	15.7	2.9	8668.4	819.6	9.5	1701.1	486.0	28.6
1974	617.2	119.1	19.3	9438.2	1114.9	11.8	2096.5	703.1	33.5
1975	534.2	84.5	15.8	8684.1	842.1	9.7	2084.8	585.0	28.1
1976	474.3	65.8	13.9	7790.7	1088.6	14.0	1469.3	463.7	31.6
1977	606.8	120.3	19.8	9491.8	1342.4	14.1	1472.4	373.0	25.3
1978	715.2	214.7	30.0	9410.6	1644.0	17.5	1551.2	329.7	21.3
1979	658.4	168.2	25.5	9924.1	2558.3	25.8	2507.1	839.9	33.5
1980[1]	814.4	195.0	23.9	10355.7	2776.2	26.8	3015.6	1028.2	34.1

[1] January-November

Table 14. USA commercial landings (metric tons, live) of Atlantic cod, by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for otter trawl trips catching cod from Georges Bank (Area 5Ze) and landing in New England ports, 1965-1980. Within each vessel class, cod landings from trips in which cod comprised 50% or more of the total trip catch weight (directed landings) is presented, and the percentage of the total landings that was obtained as directed catch is indicated.

	Class 2			Class 3			Class 4		
Year	Total Landings	Directed Landings	% Directed Landings	Total Landings	Directed Landings	% Directed Landings	Total Landings	Directed Landings	% Directed Landings
1965	671.8	27.2	4.1	5224.6	353.4	6.6	4351.4	818.7	18.8
1966	677.7	22.7	3.3	4740.6	371.0	7.8	4733.3	991.1	20.9
1967	984.3	70.3	7.1	5397.4	880.9	16.3	4520.1	1463.8	32.4
1968	321.1	15.9	4.9	6860.7	1665.2	24.3	4902.5	1442.4	29.4
1969	433.2	72.6	16.6	7941.6	2612.3	32.9	4819.0	1474.6	30.6
1970	508.0	163.7	32.2	6728.7	1694.6	25.2	4033.4	1739.1	43.1
1971	562.9	117.0	20.8	7652.2	2232.2	29.2	4215.3	2162.8	51.3
1972	524.4	152.4	29.1	6381.7	2136.9	33.5	3273.6	1878.8	57.4
1973	322.1	51.7	16.1	7813.7	3242.3	41.5	4295.1	3009.6	70.1
1974	585.1	258.6	44.2	8221.5	3706.8	45.1	5265.8	3898.7	74.0
1975	508.9	245.9	48.3	7028.5	2678.1	38.1	4527.4	3127.6	69.1
1976	421.4	159.2	37.8	7860.9	3664.6	46.6	3969.4	2663.5	67.1
1977	849.6	502.1	59.1	13250.0	6595.3	49.8	4422.6	2899.4	65.6
1978	1164.8	846.0	72.6	14853.1	6553.6	44.1	4829.4	2427.2	50.3
1979[1]	956.2	612.4	64.0	18377.2	9713.8	52.9	7116.0	4269.7	60.0
1980	1031.5	638.2	61.9	20564.5	11326.7	55.1	9582.1	5423.6	56.6

[1] January-November

Table 15. Georges Bank (Area 5Ze) Atlantic cod USA commercial catch per effort (metric tons per trip and metric tons per day fished, live weight), by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for vessels using otter trawls and landing in New England ports, 1965-1980. Catch per effort values are presented for all commercial otter-trawl trips in which cod were landed and for commercial otter-trawl trips in which cod comprised 50% or more of the reported total trip catch weight ("directed trips"). The average number of days fished per trip, by tonnage class, is also indicated.

	Class 2						Class 3				
	Total			Directed			Total			Directed	
Year	Days Fished Per Trip	Landings Per Trip	Landings Per Day Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Day Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Day Fished	Days Fished Per Trip	Landings Per Trip
1965	.82	.21	.26	.44	1.13	2.50	3.23	1.70	.53	1.51	6.20
1966	.72	.18	.25	.14	.49	3.49	3.14	1.38	.44	1.84	7.73
1967	.54	.25	.46	.38	.76	2.04	2.84	1.69	.59	2.08	7.66
1968	1.12	.63	.56	.54	3.18	5.89	3.28	2.64	.80	3.03	10.88
1969	1.67	1.31	.87	.54	4.27	7.98	3.28	3.27	1.00	3.17	10.71
1970	1.30	1.23	.95	.58	3.81	6.60	3.17	2.57	.81	2.81	8.92
1971	1.00	.83	.83	.33	2.49	7.60	3.49	3.03	.87	3.43	10.63
1972	1.15	.84	.73	.98	2.77	2.82	3.64	2.51	.69	2.90	8.65
1973	1.34	.78	.59	1.12	3.69	3.29	3.48	3.14	.90	3.07	12.14
1974	1.02	.97	.95	1.78	3.86	2.17	3.69	3.21	.87	3.13	10.41
1975	1.13	1.08	.95	1.69	4.92	2.91	3.49	2.82	.81	2.75	8.75
1976	1.32	1.17	.89	1.65	3.98	2.42	3.42	3.45	1.01	2.82	9.49
1977	1.08	1.51	1.40	1.38	5.77	4.17	2.99	4.17	1.40	2.23	10.97
1978	.85	1.38	1.63	1.15	4.55	3.94	2.72	4.30	1.58	2.10	8.39
1979	1.14	1.66	1.45	1.39	5.06	3.64	2.26	4.19	1.85	2.09	7.92
1980[1]	1.19	1.50	1.27	1.29	4.23	3.27	2.27	4.51	1.99	2.24	9.14

[1] January-November

	Class 4					
	Total			Directed		
Landings Per Day Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Day Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Day Fished
4.10	4.81	5.01	1.04	3.38	17.42	5.16
4.20	4.61	4.83	1.05	3.16	15.73	4.97
3.68	4.32	5.14	1.19	3.15	14.49	4.60
3.59	4.31	6.21	1.44	3.38	14.87	4.40
3.38	4.37	7.57	1.73	4.08	16.76	4.11
3.17	3.61	6.57	1.82	3.23	14.49	4.49
3.10	4.08	7.84	1.92	3.80	16.64	4.37
2.98	3.77	6.99	1.85	3.77	15.92	4.23
3.96	3.34	8.42	2.52	3.04	18.81	6.19
3.32	3.42	8.59	2.51	3.03	16.80	5.55
3.18	3.27	7.11	2.17	2.80	14.96	5.35
3.37	3.07	8.30	2.70	2.76	15.85	5.74
4.91	2.57	7.73	3.00	2.23	17.36	7.77
3.99	2.37	7.38	3.11	1.79	13.19	7.36
3.80	2.24	6.36	2.84	2.12	10.78	5.08
4.08	2.49	7.93	3.18	2.35	12.41	5.27

Table 16. Stratified mean catch per tow in numbers and weight (lbs) for Atlantic cod from USA offshore spring, summer, and autumn bottom trawl surveys on Georges Bank (Strata 13-25) and in the Gulf of Maine (Strata 26-30 and 36-40), 1963-1980.

	Georges Bank						Gulf of Maine					
	Spring[1]		Summer[2]		Autumn		Spring[1]		Summer[2]		Autumn	
Year	Nos	Wt (lbs)	Nos	Wt (lbs)	Nos	Wt (lbs)	Nos	Wt (lbs)	Nos	Wt (lbs)	Nos	Wt (lbs)
1963	-	-	-	-	2.80	24.2	-	-	-	-	3.79	24.4
1964	-	-	-	-	1.91	15.7	-	-	-	-	2.57	31.0
1965	-	-	-	-	2.72	15.9	-	-	-	-	2.88	16.3
1966	-	-	-	-	3.09	11.1	-	-	-	-	2.43	17.6
1967	-	-	-	-	6.66	18.4	-	-	-	-	1.64	12.5
1968	3.03	17.1	-	-	2.12	11.7	3.48	24.4	-	-	2.80	26.5
1969	2.97	24.2	-	-	1.41	10.9	2.08	18.0	-	-	1.77	20.9
1970	2.78	21.3	-	-	3.25	17.1	1.41	15.1	-	-	3.14	22.4
1971	2.17	19.3	-	-	2.04	13.4	0.92	9.5	-	-	2.80	22.5
1972	5.74	25.9	-	-	8.39	31.3	1.32	10.9	-	-	5.96	17.7
1973	36.91	128.0	-	-	7.87	42.0	4.82	25.6	-	-	2.85	11.9
1974	9.45	49.5	-	-	2.24	11.2	1.86	10.1	-	-	2.77	12.2
1975	4.42	35.5	-	-	4.11	19.1	1.61	8.2	-	-	3.94	11.7
1976	4.52	25.4	-	-	6.68	24.0	1.78	10.3	-	-	1.38	9.2
1977	4.04	21.0	7.87	38.7	4.42	25.4	2.48	11.6	2.75	19.4	2.49	20.7
1978[3]	7.89	42.5	3.62	23.5	6.97	47.3	1.31	10.5	7.55	48.8	4.66	26.2
1979[4]	3.30	23.0	5.25	27.1	4.82	33.5	2.74	12.9	10.33	44.2	2.23	23.8
1980	4.96	33.7	10.39	33.1	2.36	13.7	1.74	12.6	3.85	18.4	5.71	28.9

[1] Spring surveys, 1968-1972, were accomplished with "36 Yankee" trawl; spring surveys from 1973-1980 were accomplished with "41 Yankee" trawl. No adjustments have been made to the catch per tow data for these gear differences.

[2] Summer surveys on Georges Bank only include strata 13, 16, 19-25; summer surveys in the Gulf of Maine only include strata 26-28 and 37-40.

[3] Summer survey on Georges Bank in 1978 only sampled strata 13, 16, 19-20, 23-25.

[4] Summer survey in Gulf of Maine in 1979 only sampled strata 26-28 and 39-40.

Table 17. Stratified mean catch per tow in numbers and weight (lbs) for Atlantic cod caught in USA spring and autumn inshore bottom trawl surveys in inshore waters adjacent to the Georges Bank area (Strata 45-46, 55-61) and in the lower Gulf of Maine (Strata 58-66), 1978-1980.

	Inshore of Georges Bank				Lower Gulf of Maine			
	Spring		Autumn		Spring		Autumn	
Year	Nos.	Wt. (lbs)	Nos.	Wt. (lbs)	Nos.	Wt. (lbs)	Nos.	Wt. (lbs)
1978	0.31	0.82	Not Sampled		Not Sampled		Not Sampled	
1979	8.80	16.13	9.31	84.67	7.27	36.70	10.46	8.43
1980	4.27	22.77	2.83	46.27	39.30	52.87	9.56	21.79

Table 18. Stratified mean catch per tow in numbers and weight (lbs) for Atlantic cod from Massachusetts spring and autumn inshore bottom trawl surveys in territorial waters adjacent to the Georges Bank area (Mass. Regions 1-3), and in the Gulf of Maine (Mass. Regions 4-5), 1978-1980.

	Georges Bank Area (Mass. Regions 1-3)				Gulf of Maine Area (Mass. Regions 4-5)			
	Spring		Autumn		Spring		Autumn	
Year	Nos.	Wt (lbs)	Nos.	Wt (lbs)	Nos.	Wt (lbs)	Nos.	Wt (lbs)
1978	44.10	.90	7.32	0.25	43.40	26.81	154.28	6.65
1979	12.37	2.13	0.39	0.20	104.04	45.25	8.43	2.19
1980	11.10	4.19	0.32	0.07	73.91	39.05	14.62	3.47

Table 19. Stratified mean catch per tow in numbers and weight (lbs) for Atlantic cod from USA summer inshore bottom trawl surveys in inshore waters adjacent to Georges Bank (Strata 45-56), in the lower Gulf of Maine (Strata 58-66), and in the middle and northern Gulf of Maine (Strata 68-90), 1977-1980.

	Inshore Georges Bank		Lower Gulf of Maine		Middle and Northern Gulf Of Maine	
Year	Nos.	Wt. (lbs)	Nos.	Wt. (lbs)	Nos.	Wt. (lbs)
1977	3.26	16.04	4.95	7.48	9.66	23.36
1978	1.38	7.04	5.77	11.30	3.69	23.69
1979	0.16	4.92	4.71	14.14	3.39	3.29
1980	2.11	14.89	13.74	12.91	11.47	28.31

Table 20. Stratified mean catch per tow at age (numbers) of Atlantic cod from USA spring bottom trawl surveys on Georges Bank (Strata 13-25) and in the Gulf of Maine (Strata 26-30 and 36-40), 1970- 1980.[1]

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12+	Totals 0+	1+	2+	3+	4+	5+
							Georges Bank												
1970	.000	.244	.522	.308	.830	.104	.420	.176	.039	.087	.008	.000	.045	2.783	2.783	2.539	2.017	1.709	.879
1971	.000	.133	.525	.322	.143	.375	.091	.225	.195	.051	.032	.032	.048	2.172	2.172	2.039	1.514	1.192	1.049
1972	.036	1.860	1.175	1.693	.327	.076	.208	.078	.141	.074	.032	.009	.039	5.748	5.712	3.852	2.677	.984	.657
1973	.036	.334	27.000	4.035	4.117	.418	.325	.244	.032	.126	.110	.025	.111	36.913	36.877	36.543	9.543	5.508	1.391
1974	.000	.286	2.921	3.828	.488	1.284	.282	.065	.165	.022	.059	.016	.037	9.453	9.453	9.167	6.246	2.418	1.930
1975	.000	.041	.242	1.309	1.982	.167	.440	.083	.060	.069	.000	.000	.025	4.418	4.418	4.377	4.135	2.826	.844
1976	.071	.834	1.232	.605	.443	1.008	.105	.168	.023	.000	.000	.000	.035	4.524	4.453	3.619	2.387	1.782	1.339
1977	.000	.018	2.261	.692	.335	.179	.466	.033	.042	.000	.000	.000	.013	4.039	4.039	4.021	1.760	1.068	.733
1978	2.123	.241	.120	3.545	.621	.499	.092	.457	.033	.091	.039	.000	.031	7.892	5.769	5.528	5.408	1.863	1.242
1979	.070	.279	.871	.191	1.226	.347	.150	.056	.093	.008	.000	.000	.014	3.305	3.234	2.956	2.084	1.897	.668
1980	.067	.025	1.452	1.723	.134	.950	.383	.123	.020	.019	.000	.048	.023	4.967	4.890	4.865	3.413	1.690	1.556
							Gulf of Maine												
1970	.000	.102	.079	.035	.060	.175	.299	.394	.048	.038	.063	.064	.057	1.414	1.414	1.312	1.233	1.198	1.138
1971	.000	.016	.091	.070	.187	.031	.053	.192	.132	.099	.038	.008	.000	.917	.917	.901	.810	.740	.553
1972	.000	.226	.098	.333	.126	.128	.023	.068	.065	.147	.036	.036	.033	1.319	1.319	1.093	.995	.662	.536
1973	.000	.022	2.724	.581	.397	.224	.125	.061	.143	.161	.134	.048	.210	4.830	4.830	4.808	2.084	1.503	1.106
1974	.000	.305	.036	.871	.211	.142	.073	.031	.031	.013	.037	.028	.084	1.862	1.862	1.557	1.521	.650	.439
1975	.004	.060	.448	.068	.683	.166	.071	.003	.003	.012	.036	.017	.039	1.610	1.606	1.546	1.098	1.030	.347
1976	.000	.027	.195	.672	.098	.575	.055	.069	.042	.000	.007	.003	.037	1.780	1.780	1.753	1.558	.886	.788
1977	.000	.016	.191	.334	1.278	.070	.507	.004	.065	.000	.000	.000	.024	2.489	2.489	2.473	2.282	1.948	.670
1978	.000	.022	.067	.183	.223	.491	.048	.205	.005	.068	.000	.005	.000	1.317	1.317	1.295	1.228	1.045	.822
1979	.028	.343	1.045	.136	.320	.257	.439	.038	.091	.008	.012	.000	.022	2.739	2.711	2.368	1.323	1.187	.867
1980	.057	.057	.357	.278	.100	.339	.194	.246	.000	.105	.011	.000	.000	1.744	1.687	1.630	1.273	.995	.895

[1]Spring surveys, 1968-1972, were accomplished with "36 Yankee" trawl; spring surveys from 1973-1980 were accomplished with "41 Yankee" trawl. No adjustments have been made to the catch per tow at age data for these gear differences.

Table 21. Stratified mean catch per tow at age (numbers) of Atlantic cod from USA autumn bottom trawl surveys on Georges Bank (Strata 13-25) and in the Gulf of Maine (Strata 26-30 and 36-40), 1970-1980.

	Age													Totals					
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	0+	1+	2+	3+	4+	5+
								Georges Bank											
1970	.265	1.082	.867	.336	.445	.098	.000	.021	.035	.035	.063	.000	.000	3.247	2.982	1.900	1.033	.697	.252
1971	.256	.386	.405	.250	.193	.305	.117	.027	.057	.000	.000	.000	.048	2.044	1.788	1.402	.997	.747	.554
1972	.607	4.771	.830	1.135	.256	.156	.366	.070	.131	.014	.006	.000	.047	8.389	7.782	3.011	2.181	1.046	.790
1973	.130	1.121	3.891	.758	1.290	.135	.145	.112	.040	.089	.085	.023	.053	7.872	7.742	6.621	2.730	1.972	.682
1974	.296	.262	.419	.975	.105	.073	.066	.000	.044	.000	.000	.000	.000	2.240	1.944	1.682	1.263	.288	.183
1975	1.524	.637	.270	.400	1.080	.072	.100	.000	.000	.000	.024	.000	.000	4.107	2.583	1.946	1.676	1.276	.196
1976	.000	3.941	1.328	.489	.178	.474	.035	.173	.024	.034	.000	.013	.000	6.690	6.690	2.749	1.421	.932	.754
1977	.123	.192	2.778	.570	.204	.141	.321	.006	.022	.000	.007	.042	.014	4.420	4.297	4.105	1.327	.757	.553
1978	.321	1.505	.207	3.392	.782	.272	.134	.279	.041	.024	.000	.000	.011	6.968	6.647	5.142	4.935	1.543	.761
1979	.096	1.314	1.393	.182	1.309	.240	.146	.029	.093	.006	.014	.004	.000	4.826	4.730	3.416	2.023	1.841	.532
1980[1]	(.210)													2.357					
								Gulf of Maine											
1970	.476	.603	.170	.353	.211	.313	.271	.506	.084	.060	.023	.024	.047	3.141	2.665	2.062	1.892	1.539	1.328
1971	.863	.114	.153	.135	.383	.295	.278	.163	.204	.128	.040	.022	.020	2.798	1.935	1.821	1.668	1.533	1.150
1972	.020	3.576	.780	.978	.150	.060	.110	.025	.102	.155	.000	.000	.010	5.966	5.946	2.370	1.590	.612	.462
1973	.408	.210	1.393	.089	.325	.136	.050	.018	.033	.108	.077	.000	.010	2.857	2.449	2.239	.846	.757	.432
1974	.181	.720	.121	1.118	.187	.230	.050	.008	.008	.027	.021	.075	.031	2.777	2.596	1.876	1.755	.637	.450
1975	.030	.094	1.966	.086	1.510	.163	.070	.011	.002	.002	.000	.004	.004	3.942	3.912	3.818	1.852	1.766	.256
1976	.000	.156	.134	.405	.064	.492	.037	.061	.000	.010	.020	.000	.000	1.379	1.379	1.223	1.089	.684	.620
1977	.000	.018	.291	.446	.937	.123	.481	.031	.079	.018	.027	.000	.051	2.502	2.502	2.484	2.193	1.747	.810
1978	.202	1.111	.301	.907	.532	1.160	.091	.264	.007	.049	.000	.010	.031	4.665	4.463	3.352	3.051	2.144	1.612
1979	.003	.236	.381	.104	.536	.251	.501	.033	.138	.000	.042	.000	.011	2.236	2.233	1.997	1.616	1.512	.976
1980[1]	(.033)													5.708					

[1]Survey age samples currently being analyzed.

Table 22. Stratified mean catch per tow at age (numbers) of Atlantic cod from USA summer offshore bottom trawl surveys on Georges Bank (Strata 13, 16, 19-25) and in the Gulf of Maine (Strata 26-28; 37-40), 1977-1980.

	AGE													TOTALS					
Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	0+	1+	2+	3+	4+	5+
								Georges Bank											
1977	.131	.195	5.121	1.111	.660	.164	.326	.051	.081	.000	.000	.000	.026	7.866	7.735	7.540	2.419	1.308	.648
1978	.755	.350	.266	1.542	.369	.149	.057	.109	.000	.028	.000	.000	.000	3.625	2.870	2.520	2.254	.712	.343
1979	.236	1.459	1.767	.373	.943	.234	.050	.053	.115	.000	.000	.000	.031	5.261	5.025	3.566	1.799	1.426	.483
1980	2.646	.640	4.135	2.371	.064	.415	.092	.000	.031	.000	.000	.000	.000	10.394	7.748	7.108	2.973	.602	.538
								Gulf of Maine											
1977	.117	.090	.379	.275	.883	.108	.666	.039	.132	.000	.000	.021	040	2.750	2.633	2.543	2.164	1.889	1.006
1978	.153	1.047	.718	1.216	1.455	2.054	.076	.687	.022	.074	.000	.037	.017	7.556	7.403	6.356	5.638	4.422	2.967
1979	.690	3.438	2.851	.441	.907	.609	1.073	.063	.145	.037	.074	.000	.000	10.328	9.638	6.200	3.349	2.908	2.001
1980	.350	.319	.715	1.419	.193	.384	.109	.233	.000	.066	.000	.063	.000	3.851	3.501	3.182	2.467	1.048	.855

Table 23. Stratified mean catch per tow at age (numbers) of Atlantic cod from Massachusetts spring inshore bottom trawl surveys in territorial waters adjacent to the Georges Bank area (Mass. Regions 1-3) and in the Gulf of Maine (Mass. Regions 4-5), 1978-1980.

	Age												Totals					
Year	0	1	2	3	4	5	6	7	8	9	10+	Unknown	0+	1+	2+	3+	4+	5+
								Georges Bank Area (Mass. Regions 1-3)										
1978	42.589	1.403	.054	.034	.109	.000	.000	.000	.000	.000	.000	.000	44.099	1.510	.107	.053	.019	.000
1979	5.286	7.121	.124	.014	.020	.002	.000	.000	.000	.000	.000	.000	12.567	7.281	.160	.036	.022	.002
1980	5.092	3.965	1.973	.045	.002	.003	.019	.000	.000	.000	.000	.000	11.099	6.007	2.042	.069	.024	.022
								Gulf of Maine Area (Mass. Regions 4-5)										
1978	21.965	12.784	4.162	4.572	.872	1.028	.000	.000	.023	.000	.000	.000	45.406	23.441	10.657	6.495	1.923	1.051
1979	56.393	36.630	2.581	1.533	4.659	1.195	.183	.000	.000	.000	.000	.069	104.043	47.650	11.020	8.439	6.906	2.247
1980	8.156	50.311	12.679	.971	.745	.737	.080	.214	.000	.025	.000	.000	73.918	65.762	15.451	2.772	1.801	1.056

Table 24. Stratified mean catch per tow at age (numbers) of Atlantic cod from Massachusetts autumn inshore bottom trawl surveys in territorial waters adjacent to the Georges Bank area (Mass. Regions 1-3) and in the Gulf of Maine (Mass. Regions 4-5), 1978-1980.

	Age												Totals					
Year	0	1	2	3	4	5	6	7	8	9	10+	Unknown	0+	1+	2+	3+	4+	5+
Georges Bank Area (Mass. Regions 1-3)																		
1978	7.318	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	7.318	.000	.000	.000	.000	.000
1979	.156	.230	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000	.388	.232	.002	.000	.000	.000
1980	.475	.045	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.520	.045	.000	.000	.000	.000
Gulf of Maine Area (Mass. Regions 4-5)																		
1978	151.533	2.082	.000	.120	.140	.318	.000	.080	.000	.000	.000	.000	154.273	2.740	.658	.658	.538	.398
1979	4.933	3.430	.042	.000	.026	.000	.000	.000	.000	.000	.000	.000	8.431	3.498	.068	.026	.026	.000
1980	5.680	8.834	.052	.000	.000	.050	.000	.000	.000	.000	.000	.000	14.616	8.936	.102	.102	.102	.050

Table 25. Stratified mean catch per tow at age (numbers) of Atlantic cod from USA summer inshore bottom trawl surveys in inshore waters adjacent to Georges Bank (Strata 45-56), in the lower Gulf of Maine (Strata 58-66), and in the middle and northern Gulf of Maine (Strata 68-90), 1977-1980.

	Age												Totals					
Year	0	1	2	3	4	5	6	7	8	9	10+	Unknown	0+	1+	2+	3+	4+	5+
Inshore of Georges Bank																		
1977	.000	.695	1.580	.488	.291	.052	.128	.018	.007	.000	.000	.000	3.259	3.259	2.564	.984	.496	.205
1978	.164	.324	.507	.549	.002	.035	.000	.000	.000	.000	.000	.000	1.581	1.417	1.093	.586	.037	.035
1979	.000	.000	.000	.000	.000	.000	.000	.160	.000	.000	.000	.000	.160	.160	.160	.160	.160	.160
1980	.124	.719	.379	.425	.062	.281	.000	.000	.124	.000	.000	.000	2.114	1.990	1.271	.892	.467	.405
Lower Gulf of Maine																		
1977	.030	1.685	1.994	.627	.378	.056	.186	.004	.000	.000	.000	.000	4.960	4.930	3.245	1.251	.624	.246
1978	1.674	1.163	.938	.758	.400	.677	.010	.128	.019	.000	.000	.000	5.767	4.093	2.930	1.992	1.234	.834
1979	.598	1.369	1.027	.175	.779	.347	.416	.000	.000	.000	.000	.000	4.711	4.113	2.744	1.717	1.542	.763
1980	.510	9.298	3.042	.579	.033	.134	.011	.051	.000	.000	.080	.000	13.738	13.228	3.930	.888	.309	.276
Middle and Northern Gulf of Maine																		
1977	1.106	1.329	2.809	1.393	1.919	.258	.711	.065	.065	.000	.000	.000	9.655	8.549	7.220	4.411	3.018	1.099
1978	1.133	.871	.249	.932	.791	1.195	.077	.419	.023	.008	.000	.000	5.698	4.565	3.694	3.445	2.513	1.722
1979	.121	1.334	1.433	.218	.136	.026	.102	.026	.000	.000	.000	.000	3.396	3.275	1.941	.508	.290	.154
1980	.986	4.216	2.949	1.579	.400	.651	.143	.465	.000	.086	.000	.000	11.475	10.489	6.273	3.324	1.745	1.345

Table 26. Evaluation of relative year class abundance of the 1977-1980 year classes of Atlantic cod from the Georges Bank and Gulf of Maine stocks derived from catch per tow at age trends in USA (NMFS) and State of Massachusetts bottom trawl surveys.[1]

	Georges Bank				Gulf of Maine			
	Year Class				Year Class			
Survey Series	1980	1979	1978	1977	1980	1979	1978	1977
NMFS Autumn Offshore	A	P	AA	AA	A	P	A	A
NMFS Spring Offshore	A	P	AA	A	VS	A	A	P
NMFS Summer Offshore	VS	A	VS	A	AA	A	A	VS
NMFS Summer Inshore	A	A	A	A	A	VS	VS	A
Mass. Autumn Inshore	A	P	AA	A	A	AA	AA	P
Mass. Spring Inshore	A	A	VS	A	P	VS	AA	P

[1] A = Average abundance

AA = Above average abundance

VS = Very strong abundance

P = Poor or low abundance

Table 17. Relationship between total commercial landings of Atlantic cod (3-year averages),[1] total commercial and recreational landings of Atlantic cod (3-year averages)[1], and USA autumn bottom trawl survey stratified mean catch (weight in pounds) per tow (3-year averages)[1] from Georges Bank (strata 13-25) and the Gulf of Maine (strata 26-30 and 36-40), 1963-1980. Landings data are in thousands of metric tons, live weight.

	Georges Bank					Gulf of Maine				
	Commercial landings (A)	Commercial & recreational landings (B)	Autumn survey wt/tow (C)	Relative Exploitation Rates A/C	B/C	Commercial landings (D)	Commercial & recreational landings (E)	Autumn survey wt/tow (F)	Relative Exploitation Rates D/F	E/F
1964	30.2	42.4	18.6	1.62	2.28	3.3	5.4	23.9	0.14	0.23
1965	38.9	50.4	14.2	2.74	3.55	3.9	6.3	21.6	0.18	0.29
1966	42.7	54.3	15.1	2.83	3.60	4.3	7.7	15.5	0.31	0.50
1967	44.3	56.3	13.7	3.23	4.15	5.6	8.5	18.9	0.30	0.45
1968	39.3	52.9	13.7	2.87	3.86	7.0	10.0	20.0	0.35	0.50
1969	35.6	49.5	13.2	2.70	3.75	7.7	10.6	23.3	0.33	0.45
1970	30.6	44.8	13.8	2.22	3.25	8.1	11.1	21.9	0.37	0.51
1971	26.3	39.5	20.6	1.28	1.92	7.6	10.4	20.9	0.36	0.50
1972	27.4	39.1	28.9	0.95	1.35	6.9	9.3	17.4	0.40	0.53
1973	27.1	37.4	28.2	0.96	1.33	6.9	9.2	13.9	0.50	0.66
1974	27.1	36.3	24.1	1.12	1.51	7.6	9.9	11.9	0.64	0.83
1975	24.1	33.0	18.1	1.33	1.82	9.0	11.6	11.0	0.82	1.05
1976	24.1		22.8	1.06		10.6		13.9	0.76	0.90
1977	27.6		32.2	0.86		11.3		18.7	0.63	
1978	33.8		35.4	0.95		12.3		23.6	0.53	
1979[2]	39.9		31.5	1.27		12.3		26.3	0.47	
1980[2]	42.2		23.6	1.79		12.1		26.4	0.46	

[1] Average values calculated as $\frac{\Sigma \text{ year } i-1 + \text{year } i + \text{year } i+1}{3}$.

[2] 1980 average values calculated as $\frac{\Sigma \text{ year } 1979 + \text{year } 1980}{2}$.

Table 18. Atlantic cod landings (metric tons, live) from the Gulf of Maine (ICNAF Div. 5Y), by country, 1960-1980.

	Country					Total commercial	USA recreational	Grand Total
	USA	Canada	USSR	Spain	Other			
1960	3,448	129	-	-	-	3,577	2,621[1]	6,198
1961	3,216	18	-	-	-	3,234	2,444	5,678
1962	2,989	83	-	-	-	3,072	2,272	5,344
1963	2,595	3	133	-	-	2,731	1,713	4,444
1964	3,226	25	-	-	-	3,251	2,129	5,380
1965	3,730	148	-	-	-	3,928	2,537[1]	6,465
1966	4,008	384	-	-	-	4,392	2,645	7,037
1967	5,676	297	-	-	-	5,973	3,746	9,719
1968	6,360	61	-	-	-	6,421	2,417	8,838
1969	8,157	59	-	152	116	8,484	3,100	11,584
1970	7,812	26	-	375	48	8,261	3,046[1]	11,307
1971	7,380	119	-	159	4	7,662	2,804	10,466
1972	6,776	53	11	-	77	6,917	2,575	9,492
1973	6,069	68	-	-	9	6,146	1,821	7,967
1974	7,639	120	-	4	1	7,764	2,313[1]	10,077
1975	8,903	86	-	26	-	9,015	2,671	11,686
1976	10,172	16	-	-	-	10,188	2,963	13,151
1977	12,426[3]	106	-	-	-	12,532	-	12,532[4]
1978	12,426[3]	384	-	-	-	12,810	-	12,810[4]
1979[2]	11,679[3]	379	-	-	-	12,058	-	12,058[4]
1980[2]	11,997[3]	138	-	-	-	12,135	-	12,135[4]

[1] From angler surveys; remaining years estimated.

[2] Provisional.

[3] Reported USA landings may underestimate actual commercial catch due to unreported catch.

[4] Does not include recreational landings.

Source: ICNAF Statistical Bulletins 1960-1973.
NAFO SCS Document 80/IX/27 (September 1980)
NMFS Fisheries Management and Statistics Branch (1980 USA landings)

Table 29. Fishery management actions in the Gulf of Maine Atlantic cod fishery during fishing year October 1979 - September 1980, and first quarter of fishing year October 1980 - September 1981.

Effective Date	Action	Comments
October 1, 1979	Fishing year 1979-1980 begins. Fishing year OY (same as 1978-1979): 8500 MT (6000 MT, US commercial; 2500 MT, US recreational for charter and head boats). Quarterly quotas established for US commercial mobile and fixed gear vessel classes. Commercial US vessel catch limitations (pounds/week/vessel), implemented on 22 July 1979, continue in effect: 0-60 GRT: 2500; 61-125 GRT: 5000; over 125 GRT: 7000; fixed gear: 5000. No overruns in catch limitations are allowed. A vessel fishing for cod in both management areas (Gulf of Maine, Georges Bank, and South) may land only the larger of the weekly catch limitation from either area (i.e., eliminates "piggybacking").	New fishing year begins.
September 17, 1980	Reduction of weekly landings limitations for all US vessel classes fishing for cod in the Gulf of Maine management area from Sept. 17 through Sept. 30, 1980. Catch limitations (pounds/week/vessel) are revised as follows: 0-60 GRT: 1750: 3500; over 125 GRT: 4900; fixed gear: 3500.	Adjustments necessary to prevent optimum yield from being exceeded by significant amounts.
October 1, 1980	Approval of Amendment No. 4 to FMP. Fishing year 1979-1980 OY is revised: 12000 MT (9500 MT, US commercial; 2500 MT, US recreational for charter and head boats). Quarterly quotas revised for US commercial mobile and fixed gear vessel classes for 1979-1980 fishing year.	Optimum yield increases and revised vessel class allocations and commercial quota guidelines are based on improved stock conditions as indicated by 1979 and 1980 resource assessments.
October 1, 1980	Weekly vessel class catch limitations established for 1980-1981 fishing year. New catch limitations (pounds/week/vessel) are: 0-60 GRT: 2500; 61-125 GRT: 5000; over 125 GRT: 7000; fixed gear: 5000.	Weekly catch limitations established for 1980-1981 fishing year to spread fishing effort throughout the year and achieve optimum yield.

Table 30. Distribution of USA commercial landings (metric tons, live) of Atlantic cod from the Gulf of Maine (Area 5Y), by gear type, 1965-1980. The percentage of total USA commercial landings of Atlantic cod from the Gulf of Maine, by gear type, for each year is also presented. Data only reflect Gulf of Maine cod landings that could be identified by gear type.

	Landings (metric tons, live)						Percentage of Annual Landings					
Year	Otter Trawl	Sinking Gill Net	Line Trawl	Handline	Other Gear	Total Landings	Otter Trawl	Sinking Gill Net	Line Trawl	Handline	Other Gear	Total
1965	2480	501	462	168	1	3612	68.7	13.9	12.8	4.7	-	100.1
1966	2549	830	308	150	4	3841	66.4	21.6	8.0	3.9	0.1	100.0
1967	4312	734	206	274	<1	5526	78.0	13.3	3.7	5.0	-	100.0
1968	4143	1377	213	339	4	6076	68.2	22.7	3.5	5.6	0.1	100.1
1969	6553	851	258	162	4	7828	83.7	10.9	3.3	2.1	0.1	100.1
1970	5967	951	407	178	9	7512	79.4	12.7	5.4	2.4	0.1	100.0
1971	5117	1043	927	98	8	7193	71.1	14.5	12.9	1.4	0.1	100.0
1972	4004	1492	1234	54	2	6786	59.0	22.0	18.2	0.8	-	100.0
1973	3542	1182	1305	23	9	6061	58.4	19.5	21.5	0.4	0.1	99.9
1974	5056	1412	904	36	17	7425	68.1	19.0	12.2	0.5	0.2	100.0
1975	6255	1480	920	12	8	8675	72.1	17.1	10.6	0.1	0.1	100.0
1976	6701	2511	621	4	41	9878	67.8	25.4	6.3	-	0.4	99.9
1977	8415	2872	534	6	166[1]	11993	70.2	23.9	4.5	0.1	1.4	100.1
1978	7958	3438	393	10	91[2]	11890	66.9	28.9	3.3	0.1	0.8	100.0
1979	7567	2900	334	19	167[3]	10987	68.9	26.4	3.0	0.2	1.5	100.0
1980[4]	7591	3289	240	45	61	11226	67.6	29.3	2.1	0.4	0.5	99.9

[1] Of 166 tons landed, 107 tons were by mid-water pair trawl and 42 tons were by drifting gill nets.

[2] Of 91 tons landed, 56 tons were by Danish seine and 27 tons were by drifting gill nets.

[3] Of 167 tons landed, 119 tons were by drifting gill nets and 38 tons were by Danish seine.

[4] January - November landings only.

Table 31. USA commercial vessel trips in which Atlantic cod were landed, by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for otter trawl trips catching cod from the Gulf of Maine (Area 5Y) and landing in New England ports, 1965-1980. Within each vessel class, the number of trips in which cod comprised 50% or more of the total trip catch (directed trips) is presented, and the percentage of total trips that were directed cod trips is indicated.

	Class 2			Class 3			Class 4		
Year	Total Trips	Directed Trips	% Trips Directed	Total Trips	Directed Trips	% Trips Directed	Total Trips	Directed Trips	% Trips Directed
1965	5354	493	9.2	1145	116	10.1	60	2	3.3
1966	4637	241	5.2	1130	102	9.0	38	2	5.3
1967	3903	418	10.7	1277	231	18.1	98	1	1.0
1968	3587	386	10.8	1293	251	19.4	99	7	7.1
1969	3679	645	17.5	1494	325	21.8	186	15	8.1
1970	4342	695	16.0	1585	217	13.7	214	11	5.1
1971	3908	550	14.1	1272	193	15.2	204	7	3.4
1972	3933	492	12.5	1326	134	10.1	130	9	6.9
1973	4688	354	7.6	1241	54	4.4	146	2	1.4
1974	5145	491	9.5	1274	98	7.7	193	17	8.8
1975	5498	676	12.3	1437	218	15.2	198	11	5.6
1976	4734	554	11.7	1687	334	19.8	228	6	2.6
1977	4664	492	10.5	2010	391	19.5	298	10	3.4
1978	4655	460	9.9	1754	281	16.0	444	6	1.4
1979	5218	504	9.7	1777	331	18.6	445	10	2.2
1980[1]	4484	397	8.9	1970	288	14.6	365	11	3.0

[1] January-November

Table 32. USA commercial effort (days fished) for Atlantic cod by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for otter trawl trips landing cod caught in the Gulf of Maine (Area 5Y) and landing in New England ports, 1965-1980. Within each vessel class the number of days fished on trips in which cod comprised 50% or more of the total trip catch weight (directed effort) is presented, and the percentage of total days fished that comprised directed effort trips is indicated.

	Class 2			Class 3			Class 4		
Year	Total Effort	Directed Effort	% Effort Directed	Total Effort	Directed Effort	% Effort Directed	Total Effort	Directed Effort	% Effort Directed
1965	2690.6	183.3	6.8	964.9	73.9	7.7	92.2	0.6	0.7
1966	2379.1	91.6	3.9	937.9	84.6	9.0	82.6	3.5	4.2
1967	2174.6	179.4	8.2	1232.0	270.2	21.9	196.2	1.0	0.5
1968	2696.4	154.6	5.7	1265.5	224.1	17.7	181.8	15.6	8.6
1969	3301.3	324.1	9.8	1497.4	292.4	19.5	337.0	38.1	11.3
1970	4834.2	395.1	8.2	1665.7	151.8	9.1	424.6	14.9	3.5
1971	3999.9	370.0	9.3	1474.6	123.9	8.4	422.2	24.0	5.7
1972	4103.7	282.8	6.9	1637.4	88.2	5.4	243.7	10.5	4.3
1973	3915.3	178.8	4.6	1430.1	33.4	2.3	251.7	0.7	0.3
1974	3953.9	185.7	4.7	1454.8	91.6	6.3	367.0	30.9	8.4
1975	4423.2	330.9	7.5	1818.2	232.2	12.8	373.1	13.5	3.6
1976	4404.0	383.6	8.7	2096.3	308.3	14.7	526.6	5.6	1.1
1977	4354.4	386.0	8.9	2447.6	334.4	13.7	630.9	6.2	1.0
1978	5063.1	420.9	8.3	2617.9	296.6	11.3	808.8	7.0	0.9
1979	5623.2	381.9	6.8	2424.9	286.5	11.8	779.3	6.8	0.9
1980[1]	5528.6	294.7	5.3	2944.4	243.8	8.3	842.2	21.5	2.6

[1] January-November

Table 33. USA commercial landings (metric tons, live) of Atlantic cod, by vessel tonnage class (Class: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for otter trawl trips catching cod from the Gulf of Maine (Area 5Y) and landing in New England ports, 1965-1980. Within each vessel class, cod landings from trips in which cod comprised 50% or more of the total trip catch weight (directed landings) is presented, and the percentage of the total landings that was obtained as directed catch is indicated.

	Class 2			Class 3			Class 4		
Year	Total Landings	Directed Landings	% Directed Landings	Total Landings	Directed Landings	% Directed Landings	Total Landings	Directed Landings	% Directed Landings
1965	1412.1	393.7	27.9	935.3	309.8	33.1	45.8	1.4	3.0
1966	1265.1	253.1	20.0	1093.2	329.3	30.1	112.9	12.2	10.8
1967	1789.5	655.5	36.6	2341.0	1202.0	51.3	108.0	1.4	1.3
1968	1838.9	655.5	35.6	1955.0	995.2	50.9	219.1	50.3	23.0
1969	2991.5	1399.4	46.8	2873.6	1383.5	48.1	549.3	103.9	18.9
1970	3358.9	1369.4	40.8	2009.9	719.4	35.8	389.2	46.3	11.9
1971	2917.1	1033.3	35.4	1726.9	540.2	31.3	293.0	73.5	25.1
1972	2190.0	620.5	28.3	1462.9	321.6	22.0	192.3	46.3	24.1
1973	2018.1	380.1	18.8	1171.6	95.7	8.2	193.7	1.4	0.7
1974	2291.6	466.8	20.4	2107.9	528.9	25.1	458.1	181.4	39.6
1975	3107.6	1047.4	33.7	2599.1	1038.7	40.0	310.7	66.2	21.3
1976	3168.4	1196.6	37.8	3143.0	1276.9	40.6	261.7	21.8	8.3
1977	3816.1	1389.8	36.4	3903.2	1825.3	46.8	341.1	43.5	12.8
1978	3859.2	1314.1	34.1	3333.5	1372.6	41.2	488.5	48.1	9.8
1979	3730.9	1114.0	29.9	3169.3	1233.3	38.9	474.5	45.8	9.7
1980[1]	3556.2	1036.0	29.1	3213.7	1052.8	32.8	524.4	93.9	17.9

[1] January-November

Table 34. Gulf of Maine (Area 5Y) Atlantic cod USA commercial catch per effort (metric tons per trip and metric tons per day fished, live weight) by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT), for vessels using otter trawls and landing in New England ports, 1965-1980. Catch per effort values are presented for all commercial otter-trawl trips in which cod were landed and for otter-trawl trips in which cod comprised 50% or more of the reported total trip catch weight ("directed trips"). The average number of days fished per trip, by tonnage class, is also indicated.

	Class 2						Class 3					
	Total			Directed			Total			Directed		
Year	Days Fished Per Trip	Landings Per Trip	Landings Per Days Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Days Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Days Fished	Days Fished Per Trip	Landings Per Trip	Landings Per Days Fished
1965	.50	.26	.52	.37	.80	2.15	.84	.82	.97	.64	2.67	4.19
1966	.51	.27	.53	.38	1.05	2.76	.83	.97	1.17	.83	3.23	3.89
1967	.56	.46	.82	.43	1.57	3.65	.96	1.83	1.90	1.17	5.20	4.45
1968	.75	.51	.68	.40	1.70	4.24	.98	1.51	1.54	.89	3.96	4.44
1969	.90	.81	.91	.50	2.17	4.32	1.00	1.92	1.92	.90	4.26	4.90
1970	1.11	.77	.69	.57	1.97	3.47	1.05	1.27	1.21	.70	3.32	4.74
1971	1.02	.75	.73	.67	1.88	2.79	1.16	1.36	1.17	.64	2.80	4.36
1972	1.04	.56	.53	.57	1.26	2.19	1.23	1.10	.89	.66	2.40	3.65
1973	.84	.43	.52	.51	1.07	2.13	1.15	.94	.82	.62	1.77	2.87
1974	.77	.45	.58	.38	.95	2.51	1.14	1.65	1.45	.93	5.40	5.77
1975	.80	.57	.70	.49	1.55	3.17	1.27	1.85	1.43	1.07	4.76	4.47
1976	.93	.67	.72	.69	2.16	3.12	1.24	1.86	1.50	.92	3.82	4.14
1977	.93	.82	.88	.78	2.82	3.60	1.22	1.94	1.59	.86	4.67	5.46
1978	1.09	.83	.76	.92	2.86	3.12	1.49	1.90	1.27	1.06	4.88	4.63
1979[1]	1.08	.72	.66	.76	2.21	2.92	1.36	1.78	1.31	.87	3.73	4.30
1980	1.23	.79	.64	.74	2.61	3.52	1.49	1.63	1.09	.85	3.66	4.32

[1] January-November

Class 4					
Total			Directed		
Days Fished Per Trip	Landings Per Trip	Landings Per Days Fished	Days Fished Per Trip	Landings Per Days Fished	Landings Per Days Fished
1.54	.76	.50	.30	.70	2.33
2.17	2.97	1.37	1.75	6.00	3.43
2.00	1.10	.55	1.00	1.40	1.40
1.84	2.21	1.21	2.23	7.19	3.22
1.81	3.49	1.93	2.54	6.93	2.73
1.98	1.82	.92	1.35	4.21	3.11
2.07	1.44	.69	3.43	10.50	3.06
1.87	1.48	.79	1.17	5.14	4.41
1.72	1.33	.77	.35	.70	2.00
1.90	2.37	1.25	1.82	10.67	5.87
1.88	1.57	.83	1.23	6.02	4.90
2.31	1.15	.50	.93	3.63	3.89
2.12	1.14	.54	.62	4.35	7.02
1.82	1.10	.60	1.17	8.02	6.87
1.75	1.07	.61	.68	4.58	6.74
2.31	1.44	.62	1.95	8.54	4.37

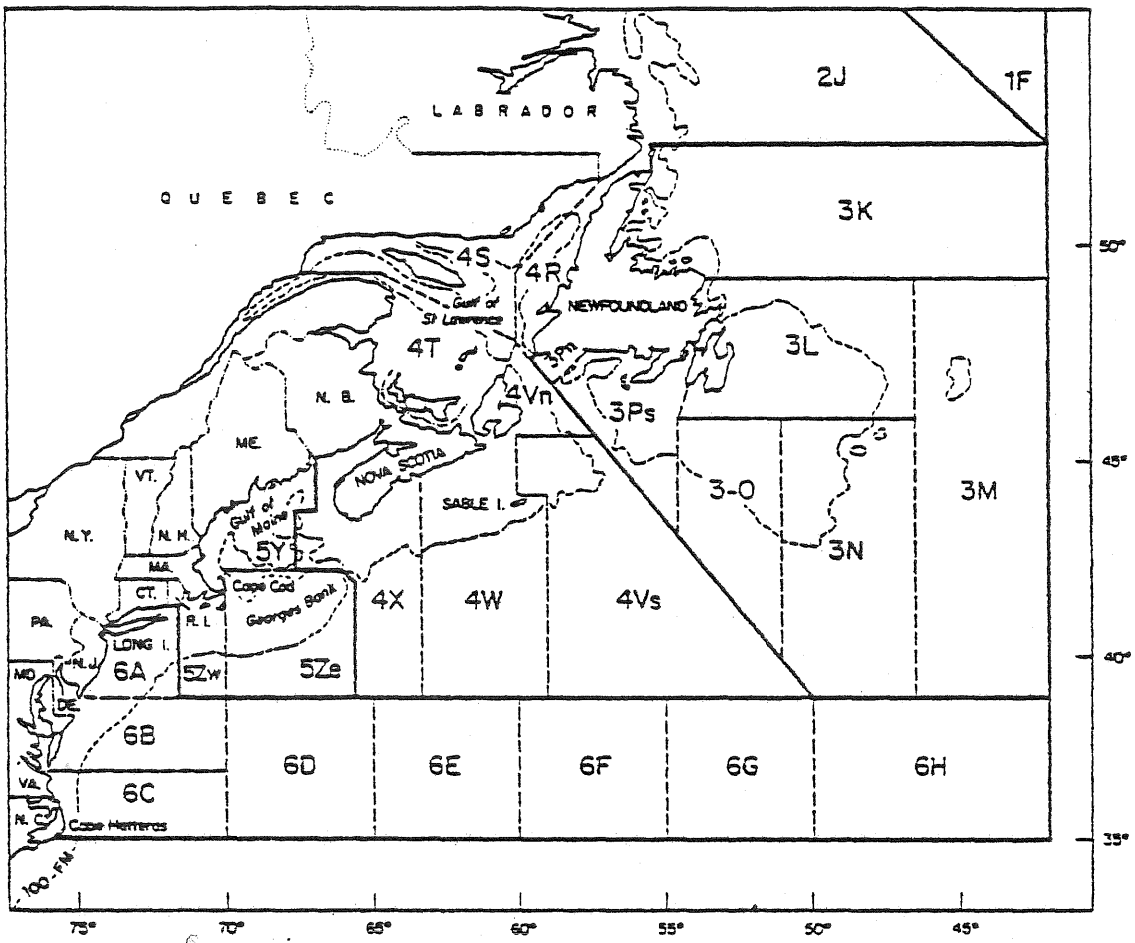


Figure 1. Northwest Atlantic from Labrador to North Carolina. The Georges Bank cod management unit encompasses areas 5Ze, 5Zw, 6A, 6B, and 6C. The Gulf of Maine cod management unit encompasses area 5Y.

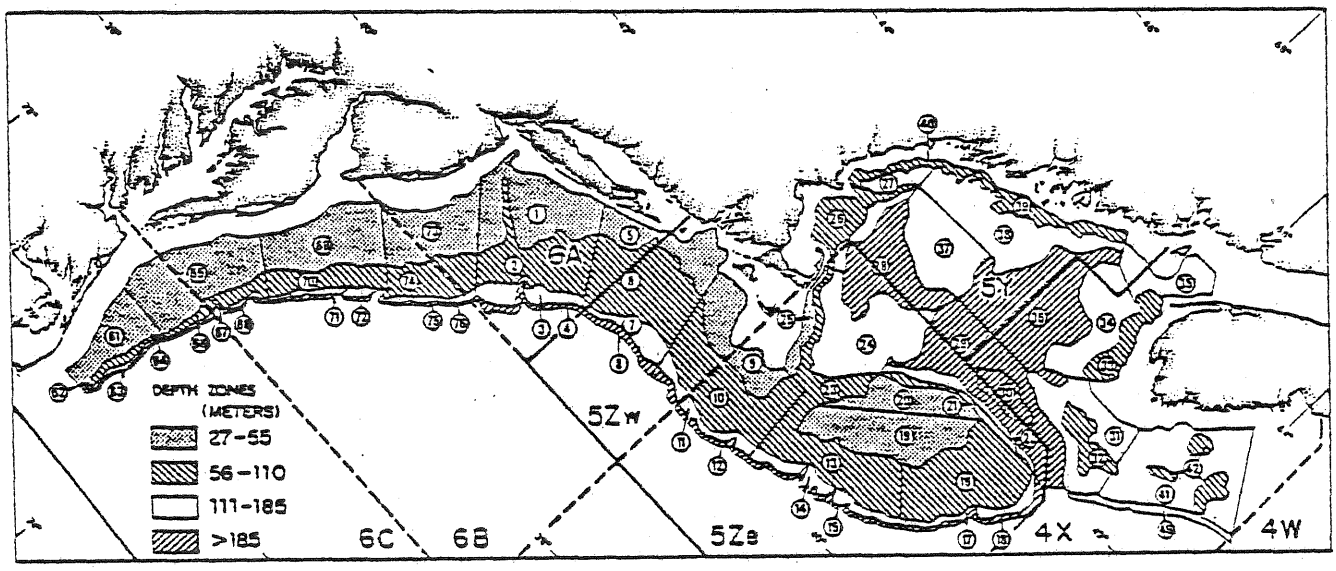


Figure 2. Northeast Fisheries Center offshore (≥27 m) bottom trawl survey sampling strata in the Northwest Atlantic, Cape Hatteras to Nova Scotia.

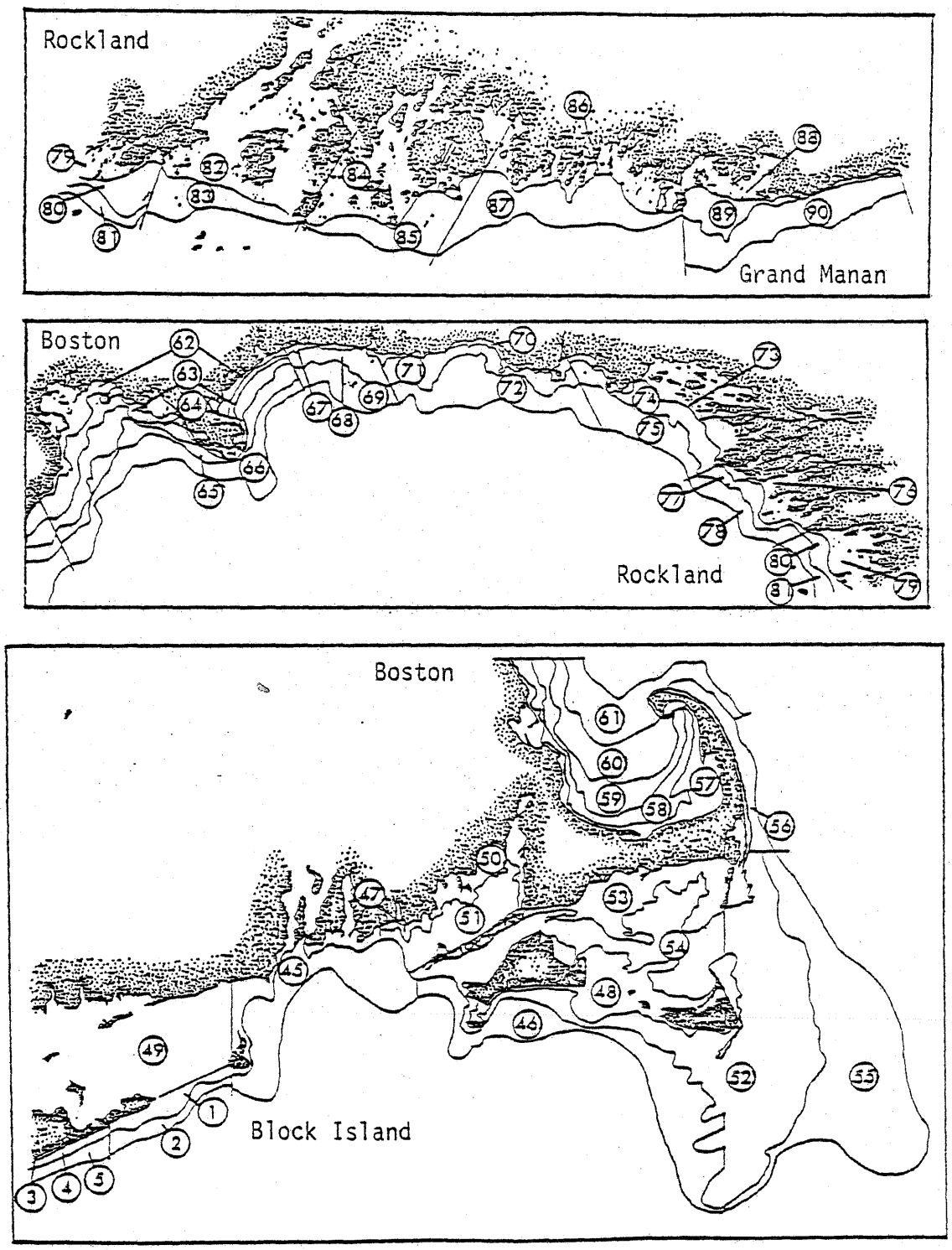


Figure 3. Northeast Fisheries Center inshore (<27 m) bottom trawl survey sampling strata in the Northwest Atlantic, Long Island to Grand Manan.

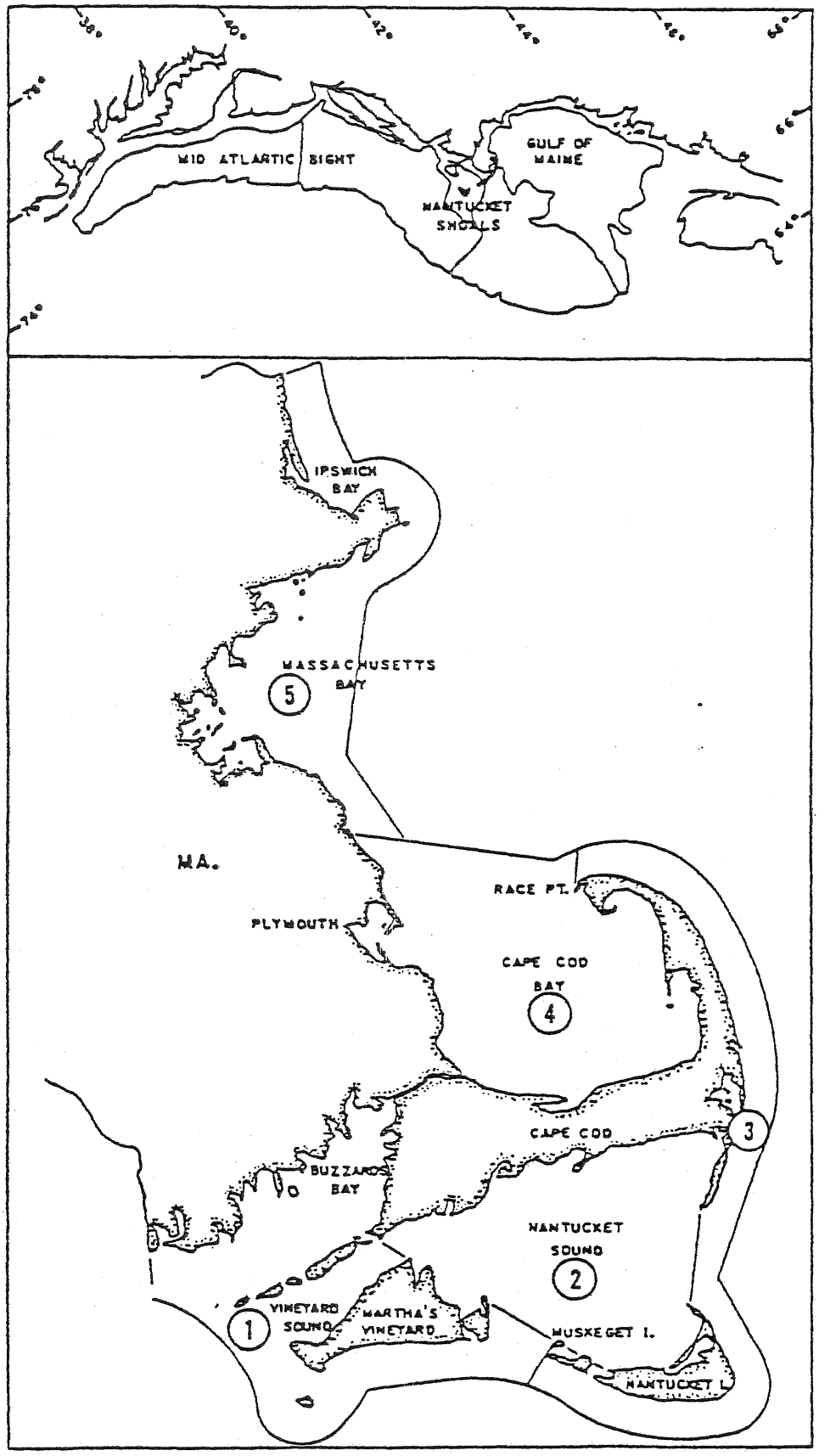
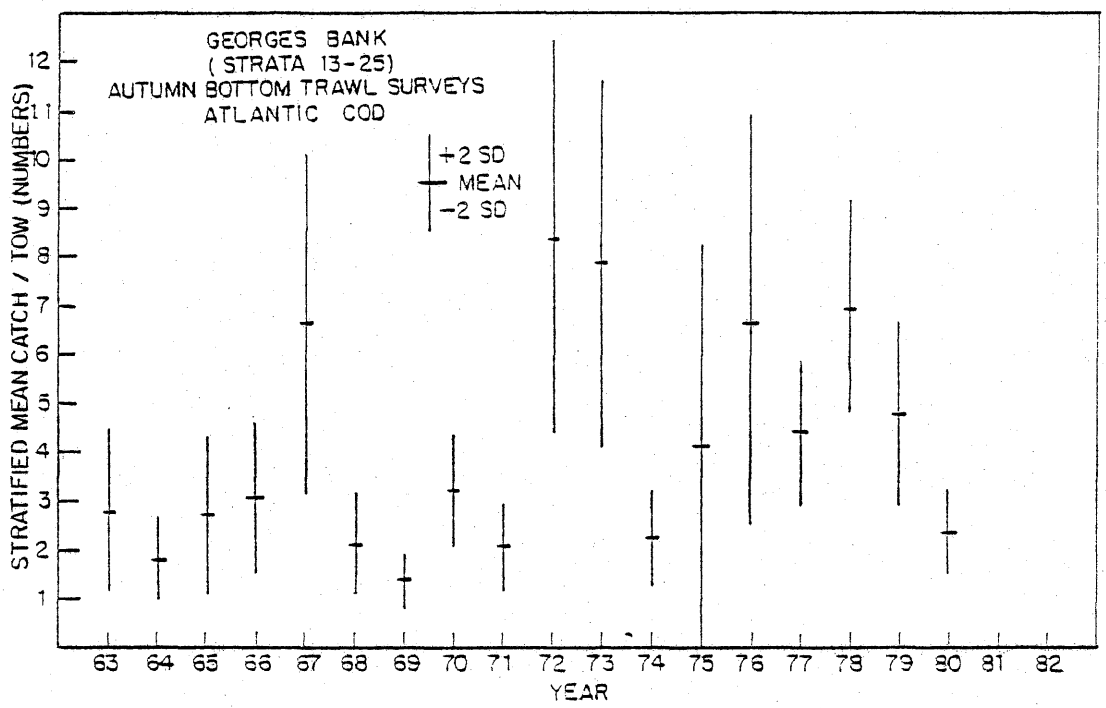


Figure 4. State of Massachusetts inshore (0-80 m) bottom trawl survey sampling regions and their geographical location with respect to the Northwest Atlantic area from Cape Hatteras to Nova Scotia.



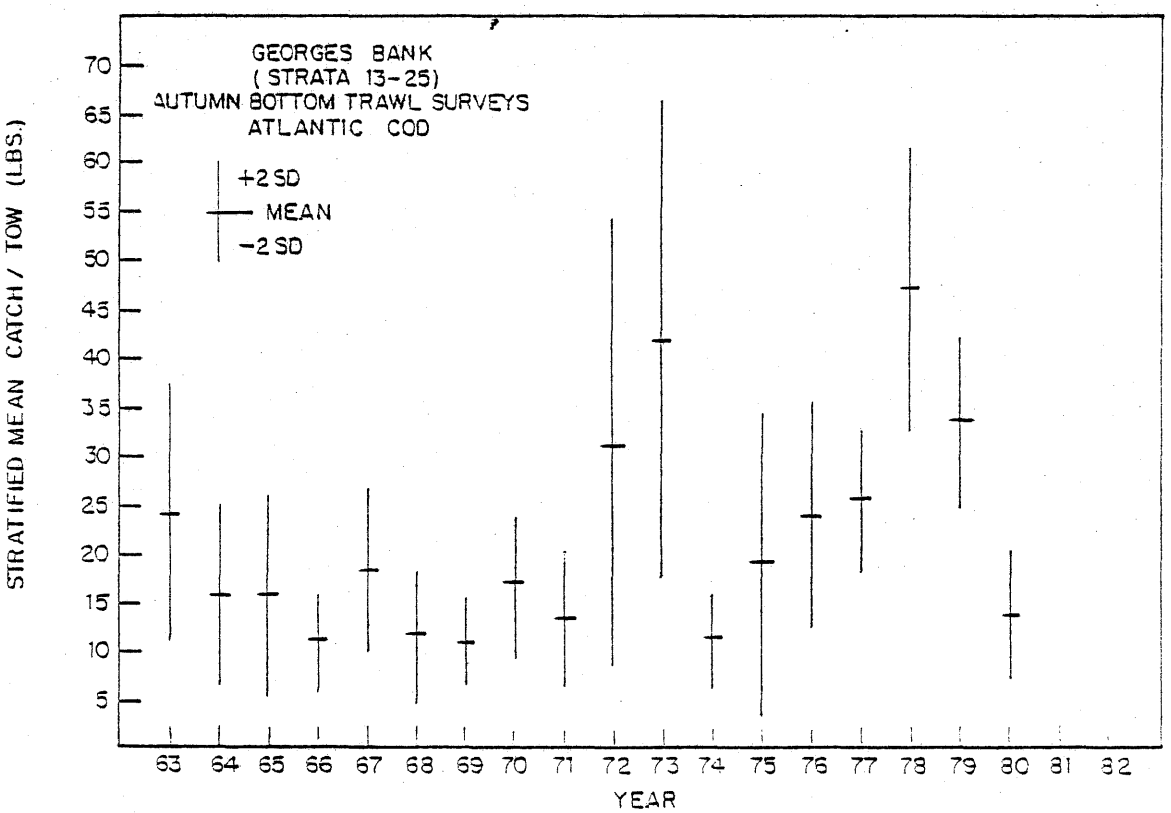
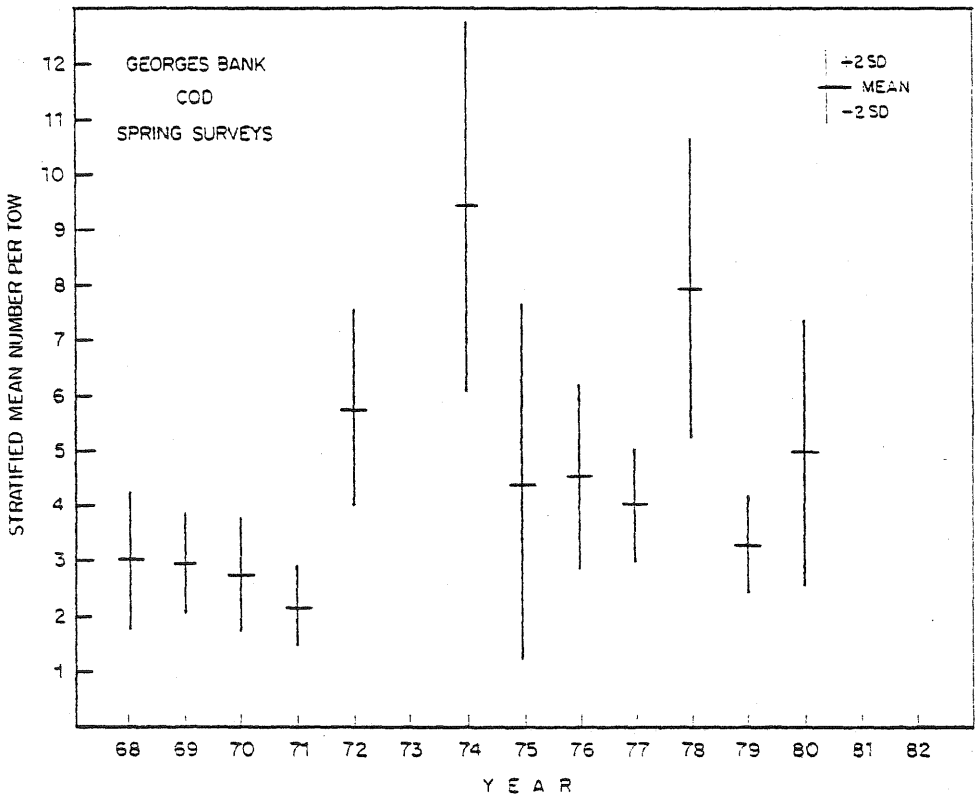


Figure 5. Stratified mean number (upper) and weight (lower) per tow of Atlantic cod from NEFC autumn offshore bottom trawl surveys on Georges Bank (strata 13-25), 1963-1980.



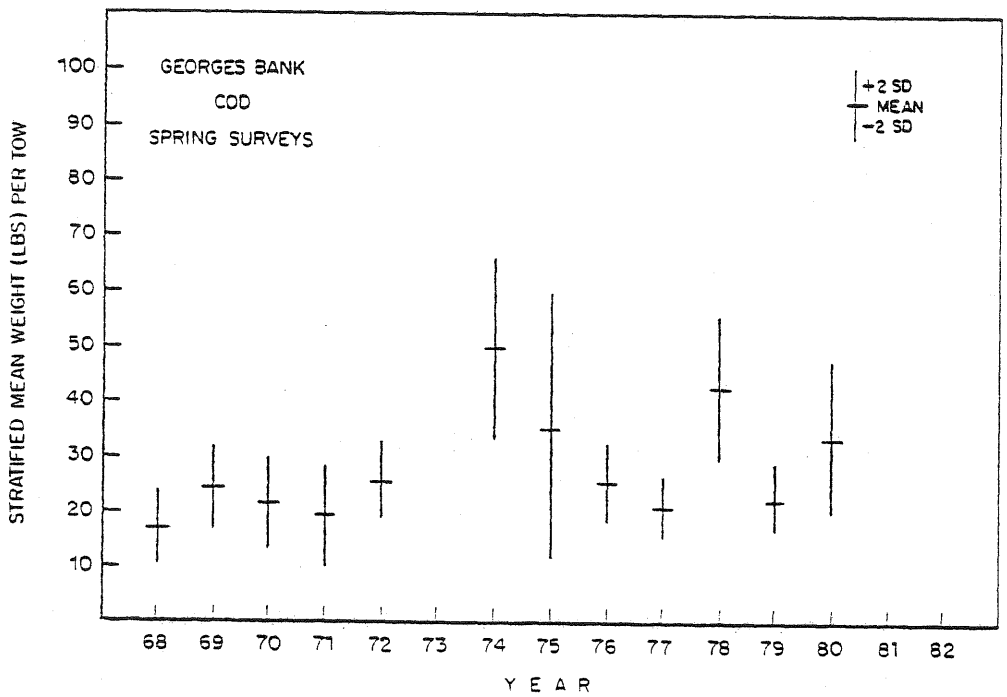
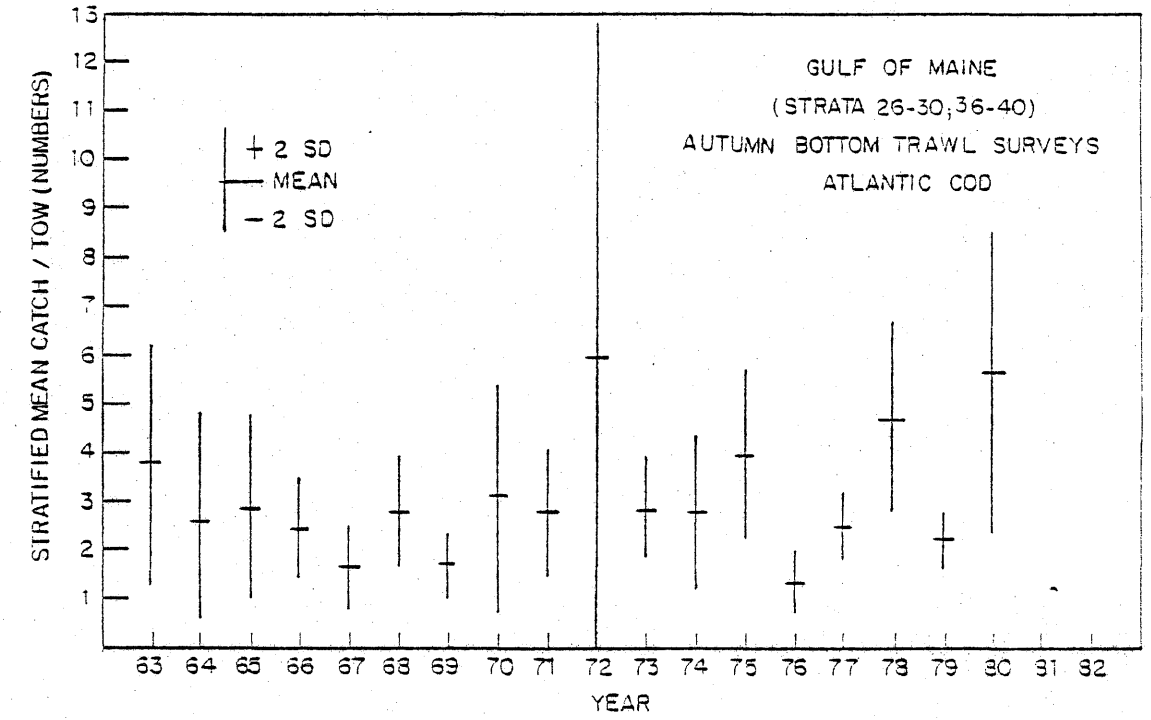


Figure 6. Stratified mean number (upper) and weight (lower) per tow of Atlantic cod from NEFC spring offshore bottom trawl surveys on Georges Bank (strata 13-25), 1963-1980. The 1973 indices have not been plotted since they are beyond the range of the figures and are considered anomalously high.



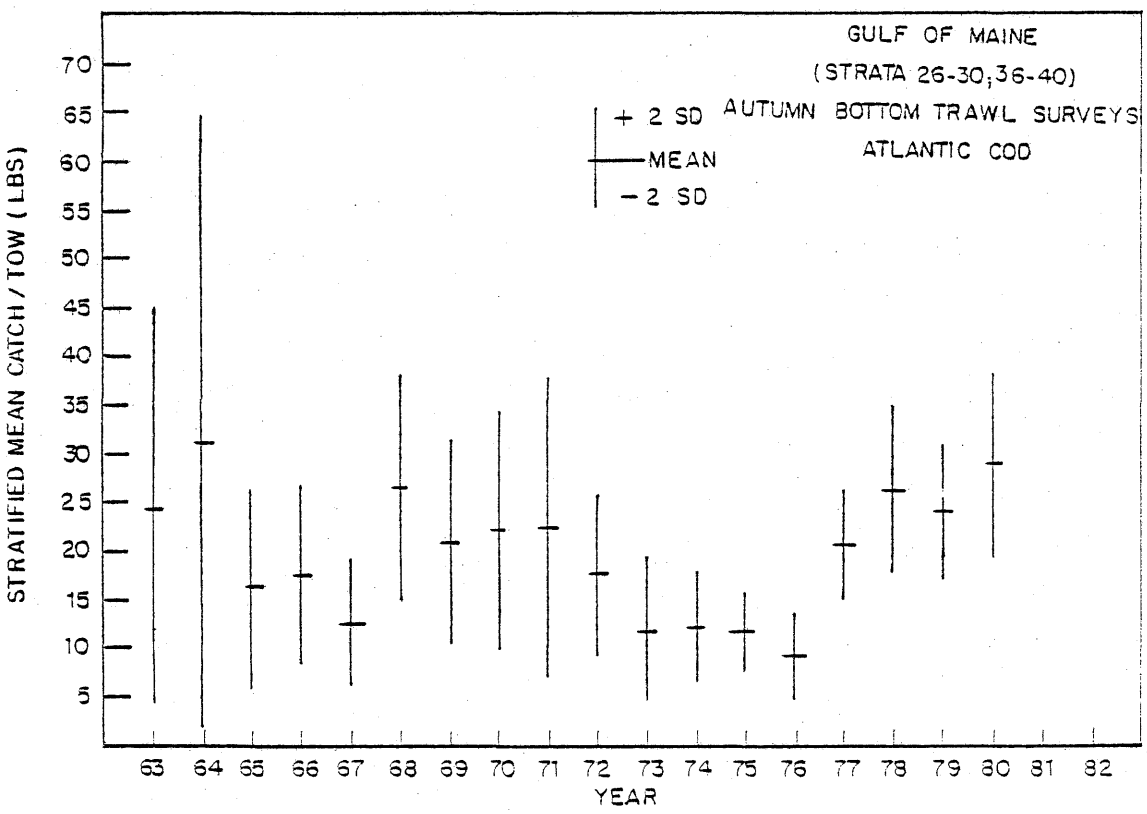


Figure 7. Stratified mean number (upper) and weight (lower) per tow of Atlantic cod from NEFC autumn offshore bottom trawl surveys in the Gulf of Maine (strata 26-30, 36-40), 1963-1980.

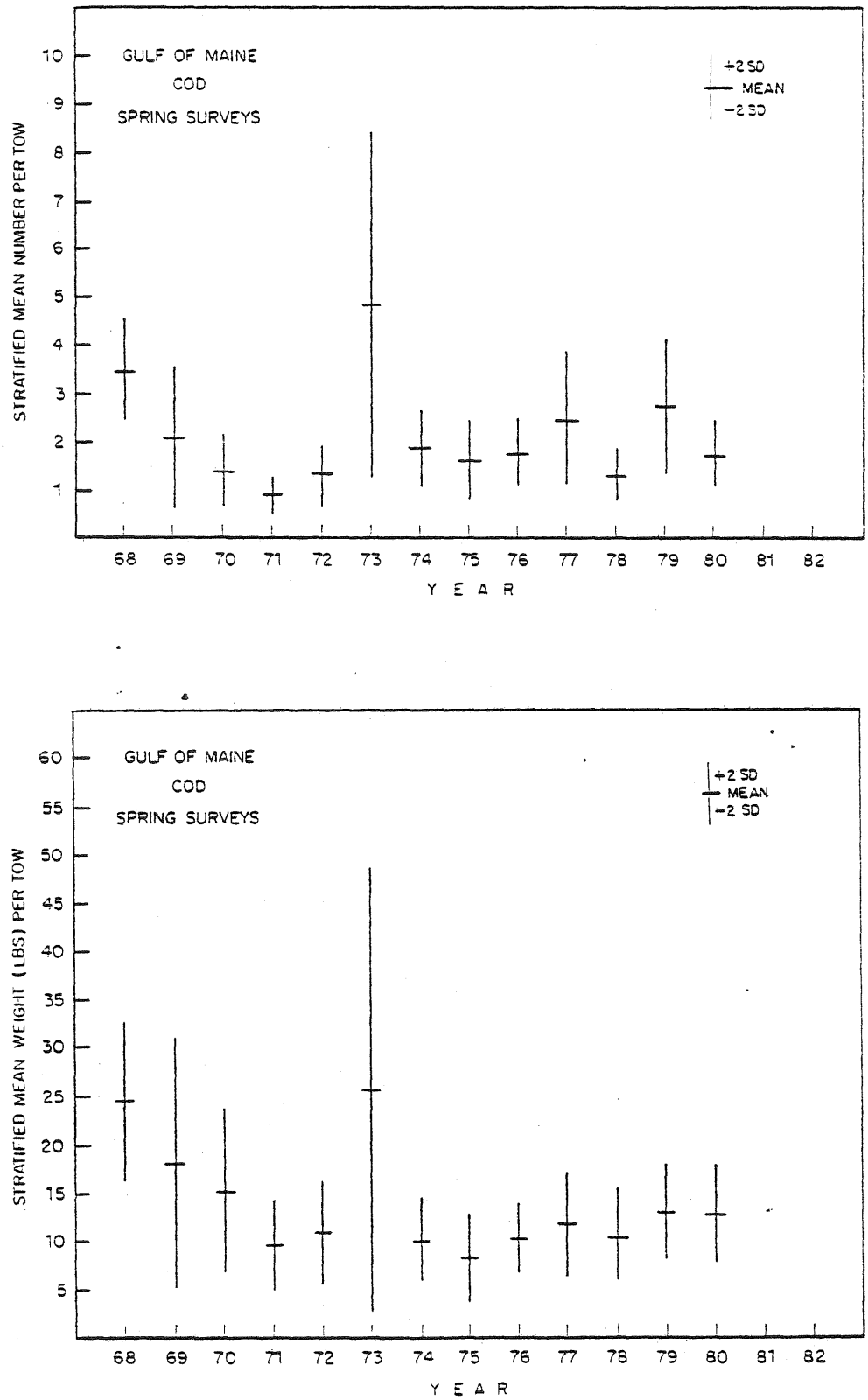


Figure 8. Stratified mean number (upper) and weight (lower) per tow of Atlantic cod from NEFC spring offshore bottom trawl surveys in the Gulf of Maine (strata 26-30, 36-40), 1963-1980.